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:

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

CASE NO. 11,996

ORIGINAL

REPORTER'S TRANSCRIPT OF PROCEEDINGS, Volume III

COMMISSION HEARING

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

August 19th, 1999

Santa Fe, New Mexico

This matter came on for continued hearing before the Oil Conservation Commission, LORI WROTENBERY, Chairman, on Thursday, August 19th, 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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A P P E A R A N C E S

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* * *

WHEREUPON, the following proceedings were had at 10:30 a.m.:

CHAIRMAN WROTENBERY: Back on the record, then.

It's 10:30 a.m. on August 19th, and we're continuing our hearing in Case Number 11,996.

We might want to visit a little bit before we get started about how we're going to proceed. We did get some additional information since we adjourned last Friday.

We have some information from Pendragon on the fracture simulation model GOHFER that was submitted at Commissioner Lee's request.

We also have some, I guess, copies of additional simulation runs, as requested by Mr. Gallegos last week.

And let's see, we have some sets of the pumper reports on the Chaco wells that I requested as a follow-up to Mr. Ancell's testimony, I believe it was.

MR. HALL: Yes.

CHAIRMAN WROTENBERY: And then from Whiting and Maralex we have information on the FRACPRO model, that was put together by Mr. Robinson.

I'm thinking what we might do is start by recalling Mr. Conway to talk first about the GOHFER. I know Commissioner Lee has some additional questions on that particular issue. We'll go ahead and take care of that.

Mr. Gallegos, I think we could then handle the information from Mr. Robinson with his testimony --

MR. GALLEGOS: That will be fine.

CHAIRMAN WROTENBERY: -- when he comes up.

MR. GALLEGOS: I didn't anticipate we were going to be talking to Mr. Conway about his things, so I'm going to need a moment to try and find the materials.

CHAIRMAN WROTENBERY: Surely, take what time you need.

MR. HALL: If I haven't previously, I'd move the admission of Exhibits A-12, the pumper reports.

CHAIRMAN WROTENBERY: Is there any objection to the admission of --

MR. GALLEGOS: Of what?

CHAIRMAN WROTENBERY: -- Exhibit A-12? This is the pumper reports on the Chaco well, which in fact I think we had decided were already part of one of Whiting's exhibits.

MR. CONDON: Some of them are.

MR. GALLEGOS: And they're marked now as A-12?

CHAIRMAN WROTENBERY: A-12.

MR. GALLEGOS: Okay, we have no objection.

CHAIRMAN WROTENBERY: Okay, then Exhibit A-12 will be entered into the record.

MR. HALL: In addition to that, Mr. Conway has provided us some materials pursuant to Dr. Lee's request, which we've labeled as Exhibits C-19 through C-25, and he will be able to authenticate those for us.

CHAIRMAN WROTENBERY: Do you need a little more time?

MR. GALLEGOS: Yeah, we'll need a little time because I hadn't anticipated this, and Mr. Robinson hasn't had a chance to look at these new simulation exhibits, because I was -- just thought were going to be kicking off with Mr. Cox, so I didn't --

CHAIRMAN WROTENBERY: Okay.

MR. GALLEGOS: -- prepare for this.

CHAIRMAN WROTENBERY: Well in that case, would you have any objection, Mr. Hall, if we took Mr. Conway's testimony right after lunch, so Mr. Gallegos --

MR. HALL: I have no objection, that's fine.

CHAIRMAN WROTENBERY: -- can take a look at the materials?

MR. GALLEGOS: Good, if we could do that.

CHAIRMAN WROTENBERY: Okay. Thank you, Mr. Hall.

MR. HALL: Let me regroup now.

CHAIRMAN WROTENBERY: Okay. Then are we ready to start with Mr. Cox's testimony?

MR. HALL: Yes, at this time we'd call Dave Cox to the stand and ask that he be sworn.

DAVE O. COX,

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, please state your name, sir.

A. My name is Dave O. Cox.

Q. And Mr. Cox, where do you live and how are you employed?

A. I live at 3035 DeFrame Road in Golden, Colorado. I am a consulting petroleum engineer for Questa Engineering Corporation, in Golden, Colorado.

Q. Would you please give the Commissioners a brief summary of your educational background and work experience?

A. Yes, I received a BS in petroleum engineering from the Colorado School of Mines in 1974. I then went on to graduate school and did a master's program, also at the Colorado School of Mines, and received a master's of science in petroleum engineering.

In 1975 I went to work full time as a consulting engineer for Energy Consulting Associates in Denver, Colorado. I worked for them for about six years and -- primarily in reservoir-engineering type of jobs.

In 1980 they were sold to another company, so I opened my own business as a petroleum engineering consultant, which I had for four years.

Then in 1984 I went to work for an independent oil company called ANGUS, A-N-G-U-S, Petroleum in Colorado and rose to the position of vice president of engineering with ANGUS.

Then in 1990 they moved to Dallas and I stayed in Denver, became an independent consultant again for two years on my own, and then for five years with Advanced Resources International in Lakewood.

Then in 1997 I joined Questa.

The majority of my work through these 25 years has been reservoir-engineering types of things, especially well testing, fluid flow through porous media, modeling, reservoir modeling, and unconventional gas, including coalbed methane.

Q. And do you have particular expertise in well-testing methodology?

A. Yes, I do. I have taught both basic and advanced well testing at the Colorado School of Mines, I've analyzed several thousand well tests during my career. Currently I'm a consultant to Nye County, Nevada, analyzing well tests for them, and have written a numbers of papers on well testing.

Q. Are you familiar with the Application that's been filed in this case?

A. Yes, I am.

Q. And are you familiar with the lands and the wells that are the subject of this proceeding?

A. Yes, I am.

Q. And have you prepared certain written testimony in exhibits in connection with this hearing today?

A. Yes, I have.

Q. And do you affirm and adopt your written testimony?

A. Yes, I do.

Q. And were Exhibits C-1 through C-60 prepared by you or at your direction?

A. Yes.

Q. At this time, Madame Chairman, we'd move the admission of Mr. Cox's testimony and Exhibits C-1 through C-60.

MR. GALLEGOS: No objection.

CHAIRMAN WROTENBERY: Thank you. Okay, Mr. Cox's testimony and Exhibits C-1 through C- -- How many are there?

MR. HALL: Sixty.

CHAIRMAN WROTENBERY: -- 60 --

MR. HALL: And more to come.

CHAIRMAN WROTENBERY: -- are admitted into the record.

Q. (By Mr. Hall) Mr. Cox, what I'd like you to do, would you please provide the Commissioners with a brief summary of your investigations in this case and the conclusions you reached.

MR. GALLEGOS: Excuse my interruption, but we already have a C series. You know, Mr. Conway's are C.

MR. HALL: His are marked "Conway".

MR. GALLEGOS: Oh, they are?

MR. HALL: Yes.

MR. GALLEGOS: They're all Conway 1 through -- I thought they were just C. Okay, just so we --

CHAIRMAN WROTENBERY: Actually, we've got -- I should clarify. They're marked -- Mr. Cox's exhibits are marked "Cox" --

MR. HALL: Correct.

CHAIRMAN WROTENBERY: -- so what we're talking about here are Cox Exhibit 1 through 60.

MR. GALLEGOS: That's what I thought --

MR. HALL: I stand corrected.

MR. GALLEGOS: -- yeah, and I think Conway's were the C, just simply C.

CHAIRMAN WROTENBERY: Thank you, Mr. Gallegos.

Q. (By Mr. Hall) Again, Mr. Cox, if you would provide the Commissioners with a brief summary of your investigations in the case and the conclusions you've reached.

A. Okay. The questions that I first looked at in this case initially were tied to the pressure response that was observed in several of the wells during the shut-in period. These Chaco wells were shut in June 30th of last year, and during the last twelve months, or now 14 months, considerable information has been gathered with the shut-in pressures being obtained on a daily basis at the wellhead.

That information, when I first looked at it, I had some concerns as to what I could do with it, what type of things could I learn from that? And some of the specific questions that I was asked by Pendragon included, could I tell whether or not that pressure communication was coming through one zone or the other or both? Could I devise tests that would determine that conclusively or show that conclusively? Could I determine through that or other information where the connection exists between these formations?

And so I looked at all the information, and in particular the pressure information from these wells, the -- there's some limited well-test information, core information from an offsetting well, the Lansdale Federal, and then production records as well, production information.

Then in addition, I found that they had BTU and compositional information, so I looked at that to try and determine whether that would be helpful in determining where the source of communication between the zones was.

What I found, in a nutshell, was that four -- Well, let me back up. Three of the Chaco wells are not showing communication to any other wells, and those are -- May I point at the map here? Those are the Chaco 2-J, the Chaco 1-J and the Chaco 2-R, which are not evidencing any communication with any other wells.

The Chaco Number 1 is showing communication because its pressure has been declining over the past year, but that communication is indicated to be from wells that are fairly distant from it, and they may be Fruitland wells or they may be Pictured Cliffs wells. The communication of the Chaco 1 is sufficiently small that I can't identify which wells it's responding to.

But the Chaco Number 4 and Number 5 responded very quickly each time the coalbed methane wells were shut in. And this response happened over a period of as short of a time as one to two days. To have that rapid of response indicates to me, from a well-test analysis standpoint or from a reservoir-flow standpoint, that the system allows transients to move through it very rapidly.

We typically find in designing interference tests that we often have to go as much as 30 days to see interference between wells. And yet here when wells are shut in on the coalbed methane wells, response is observed within a matter of a day or two at Chaco 4 and Chaco 5.

So then I took that information and set up a reservoir model or a reservoir analysis to determine how that could occur.

And what I found was that the coals have a very high effective compressibility, and this is because of the high gas content that they have relative to the Pictured Cliffs. And that very high effective compressibility means it's hard to push a pressure wave through the coal, whereas the Pictured Cliffs has much lower compressibility, so it's very easy to push a pressure wave through it. It's sort of like having -- The coal acts like a balloon filled with air, and it's kind of slushy; whereas the Pictured Cliffs is like a water balloon, things move through it very quickly.

Then I looked at other information to evaluate what it had to tell me. I found that the pressure information from these wells was very conclusive in demonstrating that the Chaco 4, the Chaco 5 and the other Chaco wells do not directly communicate with the Fruitland Coal. It's an indirect connection through the Fruitland Coal wells, that the coal wells communicate with the Pictured Cliffs, not the other way around.

And the reasons for this are the -- First, the pressure response being very rapid to Chaco 4 and Chaco 5.

Secondly, the pressures on many of these Chaco wells, even today, are still -- right now are higher than the pressures in the Chaco wells -- or, excuse me, in the coal wells. The 1-J and 2-J pressures are considerably higher than the coal pressures, whereas the pressures of the coal wells build up to higher levels than those of the Chaco 4 and Chaco 5. This can't happen if the Chaco 4 and Chaco 5, for example, were directly communicating with the coal.

So, all the evidence that I see shows conclusively that the communication occurred through the Whiting coalbed methane wells and not through the Pictured Cliffs wells.

Now, in addition I examined the production records and found that the production curves from the Pictured Cliffs wells looked like dry-gas production curves, they don't look like coalbed methane production curves, which have a typical incline in production at early time, followed later in life by declining production. We don't see that in the Chaco wells. They don't have the same production character.

We don't see the same amount of water production from the Chaco wells as the coal wells. The coals need to be dewatered in order to be produced. The Pictured Cliffs, on the other hand, you just have a little bit of water you need to lift.

Then in addition, finally, we come to the BTU information and the compositional information, and in looking at that I found that there's a range of values of BTU or ethane or other constituents where in certain cases, in particular, all of the samples that I saw that had more than 1100 BTUs per cubic foot were from the Pictured Cliffs. All the samples that had less than 1000 were from the coal. But in that range of 1000 to 11000, we can't use the compositional information alone to distinguish between Pictured Cliffs and Fruitland.

And so accordingly, for most of the samples and for most of the wells, the gas composition is not sufficiently distinguishing to be able to tell whether it's producing from the Fruitland or from the Pictured Cliffs.

Now, an exception here is the February samples that were taken from the Chaco 1, 4 and 5 all had very high BTU. Those are Pictured Cliffs gas. They're all more than 1100 BTUs per cubic foot. That's not coalbed methane, that's not coalbed gas. That's Pictured Cliffs gas.

I think that's pretty much a summary of my findings.

Q. Mr. Cox, beginning on about 50 of your testimony, you list your findings in summary form again, and you have eight findings basically. Let's discuss each of those in a little more detail.

First, you found that the restimulations of the Pendragon Chaco wells did not connect directly to the Fruitland Coal. Explain your basis for that finding.

A. Well, if I may set up one set of exhibits?

Q. Yes, please.

A. And these are all exhibits that are in your packet.

The pressure information is most conclusive here. What we found is, in taking -- kind of work through each well in particular here. The Chaco Number 1 on Exhibit Cox Number 3, you can see as a long-term decline in production. There are periods of erratic types of pressure response, and this is a result of water loading up in the tubing, and so the surface pressure then no longer corresponds to the bottomhole pressure.

But it's generally a downward trend, which is indicating on that particular well that it is seeing drainage from other wells, that the reservoir around that well is being drained.

Now, we look at the Chaco Number 1-J, it has a -- and this is Exhibit Cox Number 4 -- its pressure stayed in the 145- to 147-p.s.i. range for over twelve months now.

This well, as you can see on the map here, is very close to one of the coalbed methane wells, the -- Let's see, that's the -- I can't tell the name of that well from here. Well, one of the coalbed methane wells.

Q. Would that be the 1-2?

A. Yes, thank you, the 1-2.

If the Chaco Number 1-J were communicating with the Fruitland at all, or if the 1-2 were communicating with the Pictured Cliffs, those two wells are so close together we would see a response. We see no response at all. That's clear evidence, very conclusive proof, that this well does not communicate with the Fruitland Coal at all. And furthermore, that the adjoining coal well does not communicate with the Pictured Cliffs.

We find a similar type of thing in the case of the 2-J, which is on Exhibit Cox Number 5, where the pressure on that well rose fairly quickly to a level of about 180 p.s.i. And the most recent pressure on the well has been 190 p.s.i. Now, that's higher than the current average reservoir pressure and the Fruitland Coal. If this well were communicating to the Fruitland, there's no way that it could have that high of a pressure.

And once again, the 2-J is very close to a coal well, the 1-1 here. So again, not only does it show that the 2-J is not communicating with the Fruitland, it's also showing that the 1-1 is not communicating to the Pictured Cliffs.

The Chaco Number 2-R, Exhibit Cox-7, we saw a long-term buildup there. It took about ten months to build up the pressure on that well. This well, again, is showing no sign of interference with any other wells. And in addition, the long time it's taking to reach a buildup there is indicating that the reservoir volume that well is connected to has low effective permeability.

Now, that's not consistent with the production records on that well that show that it has produced at reasonable rates prior to shut-in, and so this long buildup is indicative of damage that's occurred to that well.

When we look at the Chaco Number 4 and Number 5, which are Exhibits Cox-8 and Cox-9, what we see, we can very clearly see the rapid buildup each the El Paso plant went down or the Whiting coalbed methane coalbed methane wells were shut down.

And in fact, I've got a composite chart, Exhibit Cox-10 and Cox-11, that also show that. And you can see here that the pressure on the Cox Number 10, the pressure in the Chaco Number 4, was actually lower than the buildup pressure that the Coal wells had reached.

Once again, this is clear proof that that well, the Chaco Number 4, is not communicating directly to the

Fruitland Coal, because otherwise it should have the pressure being essentially the same as the average reservoir in the coal, because it is a considerable distance, as you can see on the map here, from any of the coal wells.

And likewise, the Chaco 5 -- here's the 4, here's the 5 -- the Chaco 5 is also a considerable distance, and yet both of them responded very quickly.

Q. Let me ask you, when you evaluated the reservoir pictures for the Pictured Cliffs, you looked at the reported pressures, the measured pressures, for 1995, did you not?

A. Yes, I did.

Q. Are you confident that those measured pressures accurately reflect the reservoir pressure for the Pictured Cliffs formation at that time?

A. The 1995 pressures, yes, I am confident.

Q. Now, you have also concluded that a number of the Whiting Fruitland Coal wells have connected directly to the Pictured Cliffs, and you've identified three: the 26-12-6 Number 2, the 26-12-7 Number 1, and the 26-13-12 Number 1. Why don't you explain to the Commission how you reached the conclusion that those wells did or may have communicated with the Pictured Cliffs formation?

A. Okay. I start here with the key point that we know that there's communication between the Fruitland and the Pictured Cliffs, and because of the pressure observation that we have on these Chaco wells, we know that that's not occurring at the Chaco wellbore. So therefore it has to be occurring at the Whiting coalbed methane wells.

Now, which wells is it coming from, though? First off, we know, because some of these shut-ins that we see were system-wide shut-ins, whereas others were shut in solely to the coal wells. We know that we're getting response definitely from the coal wells.

Then from there we have eliminated two of the coal wells because of their proximity to two of the Chaco wells that didn't respond. So now we're down to these three wells as being possible culprit wells in this action.

Q. Did you evaluate the issue of reservoir damage in the Pictured Cliffs?

A. Yes, I did.

Q. And what did you conclude with respect to that?

A. The Pictured Cliffs formation in the Chaco wells prior to 1995 had extreme, severe, deep, very deep formation damage. This is far more than what we normally call a skin factor or skin effect. This is damage that extended to a great distance from the wellbore. And the reason I can say that is because the -- We have a couple lines of evidence.

First, we have the fact that the Chaco Number 2-R here took 10 months to fully build up in pressure. That's a long time. We contrast that to the case of the Chaco 4 and 5 where, pretty much any given day, we were seeing the average reservoir pressure around those wells after they were shut in, that they quickly built up to an average reservoir pressure, but this took ten months.

Secondly, there was a well test from the 2-J that in July of 1998 that well was blown down for one day. So they blew the water out of the hole and blew the gas out of it for less than a day. That well took more than four days -- A pressure bomb was run, a bottomhole pressure bomb. Even after 72 hours, it had not yet built up. It was more than four days to build up within 10 pounds of average reservoir pressure. And that was from less than one day of production.

So once again, that's indicating that whatever damage is here is extending a long distance in the formation.

Finally, in addition, we have the production plots. The production behavior of these wells is anomalous as compared to that of a conventional dry-gas reservoir that has constant properties that don't change over time.

What we see here is, on all of the Chaco wells --

and so this would be, in particular, Cox Exhibits 30 through Cox-35, a relatively high initial rate with a very steep, early decline -- between 40- and 70-percent per year initial decline -- followed by a stabilization at later times at relatively modest rates, in the range of 5 to about 10 MCF per day.

And this is one of the things, by the way, where I'll point out, when we look at production curves like this they can be a bit misleading, because we only see the months that have reported production. So there were a number of shut-in months in here as well.

And for the five years prior to 1995, these wells only averaged about 2 1/2 MCF per day, per well. So very low rate. And yet they still had reasonable pressures, they still had pressures in the range of 150 to 200, 180 p.s.i.

So what is different? Why did the production rate fall off here?

Well, the thing that caused the production rate to fall off, we basically have a few things in the flow equation.

We have permeability, only there's no particular reason for permeability to fall off.

We have a pressure -- There was a bit of a pressure decline, but it was not sufficient to cause the decline in production we saw here.

Or we have some kind of a buildup of skin, or damage if you will. In this case it has to be pretty extensive, because these wells would take a long time to build up. So that very extensive damage that we're seeing shows up on these production curves.

Now, if we then try and compare the amount of gas in place volumetrically to the amount that had been produced prior to 1995, we find only a small proportion of the gas in place had been produced, 20 percent, 15 percent, 25 percent. Relatively modest numbers. And yet the production rate had fallen by a factor of, in some cases, by a factor nearly a hundred. So that's saying progressive, severe damage had occurred to these wells.

Q. The production declines you show, were they inconsistent with the results you would expect, production you would expect, based on an evaluation of the core samples in the area?

A. Yes, I'm only aware of one core sample in the area, and that sample indicated a permeability average of 53 millidarcies in the coal, which is good permeability, and frankly --

Q. You mean to say -- I'm sorry, did you say the coal or the sand?

A. Excuse me, the Pictured Cliffs sand. And that is good permeability. And so, no, you should not get this type of a decline from rocks with that type of permeability.

Basically, the high initial rates are corresponding to permeabilities in the 20-, 30-, 50-millidarcy range. But by the time we're getting up here at these low rates at late time, we're looking at a millidarcy.

So effectively the well has been damaged out to a distance so far that it just can't produce effectively. The gas is still there, the reservoir pressure is still there. But prior to 1995, generally from the period about 1986 through 1995, the wells were not connecting to the reservoir.

Q. Now, late 1994, early 1995, in your opinion was the Pictured Cliffs a depleted reservoir at the time Pendragon acquired its interest in the area?

A. No.

Q. And why do you say that?

A. Well again, we go back to -- We have several different pieces we can use to evaluate reservoirs. We have volumetrics, is the simplest. There's a certain volume of gas in place. It's like we take the area times the thickness and so on.

The volumetrics said, there's still a substantial volume of gas left there, because Pictured Cliffs is relatively continuous. It extends from well to well. We get a good degree of continuity there.

Secondly, we have the material balance, the pressure information. Even the pressures that were recorded after the wells became damaged were still quite often in the 130-, 140-p.s.i. range, 125-p.s.i. range. That's sufficient that, had the permeability still been there, or the connection to the reservoir still been there, those wells would have been able to produce at much higher rates.

So we have the volumetrics, then the material balance.

Then we have the shape of these decline curves. Sure, the shape of the decline curves is telling us that something has changed in the flow character across here. To try and assume that it's depleted, it just doesn't fit. It's not consistent with the permeability of the rock here or the amount of gas in place.

Q. Earlier, you testified that your analysis of the pressure interference data showed a connection at a distance away from the Pictured Cliff wellbores to the Fruitland Coal, somewhere.

A. Correct.

Q. Is that consistent, the fact that you were able to detect that connection through the pressure-interference data, is that consistent with a depleted reservoir?

A. No, it is not. We -- The fact that we were seeing on Exhibits Cox-8 and Cox-9, we saw this rapid interference between the Fruitland wells and the Chaco Number 4 and Number 5, which are a distance of more than 1500 feet away from the coalbed wells, and the fact that the Chaco 1 is seeing response and the nearest well to the Chaco 1 is about a half a mile away from it, that's saying, number one, that we have continuity, that the reservoir in the Pictured Cliffs from these wells out a considerable.

But secondly, it's also saying that there's permeability out away from the wells. And so the native reservoir permeability still exists at a distance from the wells.

Q. Tell the Commission, why isn't the BTU data analysis going to be useful in this proceeding?

A. Well, I have a number of exhibits in the back here. I think perhaps if we just pull up a couple of those, just for illustration, because frankly they're all showing a similar type of thing.

First off, I prepared Exhibit Cox-49, where I plotted all of the sample BTUs, and you can see there are -- in many cases there's multiple samples from a single well there, so you'll see more than one circle for a given well. And you can see that there's a large degree of variability there, that in many cases samples from a single well will have a wide range of BTUs.

So then I went and looked at a histogram, and I was trying to look at this more from a statistical standpoint, just to see if I had any way of determining with certain from a gas content or -- excuse me, from a heat content, what zone that the gas came from.

And I found everything less than 1000 BTUs was coalbed methane, or coal gas, everything over 1100 was Pictured Cliffs, but in between here it could be either one. In the range of 1000 to 1050 there were just as many samples from the Pictured Cliffs as there were from the Fruitland. And this held whether or not I was including the Chaco wells for the Whiting wells. Frankly, this same type of distribution occurred no matter how I split up the wells. And that told me that there are changes or variability in the BTU measurements and in the composition of the gas that are sufficiently broad that there's a large overlap.

So no, I can't use the gas composition or BTU to conclusively in most cases say it's either Pictured Cliffs or Fruitland.

Q. Now, would your peers in the industry be comfortable with your cutoff for coalbed methane at 1000

BTU and below? Is that generally accepted?

A. Well, I'm not saying that the coalbed methane has a cutoff of 1000 or below. What I'm saying is, in this particular area, all of the samples that were less than 1000 were coalbed methane. We didn't see any Pictured Cliffs samples that were less than 1000. But there were a number of coalbed methane samples in the range -- even clear up to almost 1100. So even though we talked about coalbed methane, it's not pure methane. It also includes some CO_2 and can include ethane and some propane and so on. So it's not pure methane. Pure methane is right around 1000, and that's where most of the samples were clustered. But there is a range of variation there that is observed.

Q. All right. Do you have anything further you wish to add?

A. Well --

MR. GALLEGOS: I object to the question. There's no way you could object to a question when the question is -- you don't know what he's going to do.

(Laughter)

MR. HALL: Do you mean you're withdrawing the objection then?

(Laughter)

MR. GALLEGOS: No, I object because it's an improper question.

CHAIRMAN WROTENBERY: I think Mr. Cox has already summarized his testimony for us today, unless there's something else --

MR. HALL: Common question around here.

MR. GALLEGOS: It may be a common question, but from an evidentiary standpoint it's an improper question.

MR. HALL: We'd let Mr. Cox stand for cross-examination at this point.

CHAIRMAN WROTENBERY: Thank you, Mr. Hall.

CROSS-EXAMINATION

BY MR. GALLEGOS:

Q. A little bit on your background. You're on the faculty at the Colorado School of Mines?

A. I'm an adjunct professor, which means I teach classes periodically, from time to time when requested for -- at this point, for graduate-level classes.

Q. Previously you were on the faculty full-time?

A. No, I've never been on the faculty full-time.

Q. Oh, I see. All right. And who, other than yourself, are principles in Questa Engineering?

A. The other two principles in Questa Engineering are Dr. John Wright, W-r-i-g-h-t, and Richard McClure, M-c-C-l-u-r-e.

Q. You reference in your testimony that you were an expert in a lawsuit in Jefferson County Court, no details.

Can you give us an idea what the matter in dispute was and what your testimony was?

MR. HALL: I'm going to object. I think this is a little beyond the scope of direct.

CHAIRMAN WROTENBERY: What is it that you're trying to --

MR. GALLEGOS: I want to find out about the qualifications here a little bit. He mentions this in his testimony, it is part of his testimony. It's not beyond the scope of the direct because the direct is contained in the filed testimony.

MR. HALL: Well, let me state --

MR. GALLEGOS: He references that.

MR. HALL: Excuse me. Let me state that Mr. Gallegos did not object to Mr. Cox's tender as an expert petroleum engineer witness.

MR. GALLEGOS: No, I don't, but he talks about this in his direct testimony, I'm entitled to cross-examine him about it.

CHAIRMAN WROTENBERY: I'll allow the question.

THE WITNESS: That particular instance, I was representing the Public Service Company of Colorado. They had been sued by an offsetting landowner from their Leyden gas storage facility. The Leyden gas storage facility serves the City of Denver, it's located west of Denver, and the landowner had alleged that he felt there was leakage from that facility onto his lands. And I evaluated the wells there and the information and provided testimony for Public Service Company.

Q. About how long ago was that?

A. That trial was actually, I believe, in July or August of last year, so approximately a year ago. And I had begun work on that a couple of years before that.

Q. All right. Now, is it correct that your conclusions about the existence and location of communication between the relative formations in dispute here rest on your interference analysis?

A. No, I would not say they rest on it. It's one part of that, but even if my interference analysis were not included, I would still have reached that conclusion.

Q. Well, you filed affidavits in this proceeding some months ago in support of a motion for certain testing to take place, and in your first affidavit you state that you have come up with a method to determine the existence, location and extent of the communication between these zones, and the method you describe was this -- for shorthand I'll say the interference analysis; isn't that true?

A. No, I had proposed a well test procedure for that purpose, but that procedure in particular would have helped to identify and confirm whether or not the 12-1 or the 7-1 are offending wells, or whether the sole offending well was the 6-2.

Q. So these observations and the many pages that you go into concerning the time lapse in which pressures move through the formations is incidental to your conclusions?

A. No, it's one of the factors that I considered in reaching my conclusions. I wouldn't call it incidental.

Q. All right. And what are the other factors, if you would just enumerate those for us, besides your transient pressure observations?

A. Well, one of the very key factors is the levels of pressure observed in comparison between the pressures in the different wells during these shut-ins.

Q. All right. So we have the interference analysis, and then the pressures observed both in the Gallegos Federal wells and the Chaco wells during the shut-in period?

A. That is correct.

Q. And to be more specific, is the meaningful observation that on shut-in you have observed, at least, I think, in the Chaco 4 and the Chaco 5, that the pressures in those wells do not rise to equal the pressures in the coal wells?

A. They did not during the periods of information immediately after their shut-in, say through -- oh, about November. And then following -- I guess it would have been late September of last year, the Chaco Number 4 was blown down, and so the surface-pressure information on that is not really useful subsequent to that time, but the Chaco 5 still is. And so -- But again, that's only part of the analysis of the pressures that I put together.

Q. Well, but what I'm trying to get at, is that the key data concerning your comparisons of pressures, that the Chaco 4 and 5 increased in pressure, but not to the level of the shut-in pressure of the coal wells?

A. Yeah, I think that's a very material point, that the coal wells reached higher pressures than the Chaco Number 4 -- May I point to the exhibit here?

Q. Be my guest.

A. On Exhibit Cox-10 here, during this shut-in from August 20th through -- I believe that's the 27th, if I remember right -- you can see the red line here is Chaco number 4. The pressures of the coal wells actually reached a level higher than that of the Chaco 4. So if it had been communicating directly to the Fruitland, if the Chaco 4 had, it should have been at the average reservoir pressure of the coal. The fact that these other wells built up to a higher level than the Chaco 4 says that its pressure at that time was less than the average reservoir pressure.

Similarly, on the Chaco 5, it -- during that same period, the other wells, Gallegos Federal wells there, had risen to a level close to that of the 5 but had not quite exceeded it yet at that time were but were growing, were increasing more rapidly than the pressure from the Number 5 was. So had a longer shut-in been taken, then the pressure from the coal wells would have exceeded that from the Chaco Number 5.

Q. They didn't on the readings here, correct?

A. They didn't on the readings here.

Q. But on --

CHAIRMAN WROTENBERY: What exhibit are you looking at?

THE WITNESS: Excuse me, that's Exhibit Cox-11.

Q. (By Mr. Gallegos) So the example that you have is on the Chaco 4 where the shut-in pressure of the coal wells exceeded the pressure on the Chaco 4 during that August 20th shut-in?

A. Right, and on the Chaco 5 the pressure of the coal wells would have exceeded that of the 5, had the shut-in been longer.

Q. Well, you theorize that? You don't have data to show that?

A. No, the slope of the growth -- the increase of pressure over time for the coal wells was higher than that of the Chaco 5.

Q. Okay, and give us the differential in the pressure between the Chaco 4 and the -- what you -- You grouped the coal wells all together as one pressure?

A. No, I actually have all three coal wells plotted separately on those two exhibits.

Q. And by the three, you're talking about those that are closest offsetting the Chaco 4?

A. Yes, the 6 Number 2, the 7 Number 1, and the 12 Number 1.

Q. All right. And what -- just to give us some idea of the magnitude, average, if you can, or give us a specific between the three, what -- the three -- what are we talking about in difference of pressure during this August 20-August 27 shut-in?

A. You're speaking -- The difference between the three coal wells?

Q. Yeah, the dif- -- You're saying the Chaco 4 didn't get to the pressure of the three coal wells, and I'm just asking you, are we talking about 50 p.s.i., 5 p.s.i., or what?

A. Yeah. Well, the Chaco 4 -- and I'm reading off a graph here rather than numbers. Table of numbers do exist in the -- some of the different information that's in the files. But the Chaco 4 reached about -- it looks like 92 p.s.i., whereas the 7-1 also reached 92 p.s.i. The 12 Number 1 reached -- It looks like about a hundred and -- Oh, excuse me, these are five-pound differentials.

The Chaco Number 4 and the 7-1 reached 96 p.s.i. The 12 --

Q. Okay, well, let's back up there, let's get this straight. Chaco Number 4 --

MR. HALL: Just a moment. Let's identify the exhibit for the record, please.

THE WITNESS: This is Exhibit Cox Number 10.

Q. (By Mr. Gallegos) Okay. Chaco Number 4, 96 p.s.i. The 7-1, 96 p.s.i. --

A. The 12-1, 102 p.s.i. And the 6-2, 102 or 103 p.s.i.

Q. All right. And that's over about -- It's a seven or seven-and-a-half-day shut-in, correct?

A. I believe that to be the case, yes.

Q. All right. And in your mind there's no other explanation for that differential in pressure, other than what you've stated that you think the communication between the zones is at the Whiting wells and not at the Chaco wells, or the Chaco well?

A. That's correct.

Q. Okay.

A. The amount of differential that we're talking, that Chaco Number 4 increased during that time by 21 p.s.i., but these coal wells had started at 5 to 10 p.s.i. or under 10 p.s.i., so they had increased more than 90 -- 85 to 90 p.s.i.

Q. Well, Mr. Cox, the coal wells were on compression. That 5 you're seeing is suction pressure on a compressor. That doesn't represent the regular flowing pressure. Or were you not aware that they were on compression?

A. I'm aware that they were on compression, yes.

Q. But that's not representative of the pressure increase. That's artificial when you have a compressor that has an inlet suction of 5 p.s.i. You agree with that, don't you?

A. No, I don't. I'm saying that that inlet suction pressure influences the flowing pressure of the well, that the flowing wellhead pressure of the well at that time would have been that measured value.

Q. Well, but you don't know what the value would be on the -- the flowing pressure value would be on the coal wells absent compressors being functioning, do you?

A. No, they had compressors at that time.

Q. All right, is there another factor? You have the interference analysis, which we will discuss with you in a minute, the pressure observation that you've talked about,

and is there some other factor underlying your conclusions regarding the --
A. Yes.
Q. -- location of the communication?
A. Yes, there is, and that is that the Pictured Cliffs wells were producing volumes that were less than their gas in place, whereas the indications are that these Fruitland Coal wells are going to end up producing more than their indicated gas in place on 320 acres. That extra gas has to come from somewhere.
Q. Okay.
A. Then there's one other factor, which is the BTU measurements from February of this year. If the Chaco 4, the Chaco 5 and the Chaco 1 were in direct communication with the Fruitland Coal and contained coalbed methane or coal gas, then they would not have had the BTU contents that were observed in February of 1999.
Q. Okay, and these measurements that you're talking about in February of 1999 were taken -- let's see, eight months, I guess, roughly eight months after the Chaco Pictured Cliff wells had been shut in?
A. Yes, seven or eight months, I'm not sure which.
Q. Okay. And you don't think there's any phenomenon that would take place near the wellbore, so that if you just took a simple gas sample of the wells after they had

been shut in for eight months that would account for the gas appearing to be Pictured Cliffs source rather than coal source?

A. Not if there were a significant connection with the coal and the coal started out at a higher pressure. If the coal had been feeding the Pictured Cliffs for any period of time, you would be looking at coalbed methane there, coalbed gas, not Pictured Cliffs gas.

Q. Well, if the coal formation had been feeding the Pictured Cliffs and then the Pictured Cliff wells were shut in in July of 1998, do you have an opinion whether that coal gas would begin to flow back out of the Pictured Cliffs formation, as the Gallegos Federal wells were producing?

A. Well, yes, it would have because the Gallegos Federal wells are communicating with the Pictured Cliffs. They are frac'd into the Pictured Cliffs. If they were not frac'd into the Pictured Cliffs, then the answer would be no.

Q. Okay. And if they're not frac'd into the Pictured Cliffs but there is a pathway at the Chaco wells, created by fracture-stimulation, I ask you the same question: Would you expect with the shut-in of the Chaco wells that the coal gas which had flowed into the Pictured Cliff formation would begin to be drawn out of that formation?

A. In time, but it would not have happened that quickly.

Q. It wouldn't happen in eight months?

A. No.

Q. Well, what time then? How long?

A. I don't know. That would depend on the degree of connection that might exist, and the amount of -- the relative flow rate from the Pictured Cliffs into the Fruitland at that point.

Q. All right. So do we have your factors now that are the basis for your conclusions?

A. I believe so.

MR. GALLEGOS: All right. Let's take a close look at those conclusions, well by well. And let me ask the members of the Commission, I handed out copies of this plat that shows all the wells. It's Exhibit JTB Number 1. Does anybody need another copy? I do have one or two copies.

CHAIRMAN WROTENBERY: It's buried.

MR. GALLEGOS: It's buried somewhere down in there? Do you have another copy? I'd like to have another one for Mr. -- Can I borrow this one here?

Let me hand you a copy of that exhibit, because it just helps to be able to reference these wells.

Then I have -- To help with this discussion I have copies of Exhibit JTB-2, which provides information on the distances between these wells.

MR. HALL: Are these laydown 640s? I'm just joking.

Q. (By Mr. Gallegos) All right, let's take the Chaco 1-J. The Chaco 1-J is not connected to the Fruitland Coal in your opinion, correct?

A. That is correct.

Q. All right. The Chaco 1-J is located in the southwest of Section 1, and if we look at Exhibit JTB-2, we see that it's 740 feet from the Gallegos Federal 1 Number 2. Correct? Do you follow that?

A. That's what this exhibit says.

Q. All right. Do you have any information to indicate that this is inaccurate?

A. No, I don't.

Q. Okay. The Gallegos Federal 1 Number 2 was fracture-stimulated by Pendragon in December of 1992. Are you aware of that?

MR. HALL: Objection. I think you have your wells mixed up, Gene.

MR. CONDON: By Whiting. You said Pendragon.

MR. GALLEGOS: I'm sorry. I'm sorry, thank you. By Pendragon.

MR. HALL: No, by Whiting.

CHAIRMAN WROTENBERY: No --

MR. GALLEGOS: By Whiting, thank you.

THE WITNESS: Could you start that question again for me?

MR. GALLEGOS: I think I should.

(Laughter)

Q. (By Mr. Gallegos) The Gallegos Federal 1 Number 2 well was fracture-stimulated by Whiting and Maralex in December of 1992. Are you aware of that?

A. Yes.

Q. Okay, located 740 feet from the 1-J, as we see. Do you know the size of the fracture-stimulation?

A. I have it on a board here.

Q. All right. Well, the stimulations applied by Whiting have been characterized by Pendragon as being large or heavy stimulations, and they involved 125,000 to 150,000 pounds of sand. Does that comport with the information that's come to your attention in your work on this case?

A. In general, yes, except that it's my understanding that a couple of the Whiting wells, the frac job screened out before the full amount of sand could be emplaced.

Q. Okay. Is that a factor that bears on any of your conclusions?

A. Frankly, I'm not sure that it does in this case.

Q. All right. Now, the Chaco 1-J was not fracture-stimulated by Pendragon; is that a true statement of fact?

A. Insofar as I know, yes.

Q. Okay. So we have the Whiting well fracture-stimulated 740 feet from the Pendragon well, the Pendragon well not fracture-stimulated, and in your opinion there is no communication between the zones?

A. At that well, yes.

Q. All right. So the fracture-stimulation of the Pendragon 1 Number 2 did not cause communication or open a fracture into the Pictured Cliff formation, in your opinion?

A. If you mean the Whiting 1 Number 2, I would agree with you.

Q. Okay, did I misstate that again?

A. I think you said Pendragon again.

Q. Okay, I mean the Whiting well --

A. Yes, that --

Q. -- the 1 Number 2.

A. That is correct, I don't --

Q. I'm going to start calling them Gallegos Federal wells, I should be able to remember that.

(Laughter)

THE WITNESS: I would hope so.

Yes, it is my opinion that the 26-13-1 Number 2 did not communicate with the Pictured Cliffs.

Q. (By Mr. Gallegos) And is that circumstance evidence that was taken into consideration by you in arriving at your conclusions?

A. The circumstance that I don't believe that it communicated?

Q. The circumstance that the coal well was fracture-stimulated, and the Pendragon Pictured Cliffs well was not fracture-stimulated?

A. No, that frankly was not -- I did not include that in the analysis that I needed, but -- I recognized that fact and was aware of it, but it was not material in reaching my conclusions.

Q. Okay. Next, you tell us that the Chaco 2-J is not connected or communicated with the Fruitland Coal formation?

A. That is correct.

Q. All right. The Chaco 2-J is in the northeast of Section 1. We find it on both of these plats. And it's located on the same pad as the Gallegos Federal 1 Number 1 well.

MR. HALL: I object, that assumes facts not in evidence.

Q. (By Mr. Gallegos) Are you aware of whether that's a fact or not?

A. No, I'm not.

Q. Will you accept that it's only 180 feet distant, the distance between those wells?

A. I'll accept that, yes.

Q. Okay. Are you aware that the Gallegos Federal 1 Number 1 well was fracture-stimulated with essentially the same size treatment as we've been talking about in August of 1993?

A. Which size of treatment are you --

Q. 125,000 --

A. 125,000 --

Q. -- 150,000 pounds of sand.

A. Yes.

Q. All right. The Chaco 2-J was not fracture-stimulated by Pendragon; is that a true fact?

A. Yes.

Q. Okay. Did you take that into consideration in arriving at your conclusions?

A. I observed it, but it was not a necessary part of arriving at my conclusions.

Q. The Chaco 2-R is located, is not, Mr. Cox, in the southwest of Section 7, as shown on the plats, the plats we have in front of us?

A. Yes.

Q. The Chaco 2-R is located -- if you will assume that this plat is accurate, JTB-2 -- 768 feet from the Gallegos Federal 7 Number 1 well; is that true?

A. So far as I know.

Q. Okay. Now, the 7 Number 1 well was fracture-stimulated by Whiting in August of 1993. Are you aware of that?

A. Yes.

Q. Okay. Pendragon fracture-stimulated the 2-R in January of 1995; is that a fact?

A. I don't remember the exact month, but I know it was early 1995, yes.

Q. Are you aware that the fracture applied to the Chaco 2-R by Pendragon was different from the stimulations on the Chaco 1, 4 and 5 because of the relative depth of the perforations on those wells? That is, between the 2-R and the 1, 4 and 5.

A. No, I'm not aware of that.

Q. Okay. Exhibit WA-3 would indicate that the perforations in the Chaco 2-R through which it would have been fractured, were all located below the lowest coal seam. That's not a fact that you were aware of before now?

A. Yes, I am aware of the fact that those perforations are at that position.

Q. Okay. But you were not until now?

A. No, I was aware of that.

Q. Oh, you were. Okay.

Were you also aware that in the case of the Chaco 1, 4 and 5, there are perforations located above the lower coal and just below the upper coal, so that the fracture-stimulation on those wells would have been applied at those locations?

A. I would not characterize that as being just below the upper coal and just above the lower coal. There are multiple coal seams here.

The way that I would characterize that instead is that there is an upper bench of the Pictured Cliffs that has better development in the Chaco 1, 4 and 5 and much poorer development, or may even be absent, in the Chaco 2-R. And therefore Pendragon did not attempt to complete that interval where that upper Pictured Cliffs sand would have been, had it been present in the 2-R.

Q. Well, at this point I'm not interested in arguing about the geological terms, just so long as we have a recognition that the 2-R was perforated only, and would have been fracture-stimulated, only in the -- what we call the lower bench of the Pictured Cliffs -- can we use that terminology? -- below the coals.

A. No, that's the main -- I call that the main bench of the Pictured Cliffs.

Q. All right, the main bench. All right, as opposed to the Nicol bench, or whatever you want to call the --

MR. NICOL: Thank you.

Q. (By Mr. Gallegos) -- sandstone above the coal?

A. I call that the upper bench of the Pictured Cliffs.

Q. All right.

A. And again, I will note that at that location, that upper bench does not have the same rock quality and reservoir quality that it does at the other wells.

Q. So the well is not perforated there and it wasn't frac'd there?

A. That is correct.

Q. And in your observation from the analysis you made, the Chaco 2-R is not in communication with the Fruitland Coal?

A. That is correct.

Q. Okay. And so the Gallegos Federal 7-1 well that's located some 768 feet away did not cause a fracture to grow down into the Pictured Cliffs?

A. Now, that is not the conclusion that I've drawn.

Q. I see.

A. The conclusion that I've drawn, instead, is that it may have or it may not have. I cannot say with certainty today, and the reason I say this is because the

2-R does not communicate, and had the 7 Number 1 communicated with the Pictured Cliffs, I would have expected it to communicate to the 2-R. However, from my analysis it appears to me that this communication is occurring primarily through that upper bench of the Pictured Cliffs, and that therefore with the 2-R not having reservoir-quality sand at its location in the upper bench and not being perforated there, then it's not seeing a response.

The 7 Number 1 may still be an offending well, however.

Q. At page 6 your testimony says in reference to the Chaco 2-R, and I quote:

> This well is <u>not</u> directly connected to the Fruitland Coal. This well has exhibited no connection to continuing production from any other wells, whether they are Pictured Cliffs or Fruitland Coalbed Methane wells.

End quote.

Are you changing that testimony?

A. Not at all. The 2-R does not communicate with other wells.

Q. Let's go to the Chaco 4. The Chaco 4, you say, has indirect connection to the Fruitland Coal?

A. Yes.

Q. And you say that the connection exists between the Fruitland Coal and the Pictured Cliffs in one or more -- and then we have the 6 Number 2 and the 7 Number 1 and the 12 Number 1 as your suspect wells?

A. That's correct.

Q. And what do you mean by the connection exists in one or more of the wells? What does "in" mean?

A. What I mean by that is, at one or more of those wells there is a connection from that, a direct connection from that wellbore, to the Fruitland Coal. It may be through the induced fracture or the hydraulic fracture treatment that was done on those three Gallegos Federal wells.

Q. Okay, so you're saying that at the wellbore of one or more of those wells, there was a fracture that grew out of the coal and into the Pictured Cliffs formation?

A. Well, it may be at the wellbore, or it may be at some distance from the wellbore, but nonetheless, still within where the fracture treatment on those wells connected to. So in other words, the well is connected to the hydraulic fracture that's been created, and the hydraulic fracture is communicating with the Pictured Cliffs and the Fruitland, both.

Q. Well, that's why I asked you what you mean by the word "in", and you're telling us that you're not sure where this connection is?

A. Well, the connection occurs because of the hydraulic fracture treatment in those wells or at those wells.

Q. I'm asking about your opinion, if you have one, about location.

A. Yes, it is my opinion that one or more of those three wells had fracture treatments that communicated with the Pictured Cliffs. And those three wells are the 6 Number 2, the 7 Number 1 and the 12 Number 1.

Q. At the wellbores or near the wellbores of the coal wells?

A. Well, the wellbore -- Not at the wellbore itself. The wellbore itself is a hole, and --

Q. I'm talking, obviously -- I mean the outside of the wellbore, Mr. Cox.

A. Yes, I mean outside the wellbore as well. I'm saying that the fracture treatment that was done on those wells communicated with the Pictured Cliffs as well as the Fruitland Coal.

Q. Near the wellbore?

A. It may be near the wellbore, it may be some distance from the wellbore. But it's within the distance that the frac job communicated to.

Q. Let me ask you something about pressure observations. In Mr. Nicol's exhibit N-8 there are some -- what are called workover and completion reports, and they reflect that in the Chaco Number 4 on January 30, 1995, that well showed a shut-in pressure of 119 pounds.

MR. HALL: Shall we show the witness the exhibit you're referring to?

MR. GALLEGOS: Well, you can show him the exhibit, mine's marked up.

Q. (By Mr. Gallegos) But did you consider pressures at that time?

A. Yes, I did.

Q. Okay. You didn't plot that?

A. Yes, I have plotted that.

Q. You have plotted that --

A. Yes.

Q. -- pressure in January of 1995?

A. Yes.

MR. GALLEGOS: Mr. Hall wants me to show that to you.

CHAIRMAN WROTENBERY: I'm sorry, which exhibit was that again?

MR. HALL: N-8.

CHAIRMAN WROTENBERY: N-8.

MR. GALLEGOS: It was part -- 8 had a lot of pieces to it, but it was part of Exhibit N-8.

THE WITNESS: Yes, that does say 119 pounds.

Q. (By Mr. Gallegos) All right. And show us where that pressure is plotted for the Chaco Number 4 wells on one of your exhibits. Can you give us the exhibit number, because --

A. Yes.

Q. -- those are, you know, 8-1/2-by-11, and at any distance I think we'll do better if we can look at them in your book.

A. Yes, it's Exhibit Cox-45, and you'll note that the point that I have here is not 119 but rather is the -- if I remember correctly, there's another point there, right after the frac job, which is the one that I took and used, rather than the 119. So the --

Q. Well, I -- So you're changing --

A. Yes.

Q. -- your testimony. I asked you if you plotted it and you said yes, and now the answer is, you did not.

A. Well, I remember a point from around the time of the frac job, and so now I'm looking at the figure. There's not 119 pounds shown on that figure.

Q. So the first plot you have for the Chaco Number 4 after, oh, I would say about 1983, is after it was

fracture-stimulated in May of 1995 by Pendragon --
A. No.
Q. -- is that what we're to understand?
A. No, excuse me, that is not correct. It was after the acid treatment. This workover that you handed me was a workover for the acid treatment, not for the frac job.
Q. Right. And what happened is, there was a shut-in pressure of 119 pounds on the well. Then an acid treatment was applied, and the pressure jumped from 119 to 170 pounds; isn't that right?
A. Yes.
Q. Do you think the acid treatment communicated with the higher-pressure formation?
A. No, I think it provided more effective communication to the Pictured Cliffs.
Q. Now, at January 30, 1995, when we see a shut-in pressure of 119 pounds in the Chaco Number 4, it had been some 16 months since these suspect coal wells had been fracture-stimulated, correct?
A. That, I think, is about the right time, yes.
Q. Yeah, I'm thinking August, 1993, to January, 1995.
A. Yes.
Q. All right. So, now, what observations do you make with these wells, coal wells, fracture-stimulated and

you say communicate into the Pictured Cliffs, that is supported by this shut-in pressure of 119 pounds?

A. The coal wells, as shown on Exhibit JTB-2, are respectively 1803, 2102 and 2078 feet away from the Chaco Number 4. They're a considerable distance away from the Chaco Number 4.

In addition, the Chaco Number 4 at that time was severely damaged, and so pressure transients did not move to that well efficiently -- and now I'm speaking specifically to that wellbore -- from distances in the formation. And so accordingly, the pressure of 119 pounds that was recorded at that time, we know that that's equal to or less than the average reservoir pressure at that time. But just from that one point, you don't know what that pressure is.

Those wells were severely, severely damaged. And so when you have a well that's that damaged, you can't just take a pressure point.

Q. Isn't it understood, Mr. Cox, that even if you have so-called damage, if a well is shut in so that it stabilizes, it is going to reflect its true shut-in pressure?

A. Yes, and if you remember the plot for the Well 2-R there, it took ten months to build up to its true shut-in pressure. It can take a considerable period of time.

Q. Okay, so let's see what you're saying then. You start out by quoting the distances between the wells. We know that three wells that you suspect frac'd into the Pictured Cliff were fracture-stimulated in this area around the Chaco 4, 16 months earlier. Then in January, 1995, you have 119 p.s.i. shut-in on the Chaco 4.

So are you saying the distance means the -- What effect does that have?

A. I'm saying that the distance implies that it will take some time for those transients to move. And in addition, during those -- early time when the coal wells were producing, during that time what was probably occurring was water falling from the coal into the Pictured Cliffs, more so, with small amounts of gas coming out of the Pictured Cliffs into the coal wells. The coal wells had not yet reached their maximum productive capacity at the time that we're talking about this test in January of 1995.

Q. Now, what's this water falling in the Pictured Cliffs? Now you're telling us we're supposed to understand that that means there was water in the wellbore of the Chaco 14 when this test was taken? Is that the purpose of saying that?

A. No, I'm not saying that. I'm saying that when you're asking a question of whether or not Chaco 4 responded to pressures from the three coal wells, I'm saying, number one, it's a considerable distance from those wells.

Now, subsequently, once good communication was established between the Chaco 4 wellbore and the formation, we saw very rapid response after the shut-in last year. So we know that the Pictured Cliffs has significant permeability and that transients can move from the coal wells to the Pictured Cliffs relatively quickly -- I mean from the coal wells to the Chaco Number 4 through the Pictured Cliffs, relatively quickly, and that speed of movement is consistent with core permeability and other indications of permeability.

So what we have here is a case where what happens when those coal wells were fractured is, they're fractured and the coal wells communicated with the Pictured Cliffs. The early impact that that communication had was, first, the coal wells were probably not completely pumped off from day one, that it took some period of time before the coal wells were completely pumped off.

Secondly, the coal wells produced significant volumes of water at the beginning. And so that water which would have sat in the wellbore, in the fracture, would have fallen into the Pictured Cliffs, and some amount of water would have been going into the Pictured Cliffs at that time with minimal amounts of gas coming out of the Pictured Cliffs.

So what I'm saying is that by the time you get over, then, to the Chaco 4, which is at that time an extremely damaged well that has a hard time seeing out into the formation, you don't see any effect from the fractures breaking through the Gallegos Federal wells into the Pictured Cliffs until communication is established between the Chaco wellbores and the Pictured Cliffs, after the frac jobs were done on Chaco 4 and Chaco 5.

Q. Let's see if we can just agree as to what the data, without conclusions -- Do we agree that between August of 1993 when the coal wells were fractured and January of 1995, there was no indication of pressure response or gas production response in the Chaco Number 4?

A. Response from the Fruitland Coal well?

Q. Response -- Observable response that the pressure went up or the gas production went up, that did not happen, did it?

A. No, it did not.

Q. Okay, and we agree that within days after the Chaco 4 was acidized by Pendragon, there was a 50-pounds or more increase in the pressure shown on that well?

A. That is my understanding, yes.

Q. Okay, in early 1995, is that your understanding?

A. Yes.

Q. And the first time that that well showed a response in terms of very significant increase in gas production was after the fracture-stimulation applied by Pendragon in May of 1995?

A. That is correct.

Q. All right. Now, do we also understand that your hypothesis that the Gallegos Federal 7 Number 1 did not affect the Chaco 2-R some 750 feet away from it, but it did affect the Chaco 4, some 2100 feet away from it?

A. I'm saying that it may be affecting the Chaco 4. I can't rule it out, either way, right now.

Q. Okay, you can't rule it out or can't rule it in?

A. That is correct.

Q. The Chaco Number 5 is, in your opinion, not in direct communication with the coal, but I guess the same opinion as the Chaco 4, indirect connection with the coal -- not indirect connection with the coal, but indirect connection because of one of the three suspect Gallegos Federal wells?

A. No, one or more of the three --

Q. Okay, one or more?

A. -- suspect --

Q. One or more?

A. Yes, that is correct.

Q. Okay. Is there one of the three wells that you rule in?

A. Yes, the 6 Number 2 is definitely an offending well.

Q. Okay. Now, the 7 Number 1, who you classify as a suspect, is even farther away from the Chaco Number 5 than it is from the Chaco Number 4, considerably so, is it not, Mr. Cox?

A. Yes, it is.

Q. Okay. Now we're talking about approaching a mile, distance?

A. Approximately.

Q. Okay. But it doesn't affect -- The 7 Number 1 doesn't affect the Chaco 2-R, which is 768 feet away from it?

A. That's correct.

Q. Now, on your Exhibit C-45, for the Chaco 5, after a reading that's back, I guess, in maybe 1980, is the first pressure reading that you have for that well after it was fracture-stimulated by Pendragon in May of 1995?

A. I don't remember whether that one was before or after.

Q. Okay. If I asked you the same questions regarding whether there was any response from the Chaco 5 after the August, 1993, fracture-stimulations on the 6

Number 2, the 7 Number 1 and the 12 Number 1, your answers would be the same as for the Chaco 4, would they not? There was no observable response?

A. I saw no response in the Chaco Number 5, no.

Q. No pressure buildup after the Gallegos Federal wells were frac'd?

A. No.

Q. No gas uplift, no increase in gas?

A. But I would not expect any increase in gas. I can't imagine why there would be.

Q. And that only happened, as far as an increase in pressure, an increase in gas production, after the fracture-stimulation by Pendragon in May of 1995?

A. That's correct.

Q. Let me turn to your interference study and ask you at the outset to explain to the Commission, what is an interference study?

A. Well, being as you were also referring to the tests that I proposed as an interference thing, what particular thing do you mean as the interference study? Do you mean the analysis in my prepared testimony?

Q. Yes, that's what I mean, your analysis in which you go through and you make seven different analyses, observing the time lapse, basically, in which pressures are moving through the formations. That's what I'm referring

to. Should I use another term than interference analysis?
A. No, that's fine, I just wanted to clarify and make sure what we were talking about there.
Q. Okay, pressure-transient study, transit study, would that be a better --
A. Either one of those is fine.
Q. Okay. All right, what is it?
A. What that is is, I took and wanted to calculate what effect the difference in reservoir properties would have on how fast a pressure wave would move from one well to another, from one of the Gallegos Federal wells to the Chaco wells under different sets of conditions.
So I set up the calculations for two layers where I had a layer that was the Fruitland Coal that had extremely high compressibility because the coalbed methane reservoirs have very high compressibility, and then the Pictured Cliffs zone with a much lower compressibility but higher permeability.
And what I found was that the pressure waves moved much more rapidly through the Pictured Cliffs than they do through the Fruitland.
Q. Mr. Cox, if we could just have an answer to my question, I was asking you what -- just the methodology. What is the purpose of the study? We'll get into what --
A. Okay.

Q. -- your conclusions are, and we'll examine those. Okay?

A. Well, the purpose was to identify or to calculate how fast the transients would move and whether that would comport with the observed pressures in the Chaco 4 and Chaco 5.

Q. Well, and is the idea that if you can observe how fast the pressure moves, it will tell you whether it's going through the coal zone versus the sandstone zone?

A. That's correct.

Q. I mean, it's as simple as that, isn't it?

A. Yes.

Q. You're just saying, whichever one gets there first, that tells me that -- what? What does that tell you?

A. Well, it's telling me which wells are the offending wells.

Q. Okay.

A. Because if it's moving from the coal wells through the Pictured Cliffs to reach the Pictured Cliffs wells, then it has to -- the coal wells are offending wells. Whereas on the other hand, if the coal wells did not communicate to the Pictured Cliffs, then it has to move through the coal only, rather than through both the Pictured Cliffs and the coal.

Q. Okay, all right. So then you set up some parameters of input data in order to make this study, correct?

A. That's correct.

Q. All right. And the basic parameter that's going to give the answer is, what is the permeability of each of the formations; isn't that true?

A. No, that's one of the parameters. The other extremely important parameter is the effective compressibility of the two different formations.

Q. All right. Those are the two main factors?

A. That's correct.

Q. But isn't compressibility directly related to permeability?

A. No.

Q. No relation? They don't vary --

A. No, they're basically unrelated.

Q. All right. So permeability is measuring what?

A. Millidarcies.

Q. Not -- I didn't ask for the unit. What is it measuring? What is permeability?

A. Oh, permeability is a measure of how effectively rocks transmit fluids. So high permeability means fluids, water or gas move very quickly through the rock, or with very low pressure gradients, whereas low permeability, it's harder to get them through the rock.

Q. And in the formula, that's -- permeability is *k*; is that correct?

A. That's correct.

Q. All right. And what is compressibility?

A. Compressibility is a measure of the change in volume as you change pressure. So if you have a system where you add fluid to -- How much fluid does it take to increase the pressure by one p.s.i.? And then you divide by the volume of the container and you get the effective compressibility.

Q. Okay. And in terms of the coal, does that compressibility number decrease on -- in relation to what one assumes is the standard cubic feet per ton in the coal?

A. No, it actually increases. It's directly proportional to the gas content of the coal.

Q. It's directly proportional to the gas content of the coal?

A. That's correct.

Q. Okay. So what one assumes is the gas content in the coal is going to directly determine the compressibility factor?

A. That's correct.

Q. All right. And your Table C-1 on page 16 gives us those key parameters, does it not? And -- I have a copy here. And some other parameters that you've used.

A. Yes, that's the key parameters for analysis 1 of the seven analyses I conducted for this.

Q. Okay. You change them around a little bit for some of the other analyses?

A. That's correct.

Q. Okay. Well, we'll ask about those as we look at your analyses. But just so the -- Permeabilities, you already said, is a key factor. Porosity-compressibility product is a key factor, correct? If you change those, you're going to change the outcome of what happens in terms of the observation of the movement of this pressure transient; isn't that correct?

A. Actually -- yeah, all of these -- If you change any one of these, you'll change how fast the pressure transient moves. But those are two of the more important factors.

Q. Okay. And for thickness, for the coal you're using a thickness of 18 feet?

A. Yes.

Q. And for the Pictured Cliffs only three feet?

A. Yes.

Q. So you're eliminating -- or maybe I should put it this way: You're only considering the sandstone that is within the coal formation; is that correct?

A. Well, for analysis 1, I was looking at the upper bench of the Pictured Cliffs. I did also look at a case where the entire Pictured Cliffs formation would be included.

Q. And any of -- In your analysis? In all of your analysis you just used three feet of thickness, didn't you?

A. No, I have --

Q. Okay.

A. -- seven different cases here.

Q. I know you do. We'll try and go through it. Maybe I missed that, because I did observe some changes in the parameters. But you changed that in some of the analysis, the thickness?

A. Yes.

Q. Okay, as we take a look at your analysis, please point that out so we don't miss that, where you change that thickness.

A. All right.

Q. Can you do that, please?

A. Sure.

Q. All right. So if you've got -- The Fruitland Coal, you assign a permeability of 20 millidarcies and the Pictured Cliffs sandstone 150 millidarcies, you already know the answer as to which formation is going to allow pressure to pass through it more quickly, don't you?

A. No, that's the reason why I made the calculations, because I wanted to see what the result would be using various numbers. And so that's why I set up the calculations, was to examine that.

Q. But using those numbers, I mean, it's like saying I'm going to compare a sprinter to the 300-pound shot-putter, and I'm going to see who runs the fastest; isn't that right? I mean, you know what the result is going to be?

A. Well, no, it's -- Yes, I know that it will go faster, but I don't know how much faster until I actually calculate it.

And in addition I'll point out that I use the 20 millidarcies in the initial analysis 1; I used other permeabilities for the Fruitland Coal in other analyses. So that's not a single number that I used throughout the entire analysis.

Q. You used 150 millidarcies for the Pictured Cliffs throughout your analysis, didn't you?

A. I believe that's correct, yes.

Q. And you did take the coal up to 50 millidarcies in some of your analysis; isn't that correct?

A. Yes.

Q. All right. And then later the compressibility of the coal to .0018 instead of .0025?

A. Well, the .0018 versus .0025 was a correction in the Langmuir pressure, and so -- That, frankly, goes the other way. That's slightly reducing the porosity-compressibility product of the coal.

Q. Were the thicknesses you used measured from logs, or how did you arrive at the 18 feet for the coal?

A. I looked at the information on coal thickness that Mr. Nicol had and just picked 18 as being a representative value, that there was a range in the thickness from various wells. Likewise, the three feet for the Pictured Cliffs, I used that based on looking at his isopach of that upper bench in the Pictured Cliffs sand.

Q. Okay. Well, let's look at the permeabilities for the Pictured Cliffs sandstone. Are you aware that we have some evidence by Mr. McCartney in this case that gives us permeability on the Pictured Cliffs, his Exhibit M-25?

A. Yes, I'm aware of this exhibit.

Q. All right. And the permeabilities that he arrived at for the Chaco Number 1, the highest permeability assigned to that well would have been 6.00 millidarcies?

A. That's what this exhibit says.

Q. And for the Chaco 2-R, 8.83 millidarcies?

A. Yes.

Q. And for the Chaco 4, 21.31 millidarcies?

A. No, the highest on the Chaco 4 is 38.62.

Q. Oh, I'm sorry. I'm sorry, I stand corrected. All right.

And for the Chaco Number 5, 23 millidarcies?

A. That is correct.

Q. All right. And these perms are calculated in the early life of the well, so would you agree that it -- there should have been a period when there was little if any so-called damage affecting the reservoir?

A. I would say that there was less damage, but even early in the life of these wells damage was occurring.

Q. When did it start occurring?

A. I don't know a specific date. But based on the production curves, it was happening within months, if not days, after the wells came on stream, damage began.

Q. Okay. Even though from Exhibit M-25, in the case of the Chaco 4 we see better permeability three years after the first reading and in the Chaco 5 better permeability about a year after the first reading?

A. Well, these are calculations based on particular conditions and such from short-term tests, and they are not necessarily the same type of thing that I was looking at when I was preparing my analysis, so...

Mr. McCartney prepared these, not me.

Q. Well, your 150 millidarcies for the Pictured Cliffs isn't based on any test that you conducted, did you -- is it?

A. No, it was based on two key factors. It was based, number one, on looking at the PROMAT results that Mr. Robinson had from the previous hearing that indicated 90 to 103 millidarcy, if I remember correctly, for the Chaco Number 4 and 5, for the entire thickness of the Pictured Cliffs for those two wells, and based on the core analysis from the Lansdale Federal Number 1, which indicated streaks of permeability as high as 242 millidarcies.

So there are indications to me, or there were at that time, that there are zones or streaks of higher permeability in the Pictured Cliffs.

Since the analysis that I was doing indicated that it was primarily, or perhaps all of the communication was occurring through the upper bench of the Pictured Cliffs, which looked to be perhaps slightly cleaner than some of the other zones in the Pictured Cliffs and higher gas saturation, I therefore took numbers toward the higher end.

Q. All right, let's talk about the Lansdale Federal Number 1 core. First of all, do you agree with the statement that readings of permeability from core analysis are typically higher than the actual reservoir permeability?

A. No, that depends. It varies from reservoir to reservoir and case to case.

Q. But when you take a core down -- that's no longer down in the reservoir under the overburden pressure conditions and you break the rock and you bring it up to the surface, it's universally recognized that you're going to get a higher permeability reading than what that rock would reflect down in the reservoir, isn't it, Mr. Cox?

A. No, I disagree, it is not universally recognized, and I can say from my own experience that it is not always the case that that happens.

Q. This core, you recognize, was taken in 1978 on the Lansdale Federal Number 1?

A. That's correct.

Q. And you know that wasn't the so-called pressured cores that sometimes at great expense are being used in research now?

A. I don't think pressured cores are necessary for this type of reservoir.

Q. All right. And in the Lansdale Federal case of the cores, the average permeability that was shown on the Pictured Cliffs, if I remember correctly, was 54 millidarcies, wasn't it?

A. 53.6, yes.

Q. All right. So you take the situation where maybe there was a one-foot streak that had a higher reading and say that's what you're going to use to support your 150 millidarcies?

A. No, I was explaining to you where the 150-millidarcy number came from. At the time that I made those analyses, I had not done independent analyses of the production response or of the test information to try and determine permeability from that information. I was --

Q. Well, I thought --

A. Excuse me.

Q. I thought you said you didn't use Mr. McCartney's Pictured Cliffs permeability factors, you relied on the Lansdale Federal core -- Was that your testimony?

A. No, I did not rely on the Lansdale Federal 4. Rather what I said is that I had used the information from the Lansdale Federal core, I had used the information from Mr. Robinson's PROMAT analyses, and I used my examination of the logs that suggest to me that, if anything, the permeability of that upper bench of the Pictured Cliffs might be slightly better than average permeability, to pick a number of 150 as a number to use for that analysis.

At the time --

Q. Okay, so you --

A. Excuse me, if I may finish.

Q. Yes, please.

A. At the time that I did that analysis, I did not have Mr. McCartney's calculations in front of me.

Q. Okay, so you didn't use the 54 average of the core, you didn't use the 103 factor of Mr. Robinson that you've alluded to. You selected 150 millidarcies for the Pictured Cliffs?

A. That's correct.

Q. But it would have made a very big difference, for example, if it had been 50 millidarcies; isn't that true?

A. It will make a difference.

Q. Well, if it had been 50 millidarcies, and later you used 50 millidarcies for the coal, you wouldn't have the support for your conclusion, would you?

A. If it had been 50 millidarcies and 50 millidarcies in the coal, those wells would not have responded. You would not be able to see a pressure response from those wells.

I know that those wells respond. Therefore, I have to honor that fact and take -- I have to incorporate that in my analysis.

Q. So what you're saying, there would have been no response -- if you're saying -- If the permeability of these two formations was essentially the same, 50 -- let's say 50 millidarcies, there would be no response? Explain that.

A. No, there would not have been a response in one to two days, as was observed in the Chaco Number 4 and Chaco 5. There would still be a response, but it would take much longer to get to those two wells.

Q. All right, let's make it clear to the Commission what we're talking about. We'll come back to this discussion, but since you've touched on that, what we will observe when we look at the pressures with the Chaco wells shut in, July of 1998, and then an incident where the Whiting wells are shut in because, for example, the processing plant, El Paso's processing plant is down, we will see in one day, maybe within hours, that the pressures in the Chaco wells go up in observable quantities, 5, 6, 8 p.s.i.; isn't that true?

A. I don't know if that happens within hours or not. The information I have does not tell me that it happens within hours.

Q. Within a day? Let's just say within a day.

A. Within one to two days, yes.

Q. Which is a quick response. We're talking about a pressure transient going through a formation?

A. It's extremely rapid response, yes.

Q. Okay. So some zone there has a fairly high permeability, right? Or a high permeability, for that to happen?

A. Yes, I think so.

Q. Let's talk a little bit about the coal permeability that you selected of 20 millidarcies.

In your affidavit that was filed with the Commission, the second affidavit that was filed or made by you on May 18, 1999, you say that:

> I estimate the permeability of the Fruitland Coal to be between 20 and 25 millidarcies, based on comparison of the production rates of the Gallegos Federal wells to other coalbed methane wells in the Basin.

End quote.

I may have missed it, but I did not see this study, this comparison between the Gallegos Federal wells and the other coalbed methane wells in the Basin. Can you point us to that?

A. I don't have any formal study on that. Instead what I did is, I have analyzed -- I have conducted more than a hundred simulation runs of individual wells in the Basin that, in my experience, the higher permeability coals tend to give higher rates.

And in particular I will point to the GRI research well in Section 17 of 32-10, which has a permeability of about 25 millidarcies. That well had a peak rate of almost 12 million cubic feet per day.

And so recognizing that, I felt that the permeability of these coals would not be probably materially higher than that, just because the rates never approached anywhere near the 12 million a day. Now, there's corrections for pressure and the amount of drawdown that need to be done, and at that time I was expecting that tests would be run to evaluate the permeability of the zones here and to see which wells were offending wells.

And so getting a ballpark permeability, which I have listed as between 10 to 25 millidarcies, whereas in your question I think you read it as 20 to 25 millidarcies -- that gave me a ballpark to look at. And I just used that 20 millidarcies as a number, again, for illustrative purposes, to see whether the pressure transients would move faster through the coal than through the Pictured Cliffs.

Q. Is the short answer to my question that you don't have the information so that we can see this comparison of the Gallegos Federal wells' production to other wells in the Basin on which you posit this --

A. No, I did that based on my experience in the Basin.

Q. Okay. And your experience in the Basin would include the presentation that you made to the SPE Denver

Section Reservoir/EOR Study Group on Coalbed Methane Reservoir Engineering, 1995, would it not?

A. I'm not sure I recall the year. Is that SPE or SPEE?

Q. SPE.

A. Okay. I don't recall that presentation, but I've done many presentations.

Q. Well, let me -- I thought maybe you recalled it but since you don't, let me mark this as --

MR. CONDON: It's Cox, whatever it is.

MR. GALLEGOS: Yeah, Cox 61?

MR. HALL: Gene, let me ask that you assign another number to that, as we may have some additional --

MR. GALLEGOS: You might have some others?

MR. HALL: -- exhibits that are pre-marked.

MR. GALLEGOS: Okay.

MR. HALL: If you want to start 71, perhaps, or A.

MR. GALLEGOS: Okay. Let me mark it as 60-A, and then that won't interfere with any of your exhibits.

Q. (By Mr. Gallegos) Do you recognize the exhibit I've handed you?

A. Yes.

Q. Let me state it's not the entire presentation. We tried to just include the pages that refer to the subject that we're talking about.

Is this a portion of the presentation that you made on June 21, 1995, to the SPE Denver Section Reservoir/EOR Study Group?

A. Yes, sir, it appears.

Q. One thing I'd like to ask you about because I think it might have some interest in what we're talking about here is on your gas content factor under "Fruitland Formation Data".

A. Yes.

Q. You indicate that with the depth of the occurrence of the coal there will be -- with increasing depth, there's increasing cubic feet per ton in the coal. Is that a correct reading?

A. No, that actually isn't. It just happened to be that those were two particular samples, the one with the least gas content and the one with the greatest. The gas content of the coal does generally increase with depth, but that's -- These particular numbers just happened to be two particular samples. You can't use those for -- You'd be mistaken if you tried to draw conclusions from those numbers.

Q. Well so, when it says 4 cubic feet per ton at 280 feet to -- the word "to" -- 600 cubic feet per ton at 3500 feet, that's not any kind of a measure or indicator?

A. Well, it is, but I also have seen samples at 20 feet that have 100 standard cubic feet per ton, and I've seen reports now that are over 800 standard cubic feet per ton from some samples deep in the Basin. So there's considerable variation.

Q. All right. And the plot over here, I just wanted to ask you about. The plot over here indicates that gas recovery of Fruitland Coal wells will vary on an increasing basis as the millidarcy rating of the coal increases?

A. And again, that's generally true, but this particular graph was prepared as part of another study, and again, on a larger-scale basis I would hesitate to draw particular inferences about any specific project based on this chart.

Q. Actually, you did some calculations, did you not, that attempted to arrive at the current permeability in millidarcies of the coal that are different from the 20 millidarcies that appears in Table C-1?

A. Yes, I did.

Q. And that would appear in Table C-3, in your testimony?

A. That is correct, Table C-3 of my testimony.

Q. Table C-3 at page 36 of your testimony?

A. Yes.

Q. The handouts are just to make it easy for everybody to be able to view these and maybe set them side by side if somebody cares to do that.

So if we look at the suspect well once you've done this calculation, the 6 Number 2 you rate as having 77 millidarcies of permeability, the 7 Number 1 as 61 millidarcies of permeability, and the 12 Number 1 as 49 millidarcies of permeability; is that correct?

A. That is the calculated gas permeability as of April, 1999, correct. If that's what you mean, that's correct.

Q. What did you use as a drawdown pressure for making these calculations?

A. For those calculations I assumed that the average pressure at that time was 150 p.s.i.g. and that the wells were producing against 5 p.s.i.g.

Q. Okay, based on being on compression?

A. That's correct.

Q. What effect do you think it would have if you would have used a drawdown pressure, let's say, of 50 p.s.i. for the Fruitland Coal wells. Say they weren't on compression.

A. If they had produced at the same rates under the same condition and were not on compression and had a bottomhole pressure of 50 p.s.i., the calculated permeability would be somewhat higher but not a whole lot, because it's the square of the pressure difference that enters into that, so that would increase the permeability by 10 to 20 percent. It's not a factor of two or anything.

Q. Just to help us with a comparison to see how these different parameters look as we've discussed it, I've marked this exhibit as Cox-60-B, and would you agree that it simply gives us a comparison of the Pictured Cliffs permeability of 150 that you used, and the permeabilities of Mr. McCartney?

And I think there's an error on here that you pointed out to me, because I meant to show Mr. McCartney's highest permeability, and I want to make sure that I did that. No, I guess I did. I used the highest permeability from Mr. McCartney's exhibit.

Oh, there is an error, though, it's Exhibit M-25, not Exhibit M-28.

But would you agree that this Exhibit 60-B simply makes a comparison of what you used in your Table C-1 of 150 millidarcies to Mr. McCartney's Exhibit M-25 of the highest permeability factor for the Pictured Cliffs wells?

A. It does list those two, yes.

Q. All right. And for the Fruitland Coal does it list your C-1, 20-millidarcy permeability rating for the coal compared to your Table C-3 permeability calculations for the coal?

A. That's what it shows.

MR. GALLEGOS: I'm wondering what the pleasure of the Commission is. It's about -- It's 12:30, and I'm just about to start into his analyses, of which there are seven. It's going to take a while, so would this be a good time to --

COMMISSIONER LEE: You're hungry, right?

MR. GALLEGOS: I'm hungry.

(Laughter)

MR. GALLEGOS: I get up early and eat early.

CHAIRMAN WROTENBERY: Okay, we can go ahead and break then. We might need to start back up a little -- What would you suggest? How long do you need to break for lunch? We will have to take a break for about ten minutes right at two o'clock because one of our Department employees is leaving, and we need to go pay our respects for just a few minutes.

MR. GALLEGOS: Maybe we ought to go off the record and talk a little bit about timing, because I'm concerned about how we're going to be able to get our case on. I mean, we're -- It basically likes almost three days for the Applicant's case, and then we've got -- you know, we're going to be squeezed into putting ours on in one day or maybe slightly over one day. Are we going to be able to work evenings or have another day of hearing or -- what --

I wouldn't be surprised if Pendragon doesn't want some rebuttal, so what's --

CHAIRMAN WROTENBERY: We do plan to work evenings and try to finish up here today and tomorrow, if at all possible.

MR. GALLEGOS: So maybe we could break for dinner and have an evening session?

CHAIRMAN WROTENBERY: Yes, I think that would be a good idea.

MR. GALLEGOS: You haven't consulted with your fellow Commissioners.

(Laughter)

MR. GALLEGOS: I see some expressions that --

CHAIRMAN WROTENBERY: You knew we were going to work long days.

MR. GALLEGOS: All right, we're just trying to get some idea of how we're going to get it all in.

CHAIRMAN WROTENBERY: That's our plan, yeah. Yeah. Take what time is necessary, but --

MR. GALLEGOS: Forty-five minutes for lunch? I don't know, can we --

MR. HALL: That's fine. We're going to Hidden Chicken.

CHAIRMAN WROTENBERY: Okay, very good. Okay, well, we'll break now and start back up at 1:20 and then go for -- and just break for a very brief period at two o'clock so we can go pay our respects.

MR. GALLEGOS: Okay.

CHAIRMAN WROTENBERY: Thank you.

(Thereupon, a recess was taken at 12:35 p.m.)

(The following proceedings had at 1:25 p.m.)

CHAIRMAN WROTENBERY: Okay, we'll get started again.

MR. GALLEGOS: Back in session?

CHAIRMAN WROTENBERY: Yes.

MR. GALLEGOS: Okay.

Q. (By Mr. Gallegos) Mr. Cox, let me see if we can get a little clarification on what we left off on, which is your Table C-3. It's entitled "Estimated Coal Permeability Based on Analysis of Production History". And for the three wells, the coal wells that you suspect you calculated permeabilities of 77 for the 6 Number 2, 61 millidarcies for the 7 Number 12, and 49 millidarcies for the 12 Number 1. Okay, are you with me in that regard?

A. Yes.

Q. All right. Now, I was trying to understand and pay attention at the same time, but did you say these calculations were made in April of 1999?

A. No, those calculations were made as of April, 1999. So for the gas permeability changes over time, that's calculated permeability as of April 1, 1999.

Q. Okay, that's -- In other words, using data as of April, 1999, not necessarily physically calculated at that time?

A. That's correct.

Q. All right. Can you just -- Maybe we can do this quickly this way. If you'd use this, I'd like for you to give us the formula for the calculations so we'll know in particular what pressures you used. Would you mind illustrating this on the pad of drawing paper that's in front of the Commission?

A. Okay.

Q. Let's see if we can turn it so we can see it.

A. Okay, the formula here is *q*, which is the rate in barrels per day, is equal to permeability in millidarcies, times thickness in feet, times pressure differential in p.s.i., divided by -- There's a units constant here, and I -- right off the top of my head I don't recall what that is. And then viscosity, centipoise. There will be a water formation volume factor in reservoir barrels per standard barrel. And then a factor accounting for the size of the reservoir, and the geometry, and the skin factor.

Q. Okay, and this is just solving for k?

A. All I'm doing is coming in here and solving for k.

Q. That's what I was asking, because that's just all I was trying to see, is just solving for k --

A. Right.

Q. -- permeability?

A. Right. Oh, wait, this was the formula for water, which was the initial one.

For gas at any point in time it's in MCF per day, and that's k millidarcies, h and P, ΔP, which is squared, over μ -- and there's a 1424 here -- μ, centipoise, Z, which is dimensionless, T, the degrees Rankine, and then again r_e over r_w, minus 3/4, plus S.

All right, so all I'm doing is, I'm taking the gas rate at that time and solving this equation for permeability. And I use in this temperature of 100, Z factor of .98, viscosity .012. This was based on 320-acre spacing and whatever the well size is, I've forgotten. And then a skin factor I used here, minus 5.

Q. But when you get down to just getting permeability, k --

A. Right.

Q. -- isn't that permeability inversely proportional to the difference in two pressures squared?

A. Right that's this ΔP squared here.

Q. Right, ΔP squared. Can you just put that k equals --

A. -- equals a bunch of things over ΔP squared.
Q. Okay. But other things being equal, you're going to get your permeability with your difference between those two pressures squared?
A. That's correct.
Q. Okay. And what are those two pressures? That's what I was trying to get at, to just kind of simplify this.
A. Let's see, I don't have my report right here, but if I remember right --
Q. Well, maybe we can --
A. Oh, here's my briefcase. It was 150 p.s.i.g. for the assumed reservoir pressure and 5 p.s.i.g. for the bottomhole pressure.
Q. Okay well, let's say what this first of all, and I wanted the quantity, but first of all you're talking about the pressure of the reservoir --
A. Correct.
Q. -- squared?
A. Right.
Q. And the pressure, flowing pressure, at the surface squared, and the difference?
A. Yeah, actually technically it's not at the surface it's at the bottom of the hole.
Q. Okay.
A. So this is P, reservoir, squared, times P_wF

squared. And if you're using the average reservoir pressure, this constant is 1/2. If you're using the reservoir pressure at the edge of the drainage area it's 3/4.

Q. Okay. But if the flowing pressure -- The flowing pressure you used was 5 p.s.i. --

A. 5 p.s.i.g.

Q. -- which is up at the surface at the suction of the compressor, correct?

A. Correct.

Q. That's not the pressure down at the reservoir. You've got to make some corrections for the fact that you're going back down there, you're going through the gas column and you're down to the bottom of the reservoir, did you do that?

A. No, but the correction -- if the well -- the correction for gas at 5 p.s.i.g. is negligible. The correction for water would be a potential correction, and I assume the wells were pumped off.

Q. Okay, but I just wanted -- So what you used here was 5 p.s.i.?

A. 5 p.s.i.g., which is 13 p.s.i.a.

Q. Okay.

A. Excuse me, 18 p.s.i.a.

Q. We'll just use -- so we're comparing -- You used gauge, right?

A. Well, but I converted it to absolute for this pressure differential. You have to convert to the absolute pressure.

Q. Okay, 13.

A. 18.

Q. 18 p.s.i.a. Okay. And for reservoir pressure?

A. 150 p.s.i.g. or 163 p.s.i.a.

Q. Okay, all right. Now, you had a shut-in pressure on that well that you gave us -- not that well, but let's just take the 6 Number 2 as one, because there was one that was 96 and one 102.

In August of 1998 you had a pressure on the 6 Number 2 of 102; wasn't that correct?

A. 102 or 103.

Q. All right. And with the shut-in, wouldn't that be indicative of the reservoir pressure?

A. It's an indicator, but the pressure was still continuing to build at that point in time. That's why I used a number of 150.

Q. Seven and a half days of shut-in, and you don't use the pressure that was actually read?

A. That is correct. Coal wells, coalbed methane wells, often take longer to build up because you have two phases present. You have -- The gas re-absorbs on the coal, so as a result of those complicating factors, it often takes longer, even, than seven days.

Q. Okay, but this is -- This we should remember. The 102 I was talking about is at August, 1998, correct?

A. Yes.

Q. But you were making this calculation as of April, 1999, correct?

A. Yes.

Q. So the coal wells, Whiting wells, continue to produce in that time, so the reservoir pressure is going down, is diminishing, isn't it?

A. Yes.

Q. All right. Do you have an indication of what the reservoir pressure was in April of 1999?

A. The only indications I have are on these charts of the amount of buildup that the wells reached when they did build up.

My -- Again, the observation that coalbed methane wells commonly -- as long as they're in the two-phase region, they commonly take longer to build up than a conventional reservoir.

And then number three, there was also more recently -- in July, apparently, there was some type of a test run on the 13 Number 1, if I remember right, that indicated a pressure in excess of 100 p.s.i. at that point in time, in July.

Q. Well, can you answer my question? As of April of 1999, you have a pressure to compare to the 102 shut-in pressure observed in August of 1998 for the 6 Number 2 well?

A. No, I don't have a comparable pressure.

Q. Do you disagree that it would be a lower pressure, that that well, having produced at very significant rates for -- you know, what? An eight-, nine-month period of time?

A. I don't disagree that the average reservoir pressure dropped during that time. But I don't know that 102 p.s.i. was the average reservoir pressure at that time. In fact, what I'm saying is, the 102 was a number that was not the average reservoir pressure. It was less than the average reservoir pressure, because the well was still building up.

Q. So continually, even if you get a permeability indicator on a core or if you get a pressure reading on a well, you select not to use that data but to assume some other factor. Isn't that what you've been doing through your testimony?

A. Not at all. I disagree vehemently with that statement.

Q. Would you calculate the permeability based on what the shut-in pressure on the 6 Number 2 indicates, 102?

A. Well, that's not the average reservoir.

Q. What happens if you calculate that, Mr. Cox? You know, don't you?

A. Well, the calculated permeability will be a higher number.

Q. The calculated permeability will be higher by a factor of more than twice the 77 millidarcies that you assigned; isn't that right?

A. No, I don't --

Q. These numbers are squared.

A. Well, except your -- You need to add the 13 p.s.i. for the atmospheric, so you're comparing the square of 163 squared minus 18 squared, versus -- that would be 115 squared versus 18 squared.

Q. Would you make the calculation for the Commission?

A. Sure. I'll write these numbers down.

Okay 163 squared minus 18 squared is 26,245.

102 squared -- or excuse me, it would be 115 squared -- and that, again, would have to assume that there was no water level in the well at that time -- minus 324 is 12,901.

So indeed, that is 2.03 times.

Q. Okay. So the permeability for the coal on that calculation of between 150 and 160 millidarcies? Or if you want to be exact, 77 times 2.03 equals 156 millidarcies.

A. Okay.

Q. All right. In order to accomplish your pressure transient analysis -- transit analysis -- in addition to the parameters of permeability, porosity and so forth that's set out on your Table C-1, certain equations had to be employed; is that correct?

A. That's correct.

Q. And there is quite a number of them, but just to help the Commission, do those appear beginning at your Exhibit C Number 2?

A. Yes, on page 64 of Cox Number 2.

Q. Exhibit Cox Number 2?

A. Yes.

Q. Okay. And there are -- I wouldn't even ask you for an explanation because I probably wouldn't understand it, but why are there 18 equations?

A. That's how many equations I felt I needed to include so that if anyone wished to reproduce or check these calculations they would have the formulas that I had used.

Q. Are the equations based on radial flow for the Fruitland Coal zone?

A. Yes.

Q. Okay. Are the equations based on radial flow for the Pictured Cliffs zone?

A. Yes.

Q. All right. So that means that your equations assume that you have a well and that the flow is -- radial, is -- all is a circle around the wellbore?

A. Technically, no. By superimposing the effects of two wells, the flow is no longer radial. The calculations are the same because of superposition, though.

Q. Well but it's a radial-flow equation?

A. It's a radial-flow equation, but through superposition the flow is no longer radial, or no longer perfectly radially in the reservoir.

Q. Well, what is it less than radial, employing your equations?

A. Well, the interference effects between the two wells are included, so that not only do I have the flow from one zone to another, but I have crossflow occurring within the wellbore.

Q. Let's see if we can understand what you're saying. So you're saying it's radial until you reach an interference point, so then it's no longer entirely radial? Is that --

A. No, I'm not saying that at all. Let me, if I may, clarify this.

Q. Yes.

A. Okay. What I'm saying is, in calculating the interference effects between two wells, it's a common practice, and because it works, to examine the interference based on -- as if the flow were radial into the producing or active well. Now -- As if it were in an infinite reservoir. We saw no effects of boundaries through this interference effect, so if there were boundaries channeling that flow or causing that flow to not be going out in all directions, then those boundaries would cause potentially more rapid response.

But as far as calculating the interference response, it's done as if it's two wells existing in an infinite reservoir, and we're looking at the effects of those two wells and nothing else. So the other wells outside the drainage areas of these wells, as long as they're producing in a similar fashion, or as long as they're not interfering with these wells during the period of the test, I don't have to include them.

Q. And that wasn't the question. You're aware, aren't you, Mr. Cox, that the wells that we're examining, the Chaco 4 and the Chaco 5 and the three coal wells you've focused on, all have been hydraulically fractured?

A. That is correct.

Q. So you're aware that none of them are producing under radial-flow conditions; isn't that true?

A. No, that is not true. Right now the Chaco 4 and 5 are shut in, so they're not producing at all.

Q. Well, but they were producing.

A. When they were producing --

Q. I'm not --

MR. HALL: Let him finish, please.

MR. GALLEGOS: Well, I mean, that's -- just trying to be cute.

Q. (By Mr. Gallegos) When the wells were producing --

MR. HALL: Well, I object to that. Let him finish his answer, please.

Q. (By Mr. Gallegos) When the wells were producing, they were not producing under radial-flow conditions, were they?

A. No, when the wells were producing, the interference -- the pressure effects hundreds or thousands of feet away from that well are essentially the same as if the well were producing with radial flow.

It's only close to the well and close to the fracture, in a case like this, that the flow deviates from radial flow.

Q. There is recognized in your engineering discipline that wells that are fracture-stimulated produce on a linear flow basis; isn't that true?

A. No. Some wells do. These wells would not.

Q. If wells are hydraulically fractured, and if they are producing on a linear-flow basis, then different equations would have been employed; isn't that true?

A. If that were the case, yes. But that only applied to tight reservoirs. These are not tight reservoirs.

Q. Okay. Neither the coal nor the Pictured Cliff reservoirs are tight reservoirs?

A. That's correct.

Q. So we don't need to argue this around, but we should just understand that the equations you employed here assumed a radial flow which eliminates the effect of the fracture-stimulations, propped fractures?

A. No, that is not correct. I included the effects of the fracture-stimulations as an effective skin on the completions, and I applied an effective skin of minus 5 to account for the frac jobs.

Q. All right. So you put in your calculation the minus-5 factor, and I think that appears in your Table C-1?

A. Correct, C-1.

Q. Okay. So what that attempts to do is say, even though a radial-flow equation is used, by putting that factor in I correct for the fact that these wells are fracture-stimulated; is that a fair statement?

A. Yes, that's part of the correction. There's another implicit correction as well.

Q. And what is that?

A. That's in the equivalent interwell distance that was used, because when you have fractures, the -- if the fractures are pointed towards one of the other wells, then the pressure transient from a well approaches close to that well because of the hydraulic fracture.

Q. Do you know in which direction the fractures on these wells are pointed, Mr. Cox?

A. No, I don't.

Q. So as a further correction in your Table C Number 1, where we see Equivalent Interwell Distance, we should understand that 1000 feet is saying I am assuming that the fractures on these wells are pointed directly toward each other?

A. No. The frac-

Q. You're saying -- Excuse me.

A. It is assuming that the fractures from that well may allow more direct communication than if you took the true interwell distance, which is more than 1000 feet.

Q. Well, but doesn't it mean that the fractures have to be within 1000 feet of each other?

A. No, because there's also potentially anisotropic or directional-permeability effects as well that can cause the effect of interwell distance to be less than the actual interwell distance.

Q. So what purpose does your 1000-feet assumption here serves?

A. It serves as giving a number, using a number, that's in the right ballpark, or approximately the ballpark, to show -- again, for calculation purposes, to show the effects of interference and how the interference transients would move within that formation.

And if you'll note, I also did sensitivities on that effective interwell distance to see what impact it would have.

Q. And we'll talk about that in some of your different analyses?

A. Yes.

Q. All right. So now that we've talked about your parameters and your equation, and I guess we have some idea of this, what were you looking for, to achieve -- if I may use the term -- achieve a match that would answer your inquiry?

A. Well, initially I was not attempting to achieve a match. My first question was very simply, pressure interference had been observed at the Chaco Number 4 and Number 5. If I used what I felt to be reasonable values or potential values for the reservoir properties of the coal and the Pictured Cliffs, where would the first -- could I see levels of pressure interference that would be comparable to the observed levels.

And then secondly, from there, could I design a test to further evaluate what wells were offending wells?

Q. Okay.

A. And it was only later that I added the additional analyses where I actually matched the pressures, and that is frankly more of a -- It's showing that the pressure transients moving through the Pictured Cliffs accounts for or shows what's happening far better than the assumption that the pressure transients are moving through the Fruitland Coal.

Q. Let's see if we can examine that. I think maybe as we discuss this, if we look at your Exhibit C-10 and I guess C-11, C-10 for the Chaco 4 and C-11 for the Chaco 5 -- And I'm going to provide a copy of Exhibit JTB-5-A, which combines those pressure reactions.

You don't have a colored set?

A. There's a colored set up there.

Q. When I tried to make a comparison of pressures reflected for the shut-in periods on our Exhibit JTB-5-A, Mr. Brown's exhibit, and your 10 and 11, it looked liked there was fairly uniformly a 2- or 3-p.s.i.-lower value on your exhibits. Is that accounted for because of the -- I think it was a correction factor or something that Mr. Nicol used?

A. Yes, the gauges that were used were corrected or compared to deadweight-tested gauges, and so those correction factors were applied to the reported pressures, in my table. They do not appear to have been corrected in Mr. Brown's exhibit.

Q. Okay, and is it accurate to say that made a -- maybe a 2- or 3-p.s.i. difference?

A. Yeah, it was several p.s.i. It also, though, had another effect, which was when the gauge was lost in September of 1998 and a different gauge was used after that time, there's a discontinuity that needs to be corrected for if you are just using the raw gauge readings.

Q. All right, let's see if I can help us understand what you're looking for here.

Apart from that small difference, if I look at JTB-5-A, if you would with me, Mr. Cox, and let's look at the 7-1/2-day Chaco Plant shut-in and the green line with the little green triangles meant to indicate the response of the Chaco 4. So when we see that that's shut in, that the pressure -- When we see the shut-in of the coal wells, the pressure on the Chaco 4 rose from about 82 p.s.i. the first day to, let's say, 93 p.s.i. That's the kind of phenomenon that your study is attempting to address and explain; is that a fair statement?

A. Yes.

Q. Okay. So when I was saying "match", maybe that's the wrong term. What you're doing in your analysis is saying, I'm going to examine certain conditions, and I'm going to see what happens that would explain that when the coal wells are shut in, the Pictured Cliff wells would have a pressure increase, whatever the magnitude is. It could be 2 p.s.i. or 12 p.s.i.?

A. Yes, I was trying to use that pressure information to understand how the fluids were moving in the reservoir, how the pressure transients were moving.

Q. And if we look at the responses when the coal wells are shut in, there are some significant increases in pressure that occur from one day to the next, would you agree?

A. Now, is this graph accurate? Because it looks like the well started building up before his arrow for the shut-ins. I don't think these shut-ins are properly marked here.

Q. No, I think -- When I read it originally, I had that same problem, but there's two arrows on the August shut-in that shows where it begins and where it ends. Do you see?

A. Do you mean the little star at the bottom of the -- on the X axis, or what do you mean here?

Q. Yeah, in other words, if we look at the 7-1/2-day Chaco Plant shut-in --

A. Yes.

Q. -- the star to the right of 8-8-98, the arrow comes down there, that's when it started. And I think maybe it's just -- I see what you're talking about, the plot looks like the pressure starts going up slightly before that time. Is that what you were observing?

A. Yeah, it's showing it as going up two days before the wells were shut in, which --

Q. Well, that wouldn't --

A. -- doesn't make any sense.

Q. No, that wouldn't be correct. I guess it's just a matter of trying to get the boxes, labels up there. But let's assume that the pressure doesn't start rising until the Chaco Plant shuts down and the Gallegos Federal wells are shut in, all right?

A. Okay.

Q. Okay. But what you observed, what happens out there and what was observed in the field is that a pressure increase would be seen, really, from one day to the next. In other words, in a fairly short period of time?

A. That's correct.

Q. Okay. All right. So then you start inquiring into, let's see how I explain that with the various parameters and equations I'm using, correct?

A. I would use perhaps a different word. I'd say how would I understand that, rather than explain that. But yes.

Q. Okay, how would I understand? All right

And on your analysis number 1, which is illustrated at Cox-16, you said, I'm going to use my parameters in Table C-1, which is 20 millidarcies for the coal, 150 millidarcies permeability for the Pictured Cliffs, and this is what the plot shows?

A. That's correct.

Q. All right. And how should we read these charts? Because it was a little confusing to me. The red line says, Connection through the Fruitland Coal wells; blue line, Connection through the PC wells?

A. Yes. I have all of those, so let me get the one in color here.

Okay, the red line, which says, Connection through the Fruitland Coal well, that is the line that would happen if the frac jobs in the Whiting wells communicated to the Pictured Cliffs; whereas the blue line there is if the Whiting wells did not connect to the Pictured Cliffs but the Chaco wells were frac'd into the coal.

And so what this chart is showing, the upper line is if the Whiting wells are the offending wells, the lower line is if the Chaco wells are the offending wells.

Q. By the Chaco wells being the offending wells, what do you mean?

A. I mean if the Chaco wells were frac'd into the coal, then we would see this response on the blue line, whereas if the Gallegos Federal wells were frac'd into the Pictured Cliffs, then we'd see the response on the red line.

Q. Okay. And when we look at this it says that you wouldn't -- is this -- This is for any period of time? In other words, this doesn't relate necessarily to the July shut-in or the August shut-in, or does it?

A. Actually, it does. What it relates to is when the wells have the properties outlined in this Table C-1. And in particular they're -- the assumed average reservoir pressure for each zone, the 160 and 120, materially affect the compressibility.

And so if you look at a much earlier period, if we had had shut-ins from an earlier period when compressibilities were lower, then this would not be correct. And if you look at a much later period, say today, again compressibilities now are much higher, and so again this analysis would not apply.

So basically it's sort of for the last half of 1998. But if you were to look at it today, I would anticipate that the compressibilities would be higher and it would take longer to push a transient through.

Q. Okay, I'm trying to -- So Exhibit Cox-16 is addressing conditions, you say, in the last half of 1998?

A. Essentially, yes, the latter half of 1998.

Q. No specific shut-in, nor is it addressing any specific shut-in pressures?

A. No.

Q. In other words, like the increase of, say, 10 or 11 pounds on the Chaco 4 in one day in August?

A. No, it was not meant to address a particular shut-in or a particular point in time.

Q. And should we read Cox-16 as saying, when I do it this way, with these assumptions, it would take two days to see a pressure response if the connection is through the coal wells and -- well, I don't know, over ten days to see a response if the connection is through the Pictured Cliff well?

A. Yeah, in fact I think it would take even longer than ten days on this, because you would not be able to actually see a response less than 1 p.s.i. on a surface gauge.

Q. And when you say connection through the Pictured Cliff wells, I'm still not clear -- "connection" meaning a fracture that is a -- providing a crossflow through to both zones, but at what location?

A. What I mean there is, a fracture that is the frac- -- either, in the case of the blue curve there, the connection through the PC well, that in that case the fracture treatment of the Pictured Cliffs would have communicated to the Fruitland Coal as an assumption, at that well location or through that fracture that was induced in that well.

It may not be at exactly that specific location; it may also occur some slight distance from the well.

Q. So you're saying that if the fracture-stimulation on the Chaco 4 well vertically grew into the coal formation near that wellbore, and the coal wells are shut in, you would not see a pressure increase in the Pictured Cliff wells for -- I don't know, two weeks, maybe, according to this? Is that -- Or am I not describing that --

A. Yeah.

Q. -- correctly?

A. You seem to have some confusion between the well and the fracture treatment on the well.

When I say here connection through the PC well, what I'm saying is that the PC, the Pictured Cliffs and the

Fruitland Coal for this blue curve are in hydraulic communication. So they are in pressure communication with each other through the hydraulic fracture in the Pictured Cliffs well, for that assumption.

Whereas the other case is, the Pictured Cliffs and the Fruitland Coal are in communication through the hydraulic fracture of the Fruitland Coal well.

Q. All right. I didn't -- Maybe by using the wellbore I threw it off, but I think -- In the case of the Pictured Cliff formation, I'm assuming that the offending fracture that caused communication was a fracture on, let's say the Chaco 4; is that right?

A. That would be the assumption for the blue curve, yes.

Q. All right. And then I'm saying with the 20 millidarcies for the coal, 150 millidarcies for the Pictured Cliff, when the Chaco Plant shuts in and the coal wells are shut in, you wouldn't see any effect on that in the Chaco for two weeks or so?

A. Or more --

Q. Is that --

A. -- that's correct, yes.

Q. Is that what -- That's we're to understand what's being shown here?

A. That's what Exhibit Cox-16 is showing, yes.

Q. All right. And then your analysis number 2, basically same parameters but you change the compressibility?

A. Actually, I change the Langmuir pressure on that, not compressibility. But that does have -- The impact of that is, it does change the compressibility.

Q. And Cox-18 shows that?

A. That's correct.

Q. And it shows it doesn't really make much difference from -- As long as you still have that 20-millidarcy permeability for the coal and 150-millidarcy for the Pictured Cliff, it doesn't make much difference, does it?

A. Right, it's saying changing just that one variable has a negligible effect.

Q. Okay, right.

CHAIRMAN WROTENBERY: Mr. Gallegos, would it be okay if we took about a ten-minute break right now --

MR. GALLEGOS: Yes, certainly.

CHAIRMAN WROTENBERY: -- so we can go down the hall for just a minute? I apologize for the interruption.

(Thereupon, a recess was taken at 2:05 p.m.)

(The following proceedings had at 2:10.m.)

CHAIRMAN WROTENBERY: Ready?

MR. GALLEGOS: Yes.

CHAIRMAN WROTENBERY: Thank you for giving us that time.

Q. (By Mr. Gallegos) All right, quickly, analysis number 3, and it's illustrated at your Exhibit Cox Number 19. Let's talk about that briefly if we may. Do you have the material?

A. Yes.

Q. All right. Now, on this analysis what you did was, you changed the Fruitland Coal permeability to 50 millidarcies, correct?

A. Correct.

Q. And you kept -- Here we know you're keeping the Pictured Cliff at 150 millidarcies?

A. Yes.

Q. All right? That's really the only change; everything else remains equal?

A. It remains equal to analysis 2, because the Langmuir pressure of 332 p.s.i. was used in all of analyses 2 through 7.

Q. All right. And as a result of this, looking at your curves, it looks to me like it's about the same time lapse if the fracture communication is at the coal wells, but a considerably earlier response if the fracture communication is at the Pictured Cliff wells, down to maybe four or five days?

A. Well, you wouldn't be able to distinguish it in four or five days, because it's still less than 1 p.s.i. there. To be more than 1 p.s.i. is about nine days.

Q. Okay. And when would you be able to distinguish it if the connection is at the coal well?

A. Well, again, I'm using 1 p.s.i. because the gauge resolution was 1 p.s.i. So you certainly couldn't see anything less than about 2 1/2 or 3 days there. To see a full response on either of these, to where you were more certain that it was there, say a 2-p.s.i. response or a 3-p.s.i. response, would take 4 to 6 days if the connection is through the Fruitland well, or 13 to 18 days if it's through the Pictured Cliffs well.

Q. Okay. Let me ask you to assume, Mr. Cox, that instead of the 50 millidarcies for the coal you used the 156 millidarcies that was calculated at my request upon production history using the observed shut-in pressures, so that now we're at about the same for the Pictured Cliffs and for the coal, 156, 150. What would your curves look like then?

A. Well, they'd be closer together. But I actually do have a case in here -- the next analysis, analysis 4 -- where the Pictured Cliffs and the Fruitland had the same permeability, 50 millidarcies for each of them. It's not the 150, it would be the 50.

Q. All right.

A. So if you look at analysis 4, you can see, even so, still, the response would be much quicker, or it would be quicker for the connection through the Fruitland well. But the curves are now becoming much closer together.

Now, the problem with that is, if both of the permeabilities are 150 millidarcies, then your response would be reduced compared to what you see in analysis 4 there. So instead of seeing a response of 1 p.s.i. in seven days for the Fruitland well connection or nine days for the PC well, it would probably -- it would be considerably longer, the response time would be longer, those curves would be down more, so you'd be looking at something that would be approximately two to perhaps as much as three times longer to see a 1-p.s.i. response.

So that would not be consistent with the fact that response was actually observed.

MR. HALL: Excuse me, you're referring to Exhibit 21?

THE WITNESS: I'm sorry, yes, Exhibit Cox-21.

Q. (By Mr. Gallegos) I'm sorry, I got a little lost in your answer. Was that still with the 50 millidarcies for each formation, what you just said?

A. Let me start this again. Analysis 4 assumes 50 millidarcies for each formation.

Q. Right.
A. And you can see that --
Q. And that's shown on --
A. That's shown on --
Q. -- Cox-21?
A. -- Exhibit Cox-21, yes.
Q. All right.
A. And the curves are much closer together, but the time frame for response is now pushing to later and later dates. And if I were to run this with 150 millidarcies in each formation, then these curves would drop, compared to what we have here.

So there would be less response because of higher permeability, or the response would take longer, there would be less response at a particular time. So in order to see 1 p.s.i., that would take probably 10 to 15 days, possibly as much as 20 days, to see a 1-p.s.i. response.
Q. Now, wait a minute. You're saying if we increase -- I though the higher the permeability, the more rapidly this pressure pulse travels through the rock?
A. Well if both zones have the same permeability, then you're looking at the effect of the higher compressibility in the Fruitland Coal, would be offsetting to some extent that increase in permeability. So no, it's not going to just race through there.

You have two zones here, and that's why you have to do a model. Actually, what we ought to do, if that's your question, would be to analyze that particular case.

Q. Yes, and you did not do that?

A. No, I didn't know that you had a number of 156 millidarcies.

Q. But you didn't want to assume that number, correct?

A. I had not reason --

Q. I mean, you elected not to assume that?

A. No, I had no reason to assume 156 millidarcies.

Q. But what you're saying is, if they were both -- Let's say if they were both 150, you're not going to get the travel or response time of one day?

A. I don't think so. Frankly, I'd have to sit down and analyze it. When you have two layers like this, you can sometimes get things that are counterintuitive.

Q. All right. Analysis 5, Exhibit Cox-22, your backup to 150 millidarcies for the Pictured Cliffs.

A. Yes.

Q. Okay. But here you've also changed the thickness --

A. Yes.

Q. -- of the Pictured Cliffs formation. Instead of three feet you've got 25 feet?

A. That's correct.

Q. Does thickness really have anything to do with the permeability and the time for a pulse, pressure pulse, to pass through a formation?

A. When you have two formations that are connected to a well, then the answer is yes, it does, because those pressure pulses are moving through both formations.

And so if you -- Well, for that matter, look at the difference between the analysis 2 on Cox C-18, versus the analysis for the 25 feet on Exhibit Cox-22. You can see that it does make a difference, that having 25 feet of thickness in the Mesaverde retards the movement of that pressure pulse through the Mesaverde.

Q. What are you looking at?

A. Cox-22 versus Cox-18.

MR. HALL: Would you say the formation again, please, sir? Did you say Mesaverde?

THE WITNESS: I didn't mean to. Pictured Cliffs would be what I'm saying. We're not involved with Mesaverde here.

Q. (By Mr. Gallegos) So you're saying the interference time has a direct relation to thickness, the time for pressure to pass through a zone?

A. When you have two zones, each of the zones acts like a chamber. And if the chamber is bigger, it takes longer for a particular pressure pulse to move through it. And thus the 25-feet Pictured Cliffs thickness case, it takes longer for the response to move through that than the three-foot thickness case.

Q. So then if you select -- Back up in your input data on your Table C-1, if you would have selected thickness for the Pictured Cliffs sandstone of, let's say, eight feet, it would have made a difference from your using the three feet? It would have been a slower travel time through the Pictured Cliffs sandstone?

A. It would have been, but I actually chose three feet based on that being the representative thickness of that upper Pictured Cliffs sandstone interval in this area.

Q. Well, I understand your various selections, but I'm just saying that if there had been some evidence that the thickness is six feet or eight feet, you're saying that would make a difference in how this pressure pulse -- the speed at which the pressure pulse passes through the rock?

A. Yes, but you also need to remember that when we're saying six feet or eight feet or three feet, we're now talking what interval is it that that pressure pulse is moving through? And so if it's only moving through part of the Pictured Cliffs, we need to be putting in the interval that it's moving through, or the interval that it's connected to.

Q. Well, that's why I'm puzzled, when you have 25 feet it makes a difference, because if you have a pressure pulse, and let's say you've got three feet out of 25 that's got a high permeability, isn't your pressure going to move through that, and it's going to be the same when it gets to destination, whether it was three feet or 25 feet?

A. No, it isn't, because you have two wells there, not one well. If you had a single well and you're looking at an effect, then the answer is yes.

But you have two wells and you have two zones. So the zones crossflow to each other, and so that has to be taken into account. That's why I worked out those equations, to be able to analyze this case.

Q. Okay. To make sure that we're on the same page, when you use the term "response time", what do you mean?

A. Response time, in this particular instance what I'm saying is, how long does it take before I see a pressure transient at the observation well, the Chaco 4 or Chaco 5 in this case.

Q. In other words, how long is it before I see maybe even one-half a p.s.i.?

A. No, I can't see one-half of a p.s.i. because the gauge that was being used has a resolution of 1 p.s.i. --

Q. All right.

A. -- so it can only see one-p.s.i. increments.

Q. Okay, then I used a bad example. The response time would be -- How long does it take for the gauge to show 1 p.s.i. of increase?

A. Well, yeah, response time, we're -- you're trying to make a term that's not -- It does not have a specific definition that -- like "permeability" has a specific definition and has specific units. In this case we're just saying response time, meaning, how long does it take to have a pressure change that's big enough to observe?

Q. Well, how are you using it? It doesn't have a specific definition. What is the Cox definition that we understand is being used here?

A. Well, it's sufficient to be observed, and I did not actually set a specific value of so many p.s.i., but I can tell you the fact that the gauge resolution was 1 p.s.i. You have to have at least a couple-of-p.s.i. change to be able to be sure that you can see it, and in some cases it might be 3 or 4 if there was gauge variability. But 2 p.s.i. you can probably see, 4 p.s.i. you can definitely see.

So the time to see 2 to 4 p.s.i., that's a response time for this particular instance.

Q. Okay, let's go to your analysis 6, Exhibit Cox-24.

A. Okay.

Q. We're getting close now, right? I mean close to something that looks like the response time that is observed on these pressure charts?

A. Now, actually, Exhibit -- C-23 did you say, or -24?

Q. C-24 -- Oh, I'm sorry, C-23. I flipped over, and I meant to get Cox-23 and I got the wrong one. Excuse me. We're not getting close.

A. Right, Exhibit Cox-23 is not close.

Q. Right, I appreciate your correction there.

And here we understand that with this analysis you're using the radial-flow equation subject to all the qualifications you described, and we're using your parameters of 50 millidarcies for the coal and 150 millidarcies permeability for the Pictured Cliffs, correct?

A. That's correct.

Q. All right. And we still don't get a curve that matches up with the pressure increases in the response time that are shown on the exhibits like JTB-5-A?

A. Well, not in Exhibit Cox-23 we don't --

Q. Yeah.

A. -- and that's because the interwell distance of 2000 feet, at that distance it takes too long for those transients to move, and so you don't observe them in the period of time of the shut-ins on -- JTB-5-A, was it?

Q. Yes. So we -- And it's because of the interwell distance being 2000 feet?

A. In this case, yes, that was what I had used as a sensitivity. I was trying to change one variable at a time so that we could see the effects that each of these variables had.

Q. So let's see if we can be real clear on your definition of interwell distance. I take it it doesn't mean the distance between, let's say, the Gallegos Federal 6 Number 2 and the Chaco Number 4 wellbores?

A. No.

Q. It means something else?

A. What it means is that if you knew where the ends of the propped fractures were on each of these wells and you could then look at -- This is an approximation to the radial-flow part of it.

If you take the distance from the ends of the fracture tips of the two wells, the closest points where the tips go towards each other, or to the wellbore that happens to be closer if, for example, the fractures were perpendicular to the line between the two wells, then it would be the interwell distance, the actual interwell distance between the two wellbores.

But you also have to correct for any anisotropy or directional-permeability effects if they are present.

And that is a correction because we're using the radial-flow equation, and if you have directional permeability it turns out to be approximately an elliptical type of flow geometry, and the pressure contours would be more elliptical than they would be radial.

Q. Well, "directional permeability", is that a synonym for the permeability created by the hydraulic fractures?

A. No, that's an intrinsic pattern, if you will, to permeability in the formation. It's not induced. In some formations the permeability in one direction may be higher or lower than it is in another direction.

Q. So this interwell distance has nothing to do with the alignment of the fractures?

A. Yes, it does. If the fractures were aligned directly towards each other, the interwell distance would be substantially less than the distance between the two wellbores themselves.

Q. Let's see if we can get some idea -- visualize this some way. We've got -- I'm going to try a little -- take a risk and do a little artwork here, using this Exhibit JTB-1.

What I've drawn here, Mr. Cox, is just a kind of a hand sketch of -- off the plat of the location of these wells. I'm going to -- I put the Chaco 4 and the Chaco 5 in circles, and I'm coloring them in red, and then I've symbolized, like the plat does, the 6 Number 2 and the 12 Number 1 and the 7 Number 1 as triangles.

Can you help us understand what you're seeing, then, as the interwell distance in your analysis number 6?

A. All right. What I'm saying here is, this analysis is looking at the effects on one of the Pictured Cliffs wells -- for example, the Chaco Number 4 or the Chaco Number 5 -- when one of the Fruitland Coal wells -- for example, the 6-2 or the 12-1 or the 7-1 -- is shut in.

So if we were to say -- and again, this is hypothetical, but to show for illustrative purposes, if the fracture from the 6 Number 2 were aligned in some particular direction from that well -- and so I've now drawn in black here a line from that well -- and the fracture treatment on the Chaco Number 4 would likely be aligned in a similar direction, because the stress state in the formations is probably similar for the regional stress, however the frac job for that well, being a smaller frac job, would not have extended out nearly as far.

Now what we have is -- Let me use a different color. I'll use the red to show the actual interwell distance, right here, between the 6-2 and the Chaco Number 4, which according to JTB-2 1803 feet.

The effective interwell distance, assuming isotropic permeability, that the permeability is the same in all directions, would be approximately equal to the distance between the tip of the fractures. And you can see for this particular case where I've drawn it, that that would be substantially less than 1803 feet. It might be 1200 feet in this particular case.

So it would depend on the orientation of those frac jobs, as to what the effective interwell distance would be.

Now, I'll also point out while we're up here that with as many coal wells as there are, and the Chaco 4 and 5 being in between them, as long as that frac geometry -- It would be hard to get a direction that would not make the effective interwell distance smaller than the actual interwell distance for some -- one or more of these wells here.

Q. I'm sorry, if the fracture alignment is, for example, something more like this, more -- or just -- or let's just, to make it simple, east-west --

A. Yeah.

Q. -- then you don't diminish the interwell distance at all; isn't that true?

A. No, it is not, because -- For the record, let me point out I was drawing, whatever that is, approximately north-20-degree-east azimuth, and Mr. Gallegos was just asking what if the frac azimuth was east-west? Well, to draw the same type of thing for the 6 Number 2 -- I'll draw the frac length about the same as the one I've drawn before -- indeed, yes, now our interwell distance would be about the same.

Q. That's what I thought I asked you.

A. But now for the 12-1, doing this same kind of thing, in that case its interwell distance to the Chaco Number 4 would be much less than the interwell distance for the 6 Number 2, based on the drawing that you have here.

Q. And so in your next case where you say, well, I'm going to make the interwell distance 500 feet, you basically have to get the fracture from the coal well and the Pictured Cliff well lined up on the same alignment and coming within 500 feet of each other?

A. Right, but -- That's basically correct, yes.

Q. Okay. And that's hardly a unique match, or hardly a unique solution, is it?

A. No, it wasn't intended to be a unique match or solution.

Q. Because if those fracture alignments are anything but within that -- two 360-degree circles and coming right toward each other, then it doesn't work, you don't have the result that you're looking for, do you?

A. No, I think you're missing the point of analysis number 7, which was not intended to be an actual match of those pressures, but rather just to show what would happen if the interwell distance effectively were less than 1000 feet rather than more than 1000 feet.

But in addition, I'll point out once again that the fractures for the Pictured Cliff wells and for the coal wells ought to be aligned approximately in the same directions. They should have similar azimuths, because those directions are dependent largely on the regional stress field. And therefore you would get some alignment between the fractures in the coal wells and in the Pictured Cliff wells.

Q. For your analysis number 7 to be accepted, you would have to assume that, that you're going to get a fracture extending out from a Chaco well and lining up basically tip-to-tip with a fracture from a coal well; isn't that true?

A. No, that is not true. Once again, the purpose of analysis number 7 was to show the effect on a sensitivity variable type of thing of a lower interwell distance. And as it turned out, that happened to be very close to the actual observed pressure changes.

But it does not -- Just because it's very close does not imply that the effective interwell distance is exactly 500 feet or that the fractures have to be perfectly aligned.

Q. That is the only case, your analysis 7, that is the only case, in which you could replicate a pressure response within the time that was actually observed in the shut-in periods that we're dealing with; isn't that true?

A. No, it's the only case that I did replicate it. But by changing other variables I could match it with other things. That was not the purpose of making that analysis.

Q. By changing your permeabilities, you could match it so that the fractures in the Pictured Cliffs are the ones that are causing the communication, and you would have a reflection of the pressure response in the time shown on the shut-ins; isn't that true?

A. I don't think so, not the way that you just stated it, no.

Q. Well, I'll try and state it again. By having the high permeability in the coal and lower permeability in the Pictured Cliffs, by adjusting those permeabilities you could have the response time reflected in the shut-in data that we have and an indication that the connections are the result of the fractures in the Pictured Cliff wells?

A. No, I don't think you could while maintaining reasonable ranges for other variables, because every case I looked at, the response occurred more rapidly -- in most cases, much more rapidly -- if the connection were through the Fruitland Coal wells than if the connection were through the Pictured Cliff wells.

Q. The response time was much more rapid -- Oh, you don't mean through the formation, you're talking about the fractures at the Pictured Cliff wells versus the fractures at the coal wells?

A. That is correct.

Q. Okay. I just want to ask you a few more questions about another one of the factors that you relied on, which is, the Pictured Cliff wells are producing less than the original gas in place, the coal wells more, and if I understand, the basic reason that you set forth for the lesser or underproduction of the Pictured Cliffs wells is the damage --

A. That's correct.

Q. -- to those wells?

Okay. Now, let's have a little specifics about that, if we may. I took a note that you said that the damage in the Pictured Cliffs formation goes way out in the formation. And I assume that's not an engineering unit of measure, so what -- How far out from the wellbore do you calculate that this damage exists?

A. I don't know, I didn't calculate that.

Q. Well, in the industry, isn't damage usually referred to as the phenomenon that occurs because of --

well, commonly because of the drilling activity itself, often the mud that is used for drilling a hole, or sometimes a later mechanical problem because of scaling up on the perfs and on the formation? Are those the kind of phenomena that are typically referred to as damage?

A. Well, those are two phenomena that can be referred to as damage. There are many others as well.

Q. Okay. Now, that occurs -- Those are things that have occurred at or very near the wellbore, not out into the formation?

A. Sometimes they extend distances out into the formation as well.

Q. All right. But I don't think that's what -- I'm trying to understand your testimony. I don't think that's the kind of damage that you're referring to, right?

A. Well, I'm not speaking specifically of mud damage, no, but scale formation may be one of the factors that is affecting or causing the damage.

Q. All right. Because you disagree with the proposition that the Pictured Cliffs reservoir, or what's known in this area as the WAW-Fruitland-Pictured Cliffs, was a completed reservoir?

A. Yes, I do disagree with that.

Q. As I understand your testimony, you're saying when we look at these decline curves on the Pictured Cliff wells, many, many of them, the WAW-Fruitland-Pictured Cliff wells, where they come down essentially to shut-in or noneconomical production, that's not truly reflective of the quantity of recoverable gas remaining in the reservoir?

A. Well, it's reflective of the quantity recoverable in the reservoir with the well under those conditions. But if the well conditions change, if the well is made to where it is more effectively communicating with the reservoir, the recoverable amount of gas will increase.

Q. Okay. And you say at page 34 of your testimony:

> The wells initially produced at good rates, but were progressively damaged more and more over time. The most likely cause of the damage is water.

And then you go on to hypothesize that this -- that there has been what you call a water block which is formed. Are we at the crux of your testimony, as far as your theory that the Pictured Cliffs reservoir was damaged?

A. No. Now what you're talking about is the origin of that damage. And in my written testimony I did play out one possible explanation for the origin of that damage.

But the damage exists and it's there, whether or not it is caused by water blockage or fines migration or scale precipitation or any other thing. The damage, and the determination of the damage is there, is irrespective of the source of that damage.

Q. But Dave Cox in his testimony says the damage is the result of a water block, right?

A. No, what I say is, the most likely cause of the damage is a water block. But there are other potential explanations.

Q. Well, let's deal with your explanation, because that's the one you selected, isn't it?

A. It's the one that I think is most likely.

Q. All right. Now -- And what you're saying is that the lower benches of the Pictured Cliffs are highly water-saturated, correct?

A. No, that's not what I -- That's not the reason for my statement.

Q. What's the source of the water? I thought I understood your testimony as that being the source.

A. Well, whether it's the lower bench or whether it's the main unit of the Pictured Cliffs, there is water in the Pictured Cliffs, and some of the intervals are wetter than other parts of the interval.

And so my point there is, whatever intervals or whatever portion of the Pictured Cliffs that has more water in it, when you're producing the well you'll bring in some of that water. And some of that water is going to then come into the well or come closer to the well and be plugging off part of the more permeable intervals of the Pictured Cliffs, or the higher-gas-saturation intervals.

Q. Well, we've already had testimony from Mr. McCartney for Pendragon, Mr. Nicol for Pendragon, that the upper bench -- and I'm talking about the Pictured Cliff that occurs below the coal there -- that the upper bench is not highly water-saturated -- that's where the perforations have been -- but as you go into the lower benches, that you encounter higher water-saturation quantities. Do you disagree with that testimony?

A. Well, I was not here to hear that testimony. I do agree that as you go into the lower part of the Pictured Cliffs, that that definitely has a higher water saturation than the main part of the Pictured Cliffs or the upper part of the Pictured Cliffs.

But there are parts of the Pictured Cliffs that -- even in the main part of the Pictured Cliffs -- that do contain more water than other parts of that main part of the Pictured Cliffs.

Q. Well, but these other areas where these wells were perforated, they originally -- including what I call the upper bench of the massive sandstone there -- they originally were completed, perforated and showed economic production and then declined. So the water saturation in the upper part of the Pictured Cliffs did not cause a problem initially. Do you agree with that?

A. On day one, perhaps no. But as drawdown continued and as production came into the well, there's also water moving towards the well, as well as gas.

Q. And that's what I'm trying to understand. Where's the water coming from, in your view?

A. It's coming from the Pictured Cliffs, in my view.

Q. From the lower benches of the Pictured Cliffs, which have a much higher water saturation?

A. No, not necessarily. Even the main part of the Pictured Cliffs has some water that can move in some of -- You're talking an interval here that, you know, is in some cases 20 feet thick. That 20 feet is not absolutely identical rock from top to bottom. There are variations in the rock quality, the gas saturation, permeability and so on.

If you look at, for example, the core analysis from that Lansdale Federal, there's a considerable variability of permeability, porosity, water saturation and so on. Even within the main part of the Pictured Cliffs.

Q. Well, you stated that the most probable, likely cause of this supposed damage to the Pictured Cliffs is water. Did you look at logs of these wells to see what you saw in terms of water saturation, the occurrence of water?

A. No.

Q. So this is just a theory? You're saying there's a lot of ways it could be, and I just decided it must be water?

A. No, that's not what I'm saying. I decided that I felt the most likely cause was water. There are other potential causes.

Q. What evidence do you have to support your saying the most likely cause is water?

A. That's based on my assessment of other possible causes.

Q. Well, but doesn't the scientific method call for you to make some kind of study or examination?

A. No --

Q. That's what I'm trying to get at, if you looked at logs, if you said the water saturation is coming from the lower bench or some explanation. There is none, correct?

A. No, there is an explanation. The explanation is, these gas wells produced small amounts of water, even early on. And it doesn't take much water to form a block in a relatively low-pressure reservoir, because it's hard for the well to recover once it's picked up some water.

And in addition, the exact cause of that damage, frankly, doesn't matter much to me. The fact that I observe that the damage exists and that the Pendragon frac jobs got beyond that damage, to me that's as much as I need to know.

But I point out that I believe, based on my analysis, that water is the most likely cause of the damage. That does not mean it's the only cause, that does not mean I could prove beyond the shadow of a doubt today that it's the cause. But it's my feeling, based on my experience and analysis of this reservoir and these wells, that water is the most likely cause.

Q. Let's try and use our terms a little more exact. You said you observed that damage exists. What you observed, Mr. Cox, was that these wells, most of them, ere completed in the late 1970s or early 1980s, they produced at certain levels of 100 or 50 or 150 MCF a day, they then reflected a normal decline curve for a conventional gas reservoir of this kind and went down to basically abandonment levels of production. That's what you observed, isn't that true?

A. That was observed. And from analyzing that and other information, I have concluded that damage exists there, and that substantial damage exists.

Q. And you can just as easily -- Instead of saying that's damage, one could just as easily say, that's a depleted reservoir, and those wells quit producing because of that?

A. No, you cannot.

MR. GALLEGOS: All right. I don't have any further questions.

CHAIRMAN WROTENBERY: Commissioner Lee?

EXAMINATION

BY COMMISSIONER LEE:

Q. Can you explain where your superposition principle applies, at what point?

CHAIRMAN WROTENBERY: Could you speak up a little?

THE WITNESS: I'm sorry?

Q. (By Commissioner Lee) Okay. Can you explain to me where your superposition principle applies?

A. Where I'm applying the superposition? Yes, what I'm doing there is I'm saying, first, that the Pictured Cliff wells were shut in at the time -- They were shut in at the end of June, so when I'm examining these transients I start with the Fruitland Coal well producing and the Pictured Cliffs well shut in.

And then what I'm saying is, what is my incremental pressure change if the Fruitland Coal well is then also shut in? And so I'm taking superposition in time to account for that shut-in.

Q. If the coal uses superposition principle, what's your result barometer? Is that pressure? You superposition the pressure or you superposition the --

A. I --

Q. -- flow rate?

A. That would be superposition of rate.

Q. Of the rate?

A. Right.

Q. Okay. Can you briefly tell me what is your scheme to try to check the -- You know, suppose you are shutting in the Fruitland. Assuming it's connected to the Pictured Cliffs, where are the data you want to see? At the Fruitland, right? At that particular well?

A. Yeah, at the Pictured Cliffs well.

Q. So any rate, specific rate, you give to this approach?

A. Oh, the *q* -- Yeah, the *q* that I used was based on the producing rates for the Fruitland wells, saying when they're shut in, then that rate is dropped off to zero. So I have a change in rate equal to the rate of the Fruitland Coal well prior to shut-in.

Q. So it's a negative *q*?

A. It's a negative *q*. And that's why the production response is an increase in pressure.

Q. So you didn't use the superposition, you didn't intend to have a superposition along the formation?

A. You mean like a superposition in space?

Q. Yes.

A. Yes, I did. I did include that as well.

Q. The superposition principle -- You have a crossflow?

A. Right.

Q. The superposition principle is only valid for the independent cases, right?

A. No.

Q. No?

A. Superposition requires that the system be linear, but --

Q. Independently linear?

A. Right, but as long as we're assuming that the rocks have constant properties --

Q. Right.

A. -- during the time of the shut-in, then we can still apply superposition.

And what happens is -- Look at it this way, that the crossflow rate is directly proportional to the -- on the -- say if the Pictured Cliffs were -- the frac job had gone into the Fruitland, then your crossflow rate in the Pictured Cliffs is exactly proportional to what the producing rate from the Fruitland would have been.

Q. You talk about Langmuir pressure. In your

equation do you use Langmuir pressure?
A. Yes.
Q. Where? In what equation?
A. In the equation for calculating the effective compressibility of the coalbed methane reservoir.
Q. Okay. So it's not directly into the -- You are using the Langmuir to calculate the compressibility, then that's your input?
A. That's correct, yes.
Q. And so it's not directly, you know, when your pressure is going down or something and more gas is coming out, it is not?
A. No, what I'm -- I'm just using it to calculate compressibility, even its constant compressibility for those calculations.
Q. Okay. Another one is, all your equations are valid for single-phase, right?
A. That's correct.
Q. So you're assuming there's no water production?
A. No. As far as the calculations of the equations, that's correct, I have to set it up that way.
But by the time these wells reach the point that we're talking about, in the reservoir, gas is the dominant flow phase, now, in the reservoir and has been, you know, in the Fruitland even, for more than the last year.

The reservoir barrels per day of gas production far, far exceeds reservoir barrels per day of water production.

Q. Oh, I'm glad you talk about how gas is the dominant factor there. From your exhibit, the parameter you input into your scheme, you say, is porosity-compressibility product. One is .0025 and one is .0013?

A. That's correct.

Q. Is this the rock compressibility, overall compressibility, or is it gas?

A. No, it's ϕc_t. And what I've done there is, I've said for the coal the desorption compressibility is so much greater than the rock compressibility or the water compressibility or the free-gas compressibility that all I need to consider is desorption compressibility for the coal. So that's what I did there.

And for the gas, for the Pictured Cliffs, I just used the gas compressibility, because we are at low pressure, and it's far higher than the compressibility of the rock or the water.

Q. Suppose the Pictured Cliff, you use the gas compressibility, is supposed to be .01.

A. Right, approximately 1 over 100. But then you need to multiply by the porosity and the gas saturation there, which is another .18 or so.

Q. Well, I think -- Maybe I'm wrong, but I think that gas, as long as you are assuming this is gas in that formation, that gas compressibility is dominating the whole thing; is that true?

A. For the Pictured Cliffs, yes, but not for the coal. The desorption compressibility is orders of magnitude higher than the gas compressibility.

Q. So you realize that the -- your skin factor of negative 5 is only the conceptual -- concept, right?

A. That is correct, yes.

Q. So at no time gas is moving to another level. Your drainage radius has to use skin in no time?

A. That is correct, yes, thin skin.

Q. Okay. Another thing I would like to ask you is, what is the formula for the drainage of investigation, the formula for the propagating speed of the drainage investigation? Is that the square root of k?

A. Well, it's the square root of eta t, and so it's k over $\phi\mu c$, times t.

Q. No *h*?

A. No, there's no *h* in the --

Q. So -- Okay.

A. -- in that term.

COMMISSIONER LEE: All right, no further questions.

CHAIRMAN WROTENBERY: Commissioner Bailey?

EXAMINATION

BY COMMISSIONER BAILEY:

Q. I'd like to explore the problem of the formation damage.

A. All right.

Q. We've had testimony that the water -- that the PC wells have always made some water, 12 to 20 barrels of water per day. The testimony was that the formation was not watering out but losing pressure. You made the comment that the Pendragon frac jobs got beyond the formation damage.

But if the water production continues at the same rate, which is what we have testified here, wouldn't you expect that formation damage to return or continue?

A. To some degree, yes. But the mitigating thing is that instead of having a wellbore, which in this case is a small well, you know, with 2-7/8 tubing acting as casing, what you have is a larger frac job that extends some distance from the well. And so you're looking at a larger area, if you will, open to flow of the gas and the water to come in.

But indeed, yes, you're right, there would still -- if it's caused by water, there would still be some degree of damage that would be occurring.

Q. And if so, would we see a decrease in the water production?

A. No, not necessarily, because -- The problem here is, how much water comes up depends also on the well. You know, the well is acting like lift equipment, you know, and so the size of the tubing and the compressor size, the compressor section pressure and things like that are also entering in. The efficiency of the well to lift water is entering in, and as the reservoir pressure drops, it gets harder and harder for it to lift water.

So you may actually see the water rate decline some, even though you may have the same amount of water trying to come in towards the well.

Q. Are there particular production techniques that may aggravate this type of damage?

A. I'm not sure. I don't know. I'd have to look into that. I don't know.

Q. You also mentioned scale as a potential reason for plugging of the formation. Is scale normally a result of mixing the waters?

A. It can be, but you can also get some scale dropping out from reduced pressure and so on, and a little bit of cooling that can occur, especially close to the well.

Q. What type of scale would be dropping out because of pressure reduction?

A. I don't know, I'm not a scale expert. But I know some of the Pictured Cliffs wells, you do get a little bit of scale.

Q. And you believe that this is the case for every Chaco well, is due to formation damage?

A. For all six of the Chaco wells that are in this Application, yes. There are some other wells outside of here that apparently have much less formation damage and have continued to produce at higher rates.

COMMISSIONER BAILEY: That's all I have.

CHAIRMAN WROTENBERY: Oh, I'm sorry, Commissioner Lee?

FURTHER EXAMINATION

BY COMMISSIONER LEE:

Q. In the coal, when a gas is going through the coal, you numbered this the one compressibility?

A. Yes.

Q. I thought this is supposed to be a fractured reservoir?

A. It is, but the cleats -- Typically the cleats in the San Juan Basin would be 1/4-inch to 1/10-inch spacing, and so as far as how it acts it can be analyzed as if it's an equivalent single phase or an equivalent continuum model.

Q. So the porosity you're talking about is what porosity?

A. Well, and that's exactly the reason why I put porosity-compressibility product here. For the coal, as it turns out, the desorption term dominates. And so the desorption term doesn't care what the actual porosity is. It's totally immaterial to desorption, because you're looking at -- The matrix is where the gas is being stored, so that's where your effective compressibility comes in. But in the Pictured Cliffs that number is typically about 25-percent porosity, in the Pictured Cliffs.

COMMISSIONER LEE: Thank you.

CHAIRMAN WROTENBERY: Mr. Hall, redirect?

MR. HALL: Yes, thank you.

REDIRECT EXAMINATION

BY MR. HALL:

Q. Mr. Cox, earlier in the day Mr. Gallegos had asked you to compare some of the pressures. He referred you to your Exhibits 10 and 11, comparing pressures in the Chaco 4 and 5 to some of the Gallegos Federal wells.

And what I'd like you to do is to compare the pressures for the Chaco 2-R, for instance, with the Gallegos 12-7 Number 1, which is shown on Exhibit 17-B. How do those pressures compare?

A. Well, these orange diamonds with X's on them are the pressures of the Chaco 2-R. And as you can see, it started out -- And these, by the way, are the corrected pressures, corrected back for the deadweight test. These started out at about 56 pounds, 56 p.s.i. -- and this is p.s.i.g., gauge pressure -- and rose over a period of about ten months to reach a level of 77 p.s.i.

Now, by comparison, the 7-1 during its periodic intermittent shut-ins reached pressures of, in some cases here, 96 p.s.i., but on numerous occasions up to almost 90 p.s.i. But even after just a few days of shut-in, the pressure in the 7-1 was higher than the pressure in the 2-R, until we get out late in time here, and then it becomes questionable as to whether those shut-ins are long enough to be able to tell what the 7-1 pressure would be.

Q. Now, same question. Let me ask you to compare the shut-in pressures for the Chaco 1 and the 12-7 Number 1 wells. This is Exhibit 17, N-17-C.

A. Well, once again, the Chaco 1 here -- and these are the corrected pressures again -- started out about 85 or 86 p.s.i., climbed up, reached a level of about 93 p.s.i., and since then has been dropping and reaching levels, at its maximum, as late as April of 1999, we're still about 74 p.s.i.

But you can see that the pressure in the 7-1, even after a few days of shut-in here in August of 1998, was already higher than the Chaco Number 1 pressure. And that is saying that -- The implication of that is that the Chaco 1 and the 7-1 are looking -- or seeing two different reservoirs. They're not seeing the same reservoir or the same source of supply.

Q. Does this give you confidence that the Pictured Cliffs reservoir pressures you used in your analyses are valid Pictured Cliffs reservoir pressures?

A. Yes.

Q. You were asked to -- Let me get this out of the way.

You were asked about Mr. Nicol's Exhibit N-8 of the pressure plot for the Chaco 4, and we had a lot of discussion about the 119-pound pressure measured in January of 1995. Do you know when that pressure was -- pressure measurement was taken, whether there was any water in the wellbore?

A. No, I don't. There may have been, and if there were then the bottomhole pressure would have been much higher.

Q. Let's refer back to your table on page 16 of your testimony, which reflects your input data for your interference analysis. You were asked to discuss the input data you used and compare it to what Mr. McCartney used on his Exhibit M-25. Do you recall that? Do you have this exhibit in front of you?

A. Yes.

Q. This would be Exhibit Cox-60-B. Let's discuss that briefly.

Now, with respect to the assumptions you made for permeability, you weren't using the average permeability, were you?

A. No, I was using the permeability where the pressure transient would move through, so it would have been like the highest permeability zone that the transient could move through.

Q. So the transient doesn't move through the average, it moves where it's most readily movable, correct?

A. Well, it will also move through the average, but it moves fastest through the highest perm piece.

Q. Look at the columns in yellow there. The third one from the left, it shows the highest perm per McCartney Exhibit M-25. It's mislabeled as M-28, it's his M-25 exhibit. And I think they were derived from this. Do you have this in front of you?

A. Yes, I do.

Q. That's Mr. McCartney's M-25.

Do those representations for permeability, in fact, represent the highest permeability?

A. No, Mr. McCartney's calculations there are reflective of the average permeability in the well at that time, and being as he did not include in his equation there a correction for skin factor, what those are showing are basically a permeability if the well had zero skin. And so it's an average for the entire interval, not necessarily the conduit or highest piece of permeability that the transients are moving through.

Q. Again, referring to -- Let's refer to your Table C-3 on page 36. Then compare it back to your Table C-1, the side-by-side comparison shown on Cox Exhibit 60-B. Why did you use 20-millidarcy permeability there for the coal?

A. Well, that was the initial estimate I had, just based on the comparison I discussed about two other coal wells in the Basin, and so that was my reason for using that. In the -- All except the first couple of analyses there, I upped that number to be 50 millidarcies, to be more consistent with the permeabilities of the coal wells, as calculated.

Q. Okay. And you went through your seven analyses, did you not?

A. Yes, I went through seven analyses. The first one I included just because I had that as a basis of my affidavit, so I wanted to document that information. Then the second one was to correct the Langmuir pressure to 332 pounds from the original incorrect number. But all the other ones from there, I used the 50 millidarcies, not the 20.

Q. Early on, you were also asked to compare the fracture-stimulation treatments utilized by Whiting and Pendragon in their respective wells. Did you prepare an exhibit that compares that information?

A. Yes, I did.

Q. I give you what's been marked as Exhibit Cox-61. Would you identify that, please, sir?

A. This is a summary of the completion information for the various wells. I prepared this to show how big the frac jobs were on the different wells and to show the timing of the various activities, to summarize that, frankly, because there's enough different things being done here, I didn't want to be confused myself.

Q. All right. Now, you stated that the two primary factors that were the basis of your analysis for the conclusion that the Fruitland Coal wells communicated with the Pictured Cliff wells were, one, the pressure transient, and then the level of pressures; is that correct?

A. Yes, those were the two main factors.

Q. Now, did you observe any change in the production in the coal wells? This is from the point in time when the Chaco wells were shut in.

A. Oh, yes, the production from the coal wells jumped up by about 200 to 250 MCF a day when the Chaco wells were shut in. So once again, that clearly demonstrates that there's communication between the wells there, or between the Whiting Fruitland Coal wells and the Chaco Pictured Cliffs wells.

Q. And earlier you said you didn't see much of a response to anything in the period from August, 1993, when the Gallegos Federal wells were frac'd, up until January of 1995, when the Pendragon wells were frac'd. Would you have expected to see any response during that period of time?

A. No, those Pendragon wells were severely damaged. They were virtually incapable of production. They had been making only a few MCF per day. So there's no way in a case like that that you can see beyond the damage. That damage dominates the production and the pressure behavior on those wells in a case like that.

Q. In your calculation for permeabilities, you took into account the various pressure factors. Mr. Gallegos asked you to make various assumptions, and I think at one point he asked you to assume 102 p.s.i. in connection with that. Is there any validity to using that particular pressure

A. That was on the 6 Number 2 well, the upper limit of the shut-in pressure in August of 1998. And that well had not built up fully, so it was not at average reservoir pressure.

But in addition, the well was also making water. So there would have been some water in the bottom of the well at that time. And so just using 102 p.s.i. as an average reservoir pressure, 102 was very definitely too low. The average reservoir pressure at that time was certainly more than 102 p.s.i. because of the head of water and the fact that the well was still building.

Q. Now, did you prepare additional exhibits which help explain the pressure communication analysis that you performed?

A. Yes, I did.

Q. I hand you what's identified as Exhibits Cox-62 through -65. If you would identify those for the record, please.

MR. CONDON: Scott, excuse me, this results of pressure communication that we've got says Cox-62 also. Are there two 62's? Was this supposed to be Cox-61?

MR. HALL: That's 61. I'm sorry, did I --

MR. CONDON: It's marked -- Well, no, it's marked on ours -- no, this is Results of Pressure Communication -- I've got you, so it's one and -- There's two pages to that?

MR. GALLEGOS: No.

MR. HALL: No, no, no, 61 was here.

MR. CONDON: Could we get a copy of that? Could we get a copy? I don't think we've got one here.

Thank you.

THE WITNESS: Okay, the Cox-62 is the exhibit that says "Results of Pressure Communication Analysis".

Cox Number 63 is an exhibit that shows the "Pseudo-Steady State Radial Flow Equation" that I used in calculating the permeabilities.

Cox-64 shows the "Equation for the Desorption Compressibility for Gas Desorbing..." or adsorbing to "...Coal".

And finally, Cox-65 is a "Summary of..." the "Computed Interwell Interference Cases", those seven different analyses that we've been talking about earlier.

Q. (By Mr. Hall) Let's talk about that one in particular, referring to Cox-65. Why don't you briefly explain --

MR. GALLEGOS: Could we have those exhibits? I don't -- We don't have --

MR. HALL: I thought I gave you -- I'm sorry.

MR. GALLEGOS: All I have is 62.

MR. CONDON: Well, we've got 61 now too.

Q. (By Mr. Hall) Why don't you explain again, in summary fashion, your assumptions for the permeabilities and compressibilities you used in each of your seven analyses?

MR. GALLEGOS: Well, I object to this as improper redirect. We went through this. They had their opportunity on direct. He was cross-examined. Why are we -- Why do we have this for a third time?

MR. HALL: Well, it's entirely proper since it was brought up again on cross, he's entitled to discuss.

MR. GALLEGOS: But redirect doesn't mean you start your direct all over again, same subject. I object. We've used enough time. We've now gone almost three-fourths of the time for this hearing on the Pendragon case, and now we're repeating something that was in the direct testimony, and this is not proper redirect.

MR. HALL: Mr. Gallegos, he responded to questions from you when cross-examined -- examination about his assumptions for compressibility and permeabilities, and he's entitled to explain that in redirect.

CHAIRMAN WROTENBERY: We have spent considerable time in cross on this particular issue, so I think we can go ahead and follow up on redirect. But if you could make it as brief as possible we'd appreciate it.

THE WITNESS: All right, this table, Cox-65, I just prepared this to make it clear that only one variable is changing at a time in each of the runs and to summarize for you what things were held constant between runs or what things, what variables, were changing.

So the numbers that are bold there, the 332 in analysis 2 and so on, that's to show what was changed in that particular analysis.

Q. (By Mr. Hall) Mr. Cox, if I could have you refer back to your Exhibits 25, 26, 27, 28, 29, Mr. Gallegos discussed most of these cases with you. In conducting these analyses, were you able to match the actual pressure data to your curves at all?

A. Well, this particular case analysis, case 7, turned out to be very similar to the observed response on the different buildups.

Q. And that's Exhibit Cox-25; is that correct?

A. That's Cox-25, -26, -27, -28 and -29.

Q. Is that important for you to be able to do that, show a match like that?

A. Well, it's important from the standpoint that it helps to confirm that I'm approaching a better understanding of the pressure buildup and the flow mechanics in the reservoir.

Q. I believe you testified in response to a question from Mr. Gallegos that it is certain that damage exists in the formation; is that accurate?

A. I think so, yes.

Q. And you opine that there may be at least one cause, water. Is it possible that there are more than one cause to explain the damage?

A. Yes.

Q. And what might some of those other causes be?

A. Possibly scale precipitation or fines migration. Those would be the next two things that come to my mind.

MR. HALL: That concludes my redirect.

CHAIRMAN WROTENBERY: Mr. Gallegos? Oh, first, let me clean a couple of things up.

Do you intend to introduce Cox Exhibits 61 through --

MR. HALL: Yes, let me do that, thank you.

CHAIRMAN WROTENBERY: -- 65?

MR. HALL: Let me do that through examination. We'd like to do that.

Q. (By Mr. Hall) Mr. Cox, were Exhibits 61 through 65 prepared by you or at your direction?

A. Yes, I prepared them.

Q. And we move the admission of Exhibits Cox 61 through 65?

CHAIRMAN WROTENBERY: Objection?

MR. GALLEGOS: Yes, I object to 63, 64 and 65 as improper redirect in that area that's already more than abundantly covered in the direct prefiled testimony and exhibits.

MR. HALL: Well, it doesn't sound like an objection to admissibility.

CHAIRMAN WROTENBERY: To me they just appear to be summaries, to help the Commission, of some of the information that had been previously discussed. So I'll go ahead and admit Cox-61 through -65 into the record.

And I also wanted to ask, Cox-60-A and -60-B --

MR. GALLEGOS: Yes.

CHAIRMAN WROTENBERY: -- did you intend to introduce that?

MR. GALLEGOS: Yes, ma'am, I intend to offer those, Madame Chair. I offer 60-A and 60-B.

CHAIRMAN WROTENBERY: Any objection?

MR. HALL: No objection.

CHAIRMAN WROTENBERY: Okay, Cox-60-A and -60-B are also admitted into the record.

Mr. Gallegos?

MR. GALLEGOS: I have no further questions.

CHAIRMAN WROTENBERY: Commissioner Bailey?

COMMISSIONER BAILEY: (Shakes head)

CHAIRMAN WROTENBERY: Commissioner Lee?

COMMISSIONER LEE: (Shakes head)

CHAIRMAN WROTENBERY: Thank you very much for your testimony, Mr. Cox.

We'll take a ten-minute break at this point, after which we'll call Mr. Conway back up.

MR. HALL: All right.

CHAIRMAN WROTENBERY: Commissioner Lee has just a few questions.

MR. HALL: Right.

(Thereupon, a recess was taken at 3:38 p.m.)

(The following proceedings had at 3:50 p.m.)

CHAIRMAN WROTENBERY: Okay, we'll go back on the record.

Mr. Conway, I'll remind you you're still under oath.

MR. CONWAY: Yes, ma'am.

<u>MICHAEL W. CONWAY</u> (Recalled),

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

DIRECT EXAMINATION

BY MR. HALL:

Q. Mr. Conway, last week you were asked by Dr. Lee to provide certain materials explaining some of the software for the GOHFER simulator program. Did you provide those to Dr. Lee?

A. Yes, I did.

Q. And do those materials consist of exhibits marked Cox -- C-19 through C-25? I'm sorry, Conway.

A. Yes, sir.

Q. Would you briefly explain to the Commission what each of those materials is?

A. In an attempt to try to provide Dr. Lee the information that he requested, the first part of the submittal was an attempt to go back through the literature that I had available to me and to pull out the governing equations that are used in GOHFER for fracture-simulation work.

The original work was basically an SPE publication of Dr. Barree's PhD dissertation at the School of Mines.

We also included a section on interfacial slippage and fracture growth. In the original model, interfacial effects were not handled. In the current version that I used for these simulations they are approximately handled, based on modulus contrast, and we tried to describe the major component that's involved in the modular contrast.

The fluid formulation in GOHFER was completely redone, and from the appendix in that SPE paper we pulled out the governing equations for fluid flow and proppant transport.

The last part is the special -- we titled "Special Features Which May Be Considered 'KNOBS'", and it enumerates seven typical variables that are used to history-match, post-match fracture treatment.

Then I included the three primary SPE paper.

That gets us to Exhibit C-20. Mr. Gallegos had spent a considerable amount of time and asked that a simulation be conducted where the Poisson's ratio in the coal was .4 and in the shale was .5. The results of that simulation are shown in Exhibits C-20, -21, and -22.

The first is the predicted geometry at the end of pumping.

The second is the simulated pressures.

And the third is that detailed listing of the fractured parameters.

Exhibit C-23 was again a request that the simulation be conducted with a Poisson's ratio in the coal of .4 rather than the .5, which I used. The shale and the sandstone parameters remained the same. And that -- the geometry at the end of pumping, C-23.

The predicted pressures compared to surface pressures, C-24.

And again the input array is C-25.

Q. Were Exhibits C-19 through C-25 prepared by you or at your direction?

A. Yes, sir.

MR. HALL: We'd move the admission of Exhibits C-19 through C-25 of Mr. Cox [*sic*].

MR. GALLEGOS: No objection.

MR. HALL: Mr. Conway.

CHAIRMAN WROTENBERY: Exhibits C-19 through C-25 are admitted into the record.

MR. HALL: I turn Dr. Conway over for questioning.

CHAIRMAN WROTENBERY: Mr. Gallegos, do you have any questions?

MR. GALLEGOS: Could we --

CHAIRMAN WROTENBERY: Would you like to go first, or would you like Commissioner Lee to go first? Go ahead, if you'd like to.

MR. GALLEGOS: All right, thank you. Just a few questions.

CROSS-EXAMINATION

BY MR. GALLEGOS:

Q. Did I ask you to change the shale? I didn't --

A. The discussion was that the 1 p.s.i. per foot was the shale stress, not the value that I used.

Q. Yeah, I remember that discussion --

A. And I --

Q. -- but I didn't remember asking you to do a simulation with changing that. But that's all right, it doesn't hurt.

A. I understood that I was asked that. I may have misunderstood.

Q. As long as you're --

A. If I did, I'm --

Q. -- charged Pendragon for it, that's --

(Laughter)

Q. (By Mr. Gallegos) Let's take a look at your Exhibit C-23 with a Poisson's ratio of 0.4 for the coal. It looks like the fracture goes up into the coal, but I'm sure that's just the way that your intervals lined up on the left, and it just goes up to it, is what --

A. Up to the --

Q. -- right?

A. Yes, sir.

Q. All right. With a Poisson's ratio of 0.4, what's the effective stress in the coal?

A. I don't have that number in front of me.

Q. Could you --

A. It will be about .9 p.s.i. per foot, but -- It's approximately that.

Q. Okay. If that's incorrect, if you could check something --

A. I'll check and I'll report if that's wrong.

Q. Now -- And I'm going from memory because I haven't taken the time to pull this out, but it looks like your fracture width is a bit wider than it was before, from the color; is that correct? It's about .65 to maybe .7

inches? The width of the fracture at the base of the coal?

A. It appears to be slightly wider. I didn't -- I neither checked it on a point-by-point basis.

Q. What would you tell us that the fracture width is that runs along the base of the coal?

A. Well, according to this color, it's in the -- it's at -- in the near wellbore area, it looks like about .65 inches.

Q. Okay. Does your model calculate the amount of proppant in the fracture at the top?

A. Yes, it does.

Q. Okay, can you give us that value?

A. I'll have to get my computer and bring up that screen. I --

Q. Okay, well, I have a few more questions like this, so maybe it would be worthwhile to do that, please.

A. It's coming up, it will be up in just a second.

Q. Let's do this while it comes up: Let's turn to C-25, and I think I can ask you a couple questions and speed this up so that you won't need the computer, I hope.

On C-25 there's a column about in the middle that reads, "Process Zone Stress".

A. Yes, sir.

Q. What is that? What is process zone stress?

A. At the growing tip of the fracture -- That's one of the issues described in the "KNOBS". In the growing tip of the fracture there's a combination of fluid-lag zone and tensile strength of the rock that causes the pressure to go from the fracturing fluid pressure in the open, growing fracture, to the pore pressure at some point where the fracture is not yet initiated. So it represents the amount of pressure drop that occurs at the tip of the fracture.

Q. Now that you mention tensile strength -- and I think it was -- Was it your Exhibit C-13 where the fracture goes out and then it goes south at about 750 feet?

A. Yes, sir.

Q. And wasn't that because you changed the tensile strength?

A. That was -- The more important change was the change in the modulus, so the contrast, the moduli contrast, was much less. I did everything I could to make sure it dropped out there. I didn't spend a lot of time.

So yes, I did reduce tensile strength also.

Q. Okay, so could you give us the tensile strength that you used for each of these intervals?

A. It's given there. I use a constant of 800 p.s.i., except for the bottom-most node, and we put a large value in there so if it tried to grow out of that the simulator would continue to run instead of just getting to the end of the grid and stopping.

Q. You're saying that the process zone stress is the tensile strength?

A. It is a combination of two important factors. We've written a very long document describing those two factors, but in the short version, if I might just come to the board --

Q. Just in the interests of time -- and I don't mean to cut you off, but is there a short answer as to just giving us the tensile strength --

A. It is not only tensile strength, there's two major components.

Q. Okay.

A. So no, it can't be that short.

Q. Okay.

A. There is an area in the fracture that is not fluid-filled at the tip of the fracture. This is called the damage region, which is primarily the tensile strength of the rock.

This is a major pressure drop associated with this non-fluid-filled area, and it's called the dry zone. Gulf of Mexico, unconsolidated rocks have an effective tensile strength almost as large as the sandstone in the Rocky Mountains, because this is -- When the modulus is low, when it's weak rock, this is a very large value. In hard rock, this is the largest value.

The net effect is, there's not that much difference between soft rock and hard rock in terms of the pressure drop at the tip of the fracture.

Q. So --

A. The tensile strength, *per se* -- The tensile strength in the sandstone could be somewhere between 800 and 1200 p.s.i. The tensile strength in coal is probably less than 50 p.s.i. But that's not the only thing. That's why it's called process zones stress, not tensile strength.

Q. Can you tell me what the change in the tensile strength was at that point where your fracture left the coal?

A. In that simulation I had 800 p.s.i. everywhere except those few nodes where we were trying to make it break out.

Q. And you changed it to what?

A. Fifty, just to encourage it breaking out.

Q. Okay, from 800 to 50?

A. Yes, sir.

Q. Okay. Is the computer up so we can get a little bit of information back on C-23?

A. Yes, sir.

Q. Okay, the amount of proppant in the fracture at the top?

A. Okay, just -- All right, I'm going to give proppant concentration in pounds per square foot, because there were different proppants, and we tracked each one individually, but in pounds per square foot I have the sum at -- At the end of the simulation, which in this case was not particularly complete closure, but at the end of the simulation the proppant concentration in that uppermost node in the shale is .065 pounds per square foot.

Q. And would that be all along that node from the wellbore --

A. It decreases.

Q. -- on out?

A. It decreases. That's the highest value, and it decreases, .032, .03 -- It decreases as you go out.

Q. Okay, so the highest value would be back, looking at this exhibit, back at the left-hand or by the wellbore?

A. Yes, sir.

Q. And could you give us the lowest value out at the end of the fracture?

A. .024 pounds per square foot.

Q. Could you also give us those same values -- highest, lowest -- for the next node, the red --

A. .103 at the wellbore, .027 at the end of the fracture.

Q. Thank you. Does your computer there give us the information on the fracture conductivity?

A. No, sir.

Q. Okay. And the propped -- in the propped width then -- in other words, we've got your -- as I understand, we've got your fracture width as it's made, but can you give us the propped width?

A. Let me check and see how closed it is, and then we can calculate. A pound per square foot. One pound per square foot is .11 inches wide. And it's directly proportional, so a tenth of that would be .01 inches wide.

Q. A pound per square foot is how many inches again?

A. .11 inches.

Q. Okay.

A. And it's proportional.

MR. GALLEGOS: Okay, directly proportional, so we can calculate it. Okay.

Thank you, Dr. Conway, that's my questions.

CHAIRMAN WROTENBERY: Commissioner Lee?

EXAMINATION

BY COMMISSIONER LEE:

Q. Did you write a simulator yourself?

A. No, sir.

Q. Do you, by any chance, know Dr. Warpinski?

A. Yes, I do.

Q. Is he an expert in this field?

A. I consider him to be such.

Q. Let me read something --

A. Yes, sir.

Q. -- to you:

Contrary to expectation based on simple models, hydraulic fracturing...

This is for both sides.

...is proving to be a complex process that is still not adequately represented by theory. The reason for this is clear. As models assume the earth is homogeneous in every layer, isotropic in every layer, as a continuum, when in fact the reservoir fractures are highly discontinuous and very anisotropic and heterogeneous. Since the current model is incapable of dealing with this complexity in anything but an *ad hoc* manner, further understanding of hydraulic fracture is not likely to progress very rapidly without an ability to measure, to image or observe fracture process under *in situ* reservoir conditions.

So what's your opinion on this?

A. My opinion is that it's absolutely imperative that we make more measurements underground. In California, in shallow rock, there are many, many fractures that are modeled with downhole tiltmeters. Unfortunately, they will not work in the Rocky Mountains; it's too deep in most cases, and the wells are too far apart.

I've been on Norm for a long time, how come his tool isn't out there commercially available to make those measurements on a routine basis?

But to address his problem, that last paper that is referenced here of trying to address the inhomogeneity and getting -- using nonlinear elastic equations, is the whole reason, and that M-site work that Norm dealt with is one of the real reasons that that whole new formulation is being proposed for GOHFER, is to handle the nonhomogeneity.

CHAIRMAN WROTENBERY: Should we just identify the --

COMMISSIONER LEE: Yes --

CHAIRMAN WROTENBERY: -- paper for the record?

COMMISSIONER LEE: -- the paper is SPE 38573.

THE WITNESS: Yes, sir. No, no, no, it's -- Excuse me, it's 48926.

COMMISSIONER LEE: 38573.

THE WITNESS: Oh, you're --

CHAIRMAN WROTENBERY: I was referring to the one --

THE WITNESS: Excuse me.

CHAIRMAN WROTENBERY: -- Commissioner Lee was reading.

THE WITNESS: Yes, okay.

Q. (By Commissioner Lee) Okay, another book by Robert Schachter -- Do you know Robert Schachter?

A. I know Dr. Schachter, yes.

Q. So he's the most expert in his field?

A. He's highly respected in this area, yes.

Q. Okay, let me read something for you:

> The overall fluids loss coefficient has been seen to be an important, perhaps the most important, factor in determining the effectiveness of a given fracture treatment. It is therefore necessary to estimate C as accurately as it is possible in reasonable approximation to the fracture geometry to be obtained.

Do you agree?

A. Yes, sir.

CHAIRMAN WROTENBERY: And that paper, the title of that paper, or book?

COMMISSIONER LEE: The book is by Robert Schachter, *Oil Well Stimulation*, page 236.

Q. (By Commissioner Lee) What's your opinion on that?

A. Fluid loss is of major importance. The whole fluid-loss module has been completely rewritten in the last six months in a joint project with Halliburton. That paper will be published this fall, to include invasion of non-Newtonian fluids in porous media, to include all the effects that we know and can measure about fluid loss.

Q. Currently you don't know how to?

A. I'm sorry, you said currently we don't know how to make those measurements?

Q. Yes.

A. We can make the measurements in the laboratory.

Q. Now, this is the most -- I'm sorry, I'll let you finish.

A. There was a five-year joint industrial project developed, that was ongoing, to determine the principal factors affecting fluid loss and hydraulic fracture. So we get a lot of dynamic tests, looking at erosion of filter cakes, deposition of filter cakes, that sort of thing. That information has been incorporated into GOHFER now.

So to say we don't know, well, we've always got an uncertainty, but we're trying.

Q. Look at your input. Look at your input.

A. Yes, sir.

Q. What is the value of the input for this well?

A. For fluid loss?

Q. Yes.

A. The C -- C_w3 --

Q. C_w3, 72.

A. -- is the wall-building coefficient.

Q. This is the most important factor of the whole fracture simulation. You didn't even bother to do any work here. You put a .005 for every different formation. Is that true in real life?

A. That's the wall-building coefficient. There's three components to fluid loss. The reservoir properties are compressibility and viscous invasion. That is calculated from the input values of permeability and porosity. So the reservoir controls are calculated based on reservoir flow equations.

The wall-building coefficient is a function of the fluid that you're using. Over the range of permeabilities that we're dealing with here, that value is independent of permeability.

Q. Independent of time?

A. C_w implies square root of time. The unit of C_w is square root of time.

Q. Independent of time.

A. The C_w is a wall-deposition, a wall-building coefficient. So the actual leakoff -- It's the slope of the line, it's the slope of the leak- -- cumulative volume versus square root of time.

Q. That filter cake, are they building?

A. Yes, sir.

Q. Then how can you have this one? This varies all through your simulation.

A. That is the slope of the line. The fluid loss that occurs as a result of that coefficient is computed, and it changes at every -- and I can show you here.

Q. Change the pressure differences.

A. It depends. Over the pressure ranges that we're dealing with, most of the data says that that filter cake does not -- that the filtration through that filter cake is relatively insensitive to pressure. Our measurements say it's to the sixth root of pressure.

But the simulator is using that coefficient, which is the slope of the cumulative volume loss versus square root of time. That's what C_w is.

So it computes the -- It keeps track of the age of every node, so it computes the fluid loss in that node based on its -- how long it's been open, because time is characteristic for every node.

Q. Where did you get the .005?

A. The .005 in the history match comes about to honor the shape of the curve. When you have a wall-building fluid, it dominates leakoff. So if you use too low of a value, then the falloff at the end of the job will be too flat. If you use too large of a value, it will be too steep. So that is a history-match parameter.

Q. We're getting nowhere, okay, because both sides are beating on the Young's modulus then beating on the Poisson's ratio. All we know is two formations are connected to each other at this point. There are 20 knobs in your simulator, also in yours.

I'm asking you, one plus something is equal to two. What's that something? One, right?

A. Oh, okay. Well, I -- yeah --

(Laughter)

Q. (By Commissioner Lee) One plus something one, plus something two, equal to two. What are those two values?

A. One plus one is two, okay.

Q. No, one plus X --

A. Okay.

Q. -- plus Y equal to two. You have two knobs.

A. Okay.

Q. What are those values?

A. They're not unique.

Q. The whole reservoir problem, if you extend it to the distribution then you become the -- problem -- problem, that means you can set up any scenario and gather results.

And I'm really disappointed at this moment, the simulation is getting too much attention on this one.

Simulation is a very powerful tool to predict what you want to do, but in simulation -- I've been teaching simulation for 12 years. Simulations have too many unknowns. If you want to prove people wrong, then show that every single parameter you use -- Suppose your C_w is equal to zero. What would happen?

A. If the C_w is equal to zero, in this simulator there would be no fluid loss whatsoever.

Q. Of course, I know there's no fluid loss. But what is it actually do with the fracture plane?

A. It has a lot to do with the size of the fractures and the shape of the falloff curve at the end of pumping. That's still a real point.

Q. I tell you the C_w equal to zero, you frac over to the moon. If the frac equal to -- the C_w equal to infinity, what happens?

A. You would never create a fracture.

Q. Right. This is a very important factor.

All right, let's talk about something measurable. Don't talk about something hypothetical, because this case has great impact on the future of the operation of the San Juan Basin. Based on the simulation, we can't measure it.

Well, anyway, this is my comment on this one.

Okay, no further questions.

CHAIRMAN WROTENBERY: Mr. Hall?

REDIRECT EXAMINATION

BY MR. HALL:

Q. Briefly, Dr. Conway. When we started this dispute more than a year ago, Whiting presented a fracture-simulation scenario looking only at a fracture in the Pictured Cliffs. Do you recall that?

A. Yes, sir.

Q. Is that sound scientific method, to consider fracture simulator in just one formation?

MR. GALLEGOS: I object. Dr. Conway was not called back for this purpose. We've heard hours and hours of his testimony. He did a couple of -- or at least one item that was requested, and that's it, and I object to going off into something else and opening up a new area.

MR. HALL: Well, I think it's well within the scope of inquiry that Dr. Lee was getting into, so I think it's entirely appropriate. It's helpful in the understanding of this case.

CHAIRMAN WROTENBERY: I agree, go ahead.

THE WITNESS: Okay, I was concerned about the fact that when we use simulators, as Dr. Lee says, we can get very much misled. They had only simulated the fracs in the coal. I had my opinion in my testimony before I saw any of their simulations, that if they conducted one in the coal rather than the sandstone, that they would get a similar result, and since then we've seen that. So yes, I was very upset then.

MR. HALL: Nothing further.

CHAIRMAN WROTENBERY: Mr. Gallegos?

MR. GALLEGOS: No, no questions.

CHAIRMAN WROTENBERY: Thank you very much, Mr. Conway.

Does that conclude your direct case, Mr. Hall?

MR. HALL: It does. Turn it over to Mr. Gallegos.

MR. CONDON: Madame Chairman, could we take up a housekeeping item first? It has to do with exhibits.

We're going to call Mr. O'Hare as our first witness, but what we wanted to talk about was, Mr. O'Hare had ten exhibits that were attached to the prefiled testimony. And then on the revised exhibit list that I gave you yesterday -- and we had a discussion about this last Thursday -- our Exhibits W-1 through W-25 were all exhibits that were admitted at the Division proceeding.

I can obviously have Mr. O'Hare go through those one by one, or we can decide which of those Pendragon is going to stipulate to so that we don't have to spend time with any of our witnesses identifying exhibits that were previously identified and admitted at the Division proceeding. So that's my first question.

My second question is, for the Commission's benefit, some of those exhibits -- which consist of the Chaco well files, the Lansdale Federal well file, a hearing transcript in Case 9421 -- are voluminous. And so we haven't at this point made copies for each Commissioner and a separate copy to be admitted in the proceeding. So I'd like to know how you would like to handle those exhibits.

If you all can take notice and there's no objection from Pendragon to the admissibility of those exhibits, then my question is, how many copies do I need to prepare to tender to the Commission in the course of the proceeding?

I've got extra copies of the revised exhibit list if anybody would like one.

MR. HALL: I would, I didn't get one.

CHAIRMAN WROTENBERY: Okay, let me make sure I understand. Are we talking about Exhibits --

MR. CONDON: W-1 --

CHAIRMAN WROTENBERY: W-1 through W- --

MR. CONDON: -- through W-25. And I have --

CHAIRMAN WROTENBERY: W-25?

MR. CONDON: Yes, ma'am. And I have given Mr. Hall a letter -- I have a copy here -- where I had pointed out to him the corresponding exhibit numbers from the Division hearing. So those are set out there. They were all exhibits that were admitted at the Division hearing.

CHAIRMAN WROTENBERY: Help me out here.

MR. CONDON: Yes, ma'am.

CHAIRMAN WROTENBERY: Where were W-26 through W-38?

MR. CONDON: They are here, and they will be introduced through our witnesses as we go through with them.

CHAIRMAN WROTENBERY: Okay, okay.

MR. CONDON: And then after W-28, on the revised exhibit list, just so you know, the exhibits that are listed from there up to the N series, which I think is pretty close to the last page, till you get to the N series there, they're all the expert exhibits that were attached to the prefiled reports.

CHAIRMAN WROTENBERY: Mr. Hall, are you willing to stipulate to any of these first 25 exhibits, W-1 through W-25? Have you had a chance to look at that?

MR. HALL: I haven't been provided with them, so I can't say right here and now. And that's part of the problem. I had seen these on the initial list, and I had sent a letter to Counsel asking for an explanation, because the rules were going into this under the scheduling order, that all exhibits would be prefiled on July 23rd with respect to expert testimony anyway.

I'm not sure which of these Exhibits 1 through 25 may be used in connection with additional expert testimony that's perhaps not even included in their filing, and which is.

So until I'm entitled to see it and until we see the manner in which it's proffered, I can't really say.

The answer to your question is, yes, I can stipulate to many of these things. I don't want to appear to be unreasonable. But maybe Counsel can clear that up for us. Are they intending to elicit additional expert-opinion testimony as an avenue for introducing these new exhibits? Because that just seems unfair to me.

MR. CONDON: Well, some of -- We are going to offer some additional testimony from our witnesses in the nature of a response and rebuttal to the new theory that Pendragon offered for the first time when they filed their prefiled expert testimony in this case.

As you will recall, and I've read from the Application a couple of times during this proceeding, the Application says that Pendragon's asking for an order that Pendragon is appropriately producing from the Pictured Cliffs and Whiting is appropriately producing from the Basin-Fruitland Coal Gas Pool. And of course, we've sat through three days of testimony where they've essentially impeached the second half of that request in the Application.

I have a copy of Pendragon's proposed order in the Division proceeding, and I'll read from paragraph 79, which says:

> Consistent with the finding in paragraph 76 above, that the subject Pictured Cliffs wells and the subject coal gas wells are completed in separate common sources of supply, the production from and the operations in one pool do not result in the impairment of correlative rights in the other.

So the first time that we heard and saw the new theory that, in fact, the Whiting wells have communicated with the Pictured Cliffs formation, are causing an impairment of correlative rights of Pendragon by the production of PC gas was with the filing that we got. And because the Commission set it up as a simultaneous filing, of course, we haven't had an opportunity to respond to that.

And so yes, we are going to introduce additional testimony through our witnesses in the way of rebuttal of the testimony and the filings that have come in.

MR. GALLEGOS: Let's see, Madame Chairman, if I might, and maybe can get over a hump here.

MR. HALL: Well, let me respond to something first. I'm not sure what the purpose of this discussion about the parameters of the Application is. I think it's been very clear all along what this proceeding is all about. We have briefed that prior to the hearing. There's no new theory presented here today. They knew the nature of the case from day one, so I don't understand why we're discussing that at this point.

But my problem is, again, we had an agreed scheduling order which set forth deadlines for presenting expert testimony and exhibits. We met each and every deadline the Commission set. I don't think they met one, as I recall.

So as an issue of fairness, why are we having new expert opinion testimony and exhibits sprung on us at the hearing?

CHAIRMAN WROTENBERY: Well, we have already discussed the fact that, because we didn't make arrangements for rebuttal testimony, that we were going to accept additional testimony and exhibits in the nature of rebuttal testimony. And we have done that, as Pendragon --

MR. HALL: Sure.

CHAIRMAN WROTENBERY: -- has proceeded with its case as well.

MR. HALL: Right.

CHAIRMAN WROTENBERY: Mr. Gallegos, you had a suggestion and I have one too --

MR. GALLEGOS: Yeah --

CHAIRMAN WROTENBERY: -- but maybe --

MR. GALLEGOS: -- I have a --

CHAIRMAN WROTENBERY: -- maybe yours --

MR. GALLEGOS: I have a --

CHAIRMAN WROTENBERY: -- will be better, I don't know.

MR. GALLEGOS: -- a suggestion. And by the way, we filed our testimony on July 26th, just like they filed theirs, which was the due date.

But if we just narrow this to W-1 through W-10 -- W-1 is everybody's assignments -- how can you argue about that, and why should we spend time with copies of assignments of where each party got their interest --

MR. HALL: Let's do this: I'll stipulate to W-1 and W-2 --

MR. GALLEGOS: W-3 and W- --

MR. HALL: -- W-3, I don't know what it is.

MR. GALLEGOS: W-3 is the coalbed methane spacing study committee, their exhibit presentation, which is part of the record so you take administrative notice of that.

It's part of your records in Case 9420. You don't have an objection to that, do you?

MR. HALL: Well, in fact, I filed a motion *in limine* on that, I believe, earlier.

MR. GALLEGOS: Oh, really? Okay.

W-4 is the same -- is likewise part of your own records of the Division.

And W-10 is records of the Division which you can take regulatory notice of. It's just easier for the fact-finding body to have them as exhibits in the case.

-5 through -9 are complete well files. Everybody used those well files in the Examiner hearing. We've seen various pieces, bits and pieces of those, and these were assembled just so there would be a complete file.

So I think if we can just have W-1 through -10 in, we won't press the rest of this, and we can get on.

MR. HALL: W-10, okay.

W-3, I object.

W-4, I object.

W-5 through -9, I'd like to be able to stipulate to that, but as we found out last year when purported well files were tendered by Whiting, they included non-well-file materials. In fact, I think they included some litigation notes.

So basic courtesy would dictate that I had an opportunity to look at what's being tendered before --

MR. CONDON: Well, they have been here since last Thursday, and I'm happy to give Mr. Hall a copy of each of them and let him look through them, and then we can pick it up at a later point.

If it's after, for instance, Mr. O'Hare is done testifying and there's a problem and we need Mr. O'Hare to authenticate those, then as long as we have the understanding that we can bring him back and put him back on the stand for that limited purpose if we have to --

MR. HALL: That's all I'm saying, that's why we head deadlines, to get it taken care of in advance of the hearing and avoid all this.

CHAIRMAN WROTENBERY: What I hear so far is that we have stipulations on W-1, -2 and -10 --

MR. HALL: Correct.

CHAIRMAN WROTENBERY: -- Mr. Hall would like an opportunity to review W-5 through W-9, and I think we can accommodate his --

MR. CONDON: Sure.

CHAIRMAN WROTENBERY: -- his need there, with the hope that he'll be able to stipulate to those.

W-3 and W-4, I know, were the subject of some discussion in the prehearing conference. Ms. Hebert, do you have any suggestions?

MS. HEBERT: Mr. Hall, do you object to the entry of the exhibits on W-4 from the two cases? Only the exhibits? Or do you want to review those exhibits before you make a decision?

MR. HALL: Well, I don't know why they're being offered. As I understand it, you're being asked to take administrative notice of exhibits that --

MS. HEBERT: Did you want to reserve your right to object to them on grounds of irrelevancy or some other basis?

MR. HALL: Well, no, what I'm saying is, if you are being asked to take administrative notice of exhibits, there's a question whether demonstrative exhibits from a prior hearing are something that you can take administrative notice of, because it may or may not be factual material.

That's my point, is that it may -- exhibits may have been used in conjunction with arguments by one side or another, proposing one form of spacing order or another, which -- and materials from those exhibits may not have been included in the final order for the pool.

So it's a problem, I don't now that you can take administrative notice of them.

And my concern is here that we need to, I think, be very careful about the record we're building here, in the event that there's an appeal. So I don't mean to say I won't stipulate to the admission of some. I don't know which are being offered at this point. But right now, until I have more information I have to maintain my objection.

MR. CONDON: Very briefly, the reason --

MS. HEBERT: If you could explain the basis of --

MR. CONDON: Absolutely.

MS. HEBERT: -- the need to --

MR. CONDON: Sure.

MS. HEBERT: -- introduce these two exhibits?

MR. CONDON: Sure. The coalbed methane committee, as Mr. O'Hare will testify to, was a committee that was set up by the Division back when they were first considering the establishment of the Basin-Fruitland Coal Gas Pool, and discussion during that report involves discussion of the coal, the Pictured Cliffs.

And the same is true of the transcript, 9421, that we want to tender. We want you to have some idea of the history of what has gone before and led to the proceeding and the dispute that we're here for today, as opposed to being presented with this, kind of as if this was the first time that any of these issues about communication between the two formations and the relationship between the two formations and picking the contact between the two formations has ever come up.

It's been addressed before in prior Division proceedings, and we want you to have access to those which are your own records so that you have an opportunity, in rendering your decision in case, to look back at the history.

MR. HALL: Well, here's the problem with that, though: If that record contains --

MS. HEBERT: I think we understand their problem.

(Off the record)

MR. HALL: For the record, the problem with that is, the record from the pool-rules hearing consists of testimony by experts, arguments of counsel, many of whom, perhaps none of whom, will be here. I'm not able to cross-examine them. That's why you can't take notice of that sort of material.

CHAIRMAN WROTENBERY: What we think is that we can take judicial notice of the orders in those cases, but we do see a concern about adopting wholesale the testimony and exhibits of those proceedings.

So to the extent that you do want to introduce those materials, I think you will need to bring them up in the context of the testimony --

MR. CONDON: Okay.

CHAIRMAN WROTENBERY: -- of your witnesses --

MR. CONDON: Sure.

CHAIRMAN WROTENBERY: -- and we'll look at those and give everybody an opportunity to consider whether they're admissible --

MR. CONDON: Sure.

CHAIRMAN WROTENBERY: -- at that point.

I don't know if you have any -- Do you want us to take judicial notice of the orders at this point, or --

MR. CONDON: Oh, yes, definitely.

CHAIRMAN WROTENBERY: Okay.

MR. CONDON: That's 8768, 8768-A, 8769, and 8769-A.

MR. GALLEGOS: They are exhibits, by the way. Mr. Ayers --

CHAIRMAN WROTENBERY: We've already got --

MR. GALLEGOS: They're already exhibits.

CHAIRMAN WROTENBERY: Yeah.

MR. HALL: Sure, there's no problem with that.

CHAIRMAN WROTENBERY: Okay. And we're not going to have any further discussion at this time about W-11 through W-25; is that what --

MR. CONDON: Correct.

MR. HALL: Those are not being offered?

MR. CONDON: Not at this point.

MR. GALLEGOS: We're not going to argue about it any longer. We've offered them and we want to get on with it.

CHAIRMAN WROTENBERY: Okay. Does that take care of your --

MR. CONDON: Yes, ma'am.

CHAIRMAN WROTENBERY: -- preliminary questions?

MR. CONDON: Okay?

CHAIRMAN WROTENBERY: Ready to go.

MR. CONDON: We call Mr. O'Hare.

MR. HALL: Madame Chairman, I wonder if we might address a couple more matters of protocol here, while we're on the issue of objections.

I had filed on August 9th objections and a motion to strike testimony, part of which goes to Mr. O'Hare's testimony but also goes to some of the other witnesses. We'd be glad to take that up with you now, or witness by witness, however you wish to proceed.

CHAIRMAN WROTENBERY: We had talked earlier about taking it up witness by witness, and I think that's probably the best way to go, and we can talk about your objections to Mr. O'Hare's testimony when it comes up.

MR. HALL: Shall I proceed to address those?

CHAIRMAN WROTENBERY: You might want to get the witness sworn in and --

MR. HALL: Okay.

CHAIRMAN WROTENBERY: -- get started first.

ALEXIS MICHAEL "MICKEY" O'HARE,

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

DIRECT EXAMINATION

BY MR. CONDON:

Q. Please state your name.

A. My full name is Alexis Michael O'Hare, and I go by Mickey.

Q. Mr. O'Hare, how are you employed?

A. I'm the president of Maralex Resources.

Q. Is Maralex Resources a party to this proceeding?

A. Yes, it is.

Q. Would you please give the Commission an educational and work-history background?

A. Yes, I was educated at the New Mexico Institute of Mining and Technology and received a bachelor of science degree in petroleum engineering in 1981.

Upon graduation I went to work for Amoco Production Company in their Farmington District Office and became involved in their coalbed methane development, exploration and development, program. That included both the San Juan Basin and the Raton and Piceance Basins.

I also spent a considerable amount of time drilling wildcat wells in the western part of the United

States during that employment.

I was transferred to the Amoco Denver office in 1985, where I got involved in the reservoir group. And then I was laid off by Amoco in 1986 and went to work for NCRA, or National Co-op Refinery Association, in 1987. I was the joint operations supervisor and district engineer for their Farmington and Midland Districts during that employment.

And that lasted about three years before I started Maralex.

Q. Okay. In the 1980s did you have any involvement with the coalbed methane committee?

A. Yes, upon my employment with National Co-op Refinery Association I became a member of that committee.

Q. And what was that committee?

A. It was a committee set up by the Division to address the problems that were developing with the Fruitland Coal development in the San Juan Basin. Specifically, there were four different items that the committee was asked to address. Those included spacing, rulemaking -- and the other two escape me at the moment, but...

Q. And what was your involvement?

A. I was involved on a subcommittee addressing the spacing issues, and also on the full committee where I had a voting presence on both the subcommittee and the full committee.

Q. Did the committee prepare a report for the Division in connection with some of the proceedings that have been previously discussed?

A. Yes, it did.

Q. And what was the nature of that report?

A. It was a fairly lengthy report recommending spacing for three different areas in the San Juan Basin. It also recommended specific rules and methods to determine whether or not individual wells were producing from the coals or from a sandstone adjacent to the coals.

Q. And why was that an issue back then, in the 1980s?

A. Well, it was --

MR. HALL: At this point I feel obliged to interpose an objection because we're getting into the materials that we've already received a ruling on, aren't coming into the record.

MR. CONDON: I don't believe they're --

CHAIRMAN WROTENBERY: We didn't rule that they aren't coming into the record. We just -- We ruled that we would take the issue up in the context of each witness's testimony if there were some exhibits or materials that Whiting and Maralex wished to introduce. So if you have an objection to the relevancy or the -- any other type of objection to this information at this time, maybe it's time to bring it up and consider it.

MR. HALL: I misunderstood your earlier ruling, then. I thought you had ruled that you wouldn't be taking administrative notice of the record in those prior proceedings, and those exhibits, testimony and exhibits, would --

CHAIRMAN WROTENBERY: Well, did I misunderstand the question, maybe?

MR. CONDON: I just --

CHAIRMAN WROTENBERY: I didn't hear that that was involved in the question.

MR. CONDON: No, I'm just asking him some foundation questions about what the committee looked at, what the involvement was, what his involvement was, a lot of which goes to establish the basis for his expert opinions which Mr. Hall's going to object. If he's going to object, then I have the right to try to qualify the witness.

CHAIRMAN WROTENBERY: Proceed.

MR. HALL: I withdraw the objections, if that's the purpose.

CHAIRMAN WROTENBERY: Thank you.

Q. (By Mr. Condon) Why was the committee concerned about communication between the two formations back in the late 1980s?

A. Well, it was widely recognized at that time that there were a number of wells across the Basin, specifically Pictured Cliffs wells, that had produced huge volumes of gas that could not be accounted for by the gas-in-place numbers calculated for the Pictured Cliffs formation.

Q. Was there concern about Pictured Cliff wells producing coal gas, given the spacing difference between the two formations?

A. Yes, that was a very big concern.

Q. And what was the nature of that concern?

A. Basically, the Pictured Cliffs formation was spaced on 160 acres. The committee recommendation was that the Fruitland Coal formation be spaced on 320 acres, at least in certain parts of the Basin, and they foresaw a potential conflict, especially if Pictured Cliffs wells were able to drain Fruitland Coal Reserves on 160-acre spacing, whereas the Fruitland Coal owners would be restricted to 320-acre spacing.

Q. And what was -- How involved were you with the committee? And were you involved at all in presentation at any of the Division hearings?

A. No, I was not involved in presentations at the Division.

Q. Would you give the Commission an idea of how many coalbed wells you have been involved in drilling, emphasizing your experience in the San Jan Basin, and also an idea of your prior involvement and experience in picking the pick between the Pictured Cliffs and the Fruitland formation in the area in question?

A. I personally have drilled or supervised the drilling or designed the drilling programs and/or completion programs for literally hundreds of wells in the San Juan Basin and throughout the world probably approaching 1000 wells, well over 500 wells anyway.

Even in my days with Amoco the engineers that were responsible for the drilling of a well were required after the well was drilled and logged to pick the tops of the formations that were submitted to the state on the state forms, the C-104 -- or C-102s, I can't remember the form number right now, but... And that was one of our responsibilities as Amoco engineers.

It was also my responsibility as a district engineer when I worked for NCRA to provide that information, and of course I've continued to do that along with my engineering manager on the wells that we have drilled as Maralex.

Q. Did you prepare an expert report in connection with this proceeding?

A. Yes, I did.

Q. All right. And did you also prepare and submit along with that report AMO Exhibits 2, 4, 6, 8, 9 and 10?

A. Yes, I did.

Q. Okay. Do you affirm and adopt that report today?

A. I would like to make some corrections before I affirm and adopt this report, if I may.

Q. Okay, what are the corrections?

A. The first one has to do with the perforations in the Gallegos Federal 26-13-1 Number 2 well. I erroneously stated that the lower coal in that well had been perforated by Maralex upon the initial completion. That is not correct. There are --

CHAIRMAN WROTENBERY: Could you direct us to the page?

THE WITNESS: Surely.

MR. HALL: Seventeen.

MR. CONDON: Correct, line 1 on page 17. So in fact, that sentence should end after the word "purposes".

THE WITNESS: There is also an error on page 6, line 17, stating that we did perforate that lower coal.

CHAIRMAN WROTENBERY: So let me make sure I got the changes. We're striking the last sentence of the second paragraph on page 6?

MR. CONDON: Lines 17 through 19.

CHAIRMAN WROTENBERY: Okay. Just that last sentence?

MR. CONDON: Correct.

CHAIRMAN WROTENBERY: And then on page 17 we struck the phrase "except as to the 26-13-1 Number 2 well" on line 1.

MR. CONDON: Correct, and the next two sentences, I assume, would have to be struck also.

THE WITNESS: Yes, that is correct.

MR. CONDON: So essentially striking beginning with the word "That" on line 2 through the word "location" on line 5.

Q. (By Mr. Condon) Are there any other corrections, Mr. O'Hare?

A. Yes, on page 19, line 21.

Q. All right, and that's the sentence that begins "If the fracture stimulation..."

A. Correct.

MR. CONDON: Okay.

CHAIRMAN WROTENBERY: Strike the entire sentence?

THE WITNESS: Yes, ma'am.

Q. (By Mr. Condon) Over to page 20, line 3?

A. Yes.

Q. Okay. Is there anything --

MR. HALL: May I address something else with respect to that, Mr. Conway?

Page 19, line 15 refers to the Gallegos Federal 26-13-1 Number 2 well. I might ask the witness if that should be corrected to show the 6 Number 2 well?

THE WITNESS: No, sir.

MR. HALL: Okay.

CHAIRMAN WROTENBERY: Anything else?

Q. (By Mr. Condon) Is there any other corrections?

A. Not that I'm aware of.

Q. Okay. With those corrections, do you affirm and adopt your testimony?

A. Yes, I do.

CHAIRMAN WROTENBERY: I think this is the time we need to take up your motion to strike certain portions of the testimony that was filed by Pendragon.

MR. HALL: Madame Chairman, we would object to and move to strike at page 4, lines 18 through 20; page 12, lines 6 through 8; page 13, lines 9 through 23; page 14 in its entirety; page 15, lines 1 and 2.

With respect to the testimony to the extent it purports to offer conclusory-opinion statements that the Pictured Cliffs formation was depleted and economically nonviable, the reason for the objection is that the witness has offered no foundation, offers no basis for those conclusions and is speculative.

MR. CONDON: May I respond?

CHAIRMAN WROTENBERY: Yes, please.

MR. CONDON: In the first place, we heard testimony from Pendragon's witnesses, based on much flimsier evidence than Mr. O'Hare will point to in support of his opinions, that the Pictured Cliffs formation was this massive reservoir of untapped gas that all of the operators in the area simply didn't understand was there.

So I think in a way, Pendragon, given the testimony they've offered in this proceeding already, have waived any objection to the foundation of Mr. O'Hare's testimony.

The second response is, we do have -- and certainly Mr. O'Hare is available and I'll ask him the specific factors that he looked to in order to establish a foundation for that testimony -- but we have the report that Mr. O'Hare did back in 1993 or 1994 when Maralex was offered these wells as part of a package by Merrion and Bayless. And I do intend to offer that in connection with Mr. O'Hare's testimony.

I don't have right in front of me what that exhibit number is, but we have the package that Mr. O'Hare actually kept, unlike Pendragon's witnesses who all did back-of-the-envelope calculations to confirm how full of a reservoir the PC was and have not maintained any of those calculations. And in fact, in my response to the motion I attached pages from the Division hearing where both Mr. Blauer and Mr. Nicol testified that they did calculations on the PC prior to doing the frac jobs on them but didn't retain any of those documents in their files.

The third response is, Mr. Hall's objections go to the weight to be accorded Mr. O'Hare's testimony, and I would like an opportunity in going through that opinion with him -- because part of that is in the nature of rebuttal.

You know, we've now heard the Pendragon case about how full the PC was, and Mr. O'Hare ought to have an opportunity to offer rebuttal testimony to that. And in the context of that I will ask him the basis for his conclusions and allow him to establish a foundation, if the Commission has any concern at this point that a foundation to allow him to testify hasn't been made. I think given his knowledge, training and experience, he's more than qualified to offer that opinion.

CHAIRMAN WROTENBERY: Thank you. We agree that the testimony is admissible with one possible exception, and I wish you would address it. It's the reference to the BLM demand that many of those wells be plugged and abandoned.

MR. CONDON: I'm sorry, where are you?

CHAIRMAN WROTENBERY: That's on page 4 --

MR. CONDON: Okay.

CHAIRMAN WROTENBERY: -- lines 18 and 19. We don't, I don't think, have any documentation of that demand or any explanation of the basis for that demand.

MR. CONDON: Okay. Well, I'll ask Mr. O'Hare about the basis for that testimony. I mean, if I could --

CHAIRMAN WROTENBERY: Go ahead and do that.

Q. (By Mr. Condon) Okay. Mr. O'Hare, let me refer you to page 4, lines 18 through 20 of your report. What is the basis for your statement at that point in your testimony?

A. That is based on comments made to me by an individual at Merrion Oil and Gas at the time that we were offered the wells for purchase.

Q. Okay, and which wells did that refer to?

A. It was a general statement, it was not -- The wells were not specified during that discussion.

MR. HALL: Objection, hearsay.

CHAIRMAN WROTENBERY: We agree, it's hearsay and should be stricken.

So we will allow the testimony concerning the depletion of the Pictured Cliffs formation that's referenced in several different places outlined in Mr. Hall's motion, with the exception of the reference to the

BLM demand. So we'll strike the phrase "and the BLM was demanding that many of those wells be plugged and abandoned."

(Off the record)

CHAIRMAN WROTENBERY: Okay, we do need to ask about one other reference. On page 13 --

MR. CONDON: Yes, ma'am.

CHAIRMAN WROTENBERY: -- lines 12 through 16 --

MR. CONDON: Yes.

CHAIRMAN WROTENBERY: -- I believe again we have no documentation or other evidence in the record to support that particular statement.

Q. (By Mr. Condon) Okay. Well, Mr. O'Hare, would you tell the Commission the basis for that statement on page 13 in your report?

A. Yes, that was based on a recent conversation with one of the operators that farmed out the Fruitland Coal rights to us, Bob Bayless.

Q. Okay. Do you also have personal knowledge about the development in the Pictured Cliffs formation in the San Juan Basin?

A. Yes, I do.

Q. Independent of your discussion with Mr. Bayless?

A. Yes.

Q. And what is the nature of that knowledge and information?

A. At the time that this particular area was being developed, I was working for Amoco in the Farmington District, and Amoco actually had a Pictured Cliffs development program, and all new wells at that time were subject to the NGPA pricing for new wells. At that time it was around $3.00 an MCF.

Q. Was that an economic factor in Amoco's decision to develop its Pictured Cliff wells?

A. Most definitely.

Q. Okay. And have you been involved in looking at, analyzing production history and evaluating other Pictured Cliff wells since your time at Amoco?

A. Yes, I have.

Q. Okay. Give the Commission an idea of how much experience you've had in developing and analyzing Pictured Cliffs wells.

A. Well, we recently purchased a dually completed well that contains a Pictured Cliffs producing horizon, and we obviously evaluated that horizon before we purchased the well. At current prices and conditions that horizon is not economic, and it's currently shut in. We have not produced it more than, I'd say, a week all told, since we bought that well here about a year and a half ago.

Q. Have you also looked at information about other

Pictured Cliff wells in the area in question, in connection with your investigation in this case?

A. Fairly extensively, yes.

Q. Okay, how many other Pictured Cliff wells have you taken a look at, in one way or another?

A. I would guess ten to twenty.

CHAIRMAN WROTENBERY: Thank you.

MR. HALL: May I state an objection to that testimony? I still think there's a lack of foundation, because the testimony on page 13 is directed towards the exploitation of "these wells", meaning the Chaco wells. So to the extent he gained knowledge about the exploitation of these wells, it came through an unpresent third party.

MR. CONDON: Well, wait a second. This is the Commission's question. Mr. Hall's motion does not address this portion of the testimony.

MR. HALL: Right, I'm stating on objection.

MR. CONDON: I'm not sure why he's now jumping on the bandwagon and trying to bootstrap his way into an objection.

CHAIRMAN WROTENBERY: We're satisfied that that statement is admissible.

MR. CONDON: Thank you.

CHAIRMAN WROTENBERY: Now should we move on to the other parts of your objection, Mr. Hall?

MR. HALL: At page 10, lines 19 through 23; page 11 in its entirety -- I'm sorry, page 11, lines 1 through 5, there's discussion of some engineering studies and testimony about those studies. We had requested those in discovery, and their production was refused, yet here discussion of them crops up in the testimony. We think it's clear hearsay. The alternative to excluding the testimony is to require Whiting and Maralex to produce engineering studies to us.

MR. CONDON: If I could respond, the purpose of the testimony -- It's not offered to show that those studies, per se, came to any particular conclusion. It was offered, I believe, in the testimony as part of the history of the dispute. That's point number one.

Point number two, Pendragon did, at one point, serve a request for production which we interpreted as broad enough to ask for the parties' internal interpretive analyses. We objected based on the Commission policy that the parties are entitled to exchange raw data, but they're not entitled to see interpretive analyses that the other side has internally performed unless the side tenders it as an exhibit at the hearing.

We had a hearing with the Commission's attorney where Pendragon's attorney withdrew the request and made it clear that he was not asking for interpretive analyses, as per the commission rule. And I thought we had an agreement with Pendragon that we weren't going to be exchanging interpretive analyses.

So that's my -- And now to have Pendragon object because they weren't produced when they withdrew their request is a little disheartening.

MR. HALL: Well, discovery is one thing. To have in your testimony an assertion that coal-seam gas is being produced through the Chaco wells -- and this is on line 22, confirmed by the reports, that's the language used -- there's no hearsay exception for that period.

MR. CONDON: Well, believe me --

CHAIRMAN WROTENBERY: Well, we'll take Whiting and Maralex's assertion that that was not the purpose of this particular portion of the testimony, and we will accept it for the limited purpose of showing us how we got where we are.

Next item?

MR. HALL: At page 2, lines 12 through 22; page 15, lines 3 through 25; page 16, lines 1 through 19, here geologic testimony is offered, although the witness hasn't been tendered as an expert yet. I believe his field is petroleum engineering. I don't know that they've laid a proper foundation for geologic testimony here. That's the basis of our objection.

MR. CONDON: First of all, another waiver of objection.

I believe I heard Mr. Cox characterizing the sand between the two coals as what he called an upper Pictured Cliff sand, which is certainly geologic testimony. If Mr. Cox is entitled to give that sort of testimony, and if Mr. Nicol is entitled to tell you that he's not a fracture-stimulation expert and then offer opinions on fracture-stimulation and fracture-stimulation programs, then I certainly think Mr. O'Hare is qualified to give this sort of testimony.

Specifically, Mr. O'Hare is an operator in the area in question who has, on many occasions, based on his knowledge, training and experience, picked the boundary between the Pictured Cliffs and the Fruitland formation, and he's done it on filings that have been made with the Division.

Mr. Hall's own expert, Mr. Whitehead, recognized that part of the basis for his pick of the contact between the Pictured Cliffs formation and the Fruitland formation is based on what other operators in the area have described as the contact point. Certainly if Mr. Hall is entitled to offer expert testimony through Mr. Whitehead based on what operators in the area have described as the contact point, Mr. O'Hare as an operator ought to be entitled to give the same opinion testimony.

Finally, Mr. O'Hare is a party to this proceeding, and part of the claim that we're making in this case is that Pendragon has perf'd and fracture-stimulated in zones above the base of the Fruitland formation.

Now, the Application is a little mischaracterized because it talks about pools, and that is not the basis of the transfers of operating rights. As a party to the proceeding, Mr. O'Hare is certainly entitled to tell you what the basis for his contention is. And I think given his knowledge, training and experience, he's eminently qualified.

CHAIRMAN WROTENBERY: We agree that Mr. O'Hare is qualified to give this testimony. I think that the concerns really go to the weight to be given to the evidence, and that's something the Commission will decide after hearing all of the testimony and cross-examination.

Next item?

MR. HALL: Page 27, lines 3 through 27; page 28, lines 1 through 11. Testimony is offered with respect to the cement job on certain perforations in the Lansdale Federal well in the coal interval, which is owned by the operator. I think it's clearly barred by Rule 11-407. It's a subsequent remedial offer.

It's also tendered in the context that it's provocative in nature. It's cast in terms that it's an illegal act, and of course it's not. We've pointed out that completions like that in a nonstandard spacing unit are permitted under the Division's rules, Rule 104.D.(2), and it's common accepted practice before the Division.

CHAIRMAN WROTENBERY: Mr. Condon?

MR. CONDON: This is a very interesting argument, Madame Chairman. The Lansdale Federal well we are offering for a number of reasons, first, to show a course and pattern of conduct. And the course and pattern of conduct is to produce coal-seam gas through what is ostensibly characterized as a Pictured Cliff well.

And what's interesting -- and this is part of the -- I just want to point out to you kind of the timing sequence on the Lansdale Federal, because there's a number of things I want Mr. O'Hare to testify about.

Back in -- On December 2, 1994, Pendragon filed a sundry notice on the Lansdale Federal Number 1 which says they propose to re-enter this well and produce the Pictured Cliffs through perforations. That's December 2nd.

MR. HALL: I'm going to object. I think that mischaracterizes the completion --

MR. CONDON: Part of --

MR. HALL: -- report.

MR. CONDON: -- W-9 --

MR. HALL: Pendragon --

MR. CONDON: If I can finish, Mr. Hall.

Part of the Lansdale file is a workover and completion report that is dated December 19, 1994, two and a half weeks after that sundry notice as filed. The last line says, Plan to perforate Fruitland Coal and acidize, 12-20-94.

The notices that were then filed after the work was done on the Lansdale Federal continued to characterize it as a Pictured Cliff or a WAW-Pictured Cliff-Fruitland Sand well, not a coal well.

We are asking in the course of this proceeding that the Commission sanction Pendragon for various rule violations. This is one of them. The Lansdale Federal had 160 acres assigned to it, and yet the internal documents show that they intended to perforate the coal, even though they didn't have 320 acres, and then file notices with the Division.

Now, for an operator in the area like Maralex -- and the Lansdale Federal is very close -- the filings indicate it as a Pictured Cliff well, not a Fruitland Coal well. So for all the world it's represented as a PC well, when in fact it's clearly producing from the coal.

The history of the Lansdale Federal is also relevant to the issue of where is the gas coming from in these wells? Because the fact of the matter is, what our exhibits will show is, after the perfs in the coal were shut -- off one week prior to the Division hearing last year, I'll point out -- the well tanked, it stopped producing, even though it was still open to the PC.

So that obviously is a question that is squarely placed before the Commission, is, where are all these wells that are characterized by Pendragon as Pictured Cliff wells? Where are they getting the gas that's coming out.

So for all those reasons, we believe that the testimony regarding the Lansdale is admissible.

And I will also just say, this is not a remedial measure, as Rule 407 talks about remedial measures. You know, what the rules contemplate is the case like with the Ford Pinto, you know, when they had the gas tank in the back where if you ran into it, it would cause an accident. Where a manufacturer puts a product out like that and has a number of accidents and lawsuits and then goes in and fixes the problem, the design, then that evidence is not admissible to show that the manufacturer was negligent or that the product was defective. But that kind of evidence still comes in for any number of other reasons, as are described in the Rule.

CHAIRMAN WROTENBERY: We'll admit Mr. O'Hare's testimony on the Lansdale Federal Number 1 well, listen to the cross-examination and then give it the weight that it deserves.

I think that was your last --

MR. HALL: Yes, that's correct.

CHAIRMAN WROTENBERY: -- objection on the --

MR. HALL: Oh, I beg your pardon, I do have one more. Just make it a speaking objection to this. At page 9, the sentence beginning on line 17 through 20 discusses reports from the field with respect to quantities of water observed, and we object on the basis of hearsay.

MR. CONDON: We'll be offering testimony of both Mr. O'Hare and another Maralex employee on what they observed in terms of water production from the wells.

Although here again, I mean, all this is really nit-picky and ought to just be done in the context of cross-examination if he's got a question about the foundation for any of these statements. I mean, heaven knows, if we had done this with the Pendragon witnesses we probably wouldn't even be through Mr. Nicol's testimony yet.

MR. HALL: Well, I apologize, that's how I did it all before the hearing.

MR. CONDON: Well, you didn't do that one before the hearing.

MR. HALL: I didn't do them all.

CHAIRMAN WROTENBERY: We'll admit that particular statement as well.

Okay, we've taken care of the objections.

Now we just need to, I guess, make it clear that we have accepted --

MR. CONDON: I am offering Mr. O'Hare as an expert and tendering AMO Exhibits 2, 4, 6, 8, 9 and 10 -- oh, also -- Well, I guess we can talk about JTB-7 and WA-4. They come in in other ways anyway.

I'll offer the testimony and those exhibits at this time.

MR. HALL: For the record, I assume he's being offered as an expert in petroleum engineering?

CHAIRMAN WROTENBERY: We will accept Mr. O'Hare's testimony with the changes that we recorded and admit Exhibits 2, 4, 6, 8, 9, 10 -- is that it?

MR. CONDON: 2, 4, 6, 8, 9 and 10, at this time.

CHAIRMAN WROTENBERY: -- into the record --

MR. CONDON: At this time, at this time.

CHAIRMAN WROTENBERY: -- at this time.

And we also accept Mr. O'Hare's qualifications to testify as an expert.

MR. CONDON: Thank you. Would you like for him to summarize his report at this time, or do you want to take a break?

CHAIRMAN WROTENBERY: I think we need to take a break here.

MR. CONDON: All right.

CHAIRMAN WROTENBERY: Let's take a ten-minute break, and we'll come back with a summary of Mr. O'Hare's testimony.

(Thereupon, a recess was taken at 5:15 p.m.)

(The following proceedings had at 5:30 p.m.)

CHAIRMAN WROTENBERY: Are we ready to proceed?

MR. CONDON: I believe we are.

Q. (By Mr. Condon) Mr. O'Hare, after these delays, would you please give us a summary of your expert testimony?

A. Yes, Madame Chair, Commissioners. My written testimony contains a brief history of the project and Maralex's involvement, along with our perspective on the project.

It also contains conclusions that the PC Pictured Cliffs formation in the area of question was depleted at the time that the Chaco wells were restimulated in 1995. And we point out that Maralex had evaluated those wells as part of a 27-well package that had been offered to us by Merrion in either late 1993 or 1994 to purchase those wellbores. We discovered those wellbores, or the wells in question, had basically been depleted, there was no remaining economical gas to be produced from the wells.

I'd like to define "depletion" a little more concisely. What we were seeing is that reservoir pressures at that time were substantially lower than the initial reservoir pressure and that a very significant amount of the gas in place had already been recovered from the wells, and there was not a great likelihood that additional gas could be recovered from those wells out of the Pictured Cliffs formation.

We also reviewed the fact that those wells were what are commonly referred to as slimhole completions, meaning that they had very small casing, 2-7/8-inch tubing was actually used as casing, and we felt that for our purposes that would not be sufficient for us to be able to use those wellbores to recomplete to the Fruitland Coals and have a good chance of dewatering those coals in a short amount of time.

And when I say depleted, I want to point out that we looked at a recovery factor for the Pictured Cliffs in that area at that time. And basically, the way we did that was very simply look at the initial reported pressure of the wells, which was in the range of 230 to 250 p.s.i., and we looked at what were pressures at that time, which was on the order of 100 to 110 p.s.i.

Now, the Chaco Number 4 pressure that has been ignored very extensively by Pendragon showed a prestimulation 1995 stimulation pressure of 119 pounds. If you take that pressure and correct it to absolute pressures and ratio it against the initial pressure in that wellbore, you find that basically 55 percent of the pressure was no longer in that well, in the Pictured Cliffs formation.

Recovery factors for Pictured Cliffs formations and most conventional sand formations with the kinds of permeability that we're seeing here are on the order of 60 to 70 percent from a good well. Fifty-five percent told us that there might be some remaining reserves, but they were not substantial enough to justify expending the kind of money that would be needed to recover those reserves. So we elected not to buy those wellbores.

In hindsight, I think Ms. Hebert made a comment in the hall that if I had spent $7800 at that time we wouldn't be here today, and our problems would not have occurred. That's a great assessment and hindsight is always 20-20. Unfortunately, I didn't have the foresight at the time to get rid of that problem before it developed.

Another conclusion that we discuss in the report are the perforations in the Fruitland formation. I'd like to again show an exhibit that was presented in our opening statements. It basically describes the ownership that we received and the ownership that Pendragon received. The operating rights were granted to us from the surface of the earth to the base of the Fruitland (Coal-Gas) formation, not the Coal Gas Pool but the Fruitland (Coal-Gas) formation.

Similarly, Pendragon's ownership was limited from the base of the Fruitland Coal formation to the base of the Pictured Cliffs formation.

This is very important to me because Pendragon's Application basically asks you to find that production is coming from the appropriate common source of supply, implying the pool definition. Now that is incorrect from our standpoint, because neither one of us received rights from a pool. And so even if you accept their contention that their gas is coming from what they call a Pictured Cliffs sandstone, they do not own the rights in that particular sandstone. They own the rights from the base of the Fruitland Coal formation, which Dr. Whitehead pointed out was below the bottom of the last coal.

I'd also like to present Exhibit WA- -- I believe it's called WA-4 in my little booklet here. This is the type log of the Schneider Gas Com B Number 1. I've got a little blow-up of that. I might try to put it on the wall here. This has been colored by Dr. Ayers to show the Fruitland Coals in green, the Pictured Cliffs formation in orange. It's a massive Pictured Cliffs sandstone.

And again, when this type log was used by the coalbed methane committee, they defined the extent of the coals in the stratigraphic equivalent to go from, I believe it's 2440 feet down to 2880. If you will look above the depth of 2880 feet, between the two coals here there is a very thin sandstone that is very comparable stratigraphically to the sandstone that Pendragon is trying to claim is an upper Pictured Cliffs sandstone. The coalbed methane committee recognized that that was a part of the Fruitland (Coal-Gas) formation and should be included as part of the Fruitland Coal Gas Pool.

Another conclusion that we reached in my written testimony is that the Whiting fracs stayed in the coals. We made a very diligent effort to stay away from the Pictured Cliffs formation. Very early on we discussed perforating the basal Fruitland Coal, that small, thin coal, below the sand that the Pendragon folks are calling the upper Pictured Cliffs sand.

And in fact, part of the reason for correcting my testimony is, I believed that we had made that decision after the first well was perforated, to stay away from that bottom coal, when in fact that decision was made before we perforated the first well. And so we did not perforate any of our wells in that basal coal, in an attempt to stay away from the Pictured Cliffs formation and make sure that our fractures did not penetrate into the Pictured Cliffs formation.

Maralex has done extensive testing, especially early on in the history of the company when we were first getting started in taking leases in the San Juan Basin specifically for development of the Fruitland Coals. We spent a lot of time analyzing Pictured Cliffs production in the areas that we knew we were going to be limited to. As a new company, we knew we had no chance of getting into areas that were high overpressured fairway types of coals, like the 30-and-6 unit that Meridian was successful in developing or the Northeast Blanco Unit that Devon operates.

So we've looked at the lower pressure areas of the Fruitland Coal formation and attempted to develop some techniques that would enable us to produce low-pressure Fruitland Coal gas reserves.

Some of the testing that we did included mini-fracs, it included cooperation with other operators such as Amoco where they actually installed downhole monitoring devices, pressure bombs, in their Pictured Cliffs wellbores, on the same pad, in some cases, offsetting the Fruitland wells that we were attempting to frac, and complete with the same types of stimulations that we employed in the Gallegos Federal area.

We also did some tracer surveys after frac, gamma-ray logs to determine the placement of the sand in those coals. We looked at temperature surveys also, to see where our frac propagated, if it stayed within the coals. And we found very consistently that our fracs stayed within the coals, at least near the wellbore.

Now, obviously, Dr. Conway's testimony that the frac could have dropped through the base of the coal 750 feet away from the wellbore is not going to be discovered on any kind of test that we can do within the confines of a small wellbore.

Another very important reason for our conclusion that the Whiting fracs stayed within the coals has to do with the production and pressure history on the Chaco wells.

As this exhibit shows, there was absolutely no impact on the Chaco wells after the frac'ing of our Gallegos Federal wells, even when those wells were located relatively close to the Chaco wells. There was no increase in pressure noted at the Chaco wells, there was no increase in production, there was no increase in water production nor gas production in those Chaco wells.

Another very interesting thing that we looked at is that none of the unstimulated Chaco wells in this area showed any kind of response to our fracture-stimulations.

There are a number of other wells.

If you'll look at Exhibit 2, AMO-2, there are a number of other Pictured Cliffs wells in these areas that are offset to our Fruitland Coal wells. For example, the Chaco 11, the Chaco Limited 3-J, the Chaco Limited 3. None of those wells showed any kind of response to our fracture-stimulations in the Fruitland Coals.

Another conclusion that our testimony presents is that the Pendragon stimulations caused communication. The reason we can say that is because there was an immediate pressure and production response in the Chaco wells after Pendragon stimulated those wells. There was also contemporaneous gas analysis that showed a dramatic change in the gas composition in the Chaco wells following not just the fracs but even the acid stimulations that were performed on the Chaco wells.

There was also a noted increase in water production from those Chaco wells. Though Pendragon made every effort to hide that fact from the regulatory agencies, there were a number of instances when their pumpers reported substantial volumes of water production, and those volumes of water production were all estimates based on field observations.

They did not have tanks, steel tanks or fiberglass tanks that the water was being produced into.

All of their water was being produced into unlined earthen pits with very high percolation rates, and so there was really only one way to test the rate of water going into those pits, and that is through what is called a bucket tests.

We don't know if their pumpers even performed the bucket test, or if they merely looked at the production coming from their separators and estimated a number, but they did report and record on their daily production reports, occasionally, water volumes, significant water volumes, on the order of 20 to 40 barrels of water a day.

The old PC wells and the ones that have not been restimulated have never produced those kinds of water volumes. Their volumes may have been, as Mr. Thompson testified, in the range of five to six barrels per day, but never on the order of 20 to 40 barrels of water per day.

Again, we talked earlier about the coalbed methane committee and the fact that even back then, in 1988, there was a recognition by the members of the committee and even the State regulatory bodies that a number of Pictured Cliffs wells that had been producing in the Basin for years had to have been producing from another formation, other than the Pictured Cliffs, to recover the kinds of volumes that were noted on those wells.

And this report doesn't go into it in any detail because another of our witnesses will address it, but you will see that the gas-analysis data, contrary to what Pendragon has stated, is very specific at identifying where the gas is coming from, whether it's Fruitland Coal gas or whether it's Pictured Cliffs gas.

All of those indicators taken together show that Pendragon stimulated or caused communications through their stimulation in their wellbores with the Fruitland Coal formation.

Lastly, we conclude in the written testimony that Pendragon intentionally caused the communication that we're talking about today. And that is a very contentious issue, but there is some very disturbing evidence that points to the fact that Pendragon has done everything they can to hide production, both from the Fruitland Coals, especially in the Lansdale well, and to hide water production from the regulatory agencies.

We also know that our wells were being monitored by Pendragon's operator in the field. As Mr. Thompson testified, he on a regular basis watched the production on our wells. We believe that monitoring led them to determine which wells they would aggressively frac and which wells they would only acidize.

Again, the location of the perfs in the upper PC, in a zone -- so-called upper PC -- in a zone that is not owned by Pendragon, in my opinion, leads us to believe that they had no intention ever of trying to squeeze off those perforations, that they needed those perforations in order to more effectively communicate with the Fruitland Coal formation.

Finally, there was an attempt in 1997, late 1997 and 1998, to compress our gas to the point, or our wells to the point where we could draw down the Fruitland Coal gas reservoir far enough to be able to determine whether or not there was communication between our wells, definite communication between our wells and the Chaco wells. And we will show you that the results of that compression which Pendragon recognized a month or two after we put our wells on production and then went out and put their wells on compression also will show that there was communication that everybody recognized at that time.

And in spite of that recognition, Pendragon came before the State and asked -- or applied for an application to show that both zones were -- both sets of wells were producing from the appropriate common source of supply.

That concludes my summary.

Q. (By Mr. Condon) Mr. O'Hare, let me first ask -- distribute copies of this, because it's a first logical follow-up to your testimony. I'll give you that one. I hand you what I've marked as Exhibit W-35 and ask you if you can identify that.

A. Yes, this is what is left of my 1993 or 1994 evaluation of the wells that were offered to us by Merrion Oil and Gas, and it does include the six Pendragon wells at issue.

Q. Okay. Are all of these wells that are listed on the first page, are they all Pictured Cliff wells?

A. I believe so. I -- At the time that this evaluation was done, I believe that all but a couple of them were Pictured Cliff wells. Merrion had made a couple of attempts to recomplete some of these wells to the Fruitland Coal formation prior to the sale of their rights to us of the Fruitland Coal formation, so there may have been a number of these wells that had already been recompleted to the coals.

Q. Okay, but the vast majority of the wells that are reflected on this first page were Pictured Cliff wells?

A. That is my recollection, yes.

Q. Or at least were Pictured Cliff wells at one point in time?

A. Right.

Q. And did you evaluate all of these wells in terms of performing your evaluation of the offer from Merrion and Bayless?

A. Yes, I did.

Q. All right. So the Chaco wells that are at issue in this litigation are not the only wells that were offered as part of the package?

A. That's correct.

MR. CONDON: Lest I forget, I'm not as good as some at remembering to do all of this at the end of the testimony, so I'll offer Exhibit W-35 at this time.

MR. HALL: No objection.

CHAIRMAN WROTENBERY: Okay, W-35 is admitted into the record.

Q. (By Mr. Condon) Now, Mr. O'Hare, you were here for Mr. Nicol's testimony; is that correct?

A. Yes, I was.

Q. All right. And I'd like to refer you specifically to the testimony about the Chaco Plant 5 well kind of being the poster well for the development program of the Chaco wells.

Had you ever heard that before last Thursday, in any of the prior proceedings in this matter?

A. No, I had not.

Q. Have you prepared some exhibits to discuss that Chaco Plant 5 well?

A. Yes, I have.

Q. All right. Let me hand you what we've marked as AMO-12 and ask if you can identify that.

A. Yes, this is a production -- a plot of the production history on the Chaco Plant Number 5 well that was provided to us by Pendragon prior to the 1998 hearing. And the second page is the same production history plot for the Chaco Plant Number 5 well that was provided as Exhibit 7-A, I believe, to Mr. Nicol's testimony.

Q. Okay. Was the first page included in Mr. Nicol's exhibit packet?

A. No, sir.

Q. All right. What is the significance of that first page, the plot on the first page of AMO-12? And explain for the Commission, if you would, how it relates to the information that's provided on the graph that was included in Mr. Nicol's packet.

A. Mr. Nicol had provided testimony that the Chaco Plant Number 5 well, in addition to being the poster well for the recompletion of the Chaco wells or restimulation of the Chaco wells, he indicated in his testimony that this well could not have been a coal well because it did not show the typical inclining production that most coal and methane wells exhibit in the San Juan Basin. And if you look at the second page of this exhibit, you would reach that same conclusion.

However, the production data provided by Mr. Nicol's company prior to the 1998 hearing directly contradicts that testimony.

Q. Okay, and is that -- Are you referring to the first page of that?

A. Yes.

Q. And what is it about that graph that leads you to a different conclusion than Mr. Nicol reached?

A. Well, there's close to two years' worth of inclining production, gas production, on this well. And if you look at the actual monthly numbers, the peak production rate on this well was not reached until November of 1996. So if you take production -- the initial production rate in July of 1993 through the peak production rate of November of 1996, you have nearly three full years of inclining production, which is very similar to what we saw on our Gallegos Federal wells.

Q. Okay, is inclining production a typical characteristic of a Pictured Cliff well?

A. No, sir, it's not a typical characteristic of any conventional well.

Q. Is there anything else that you want to say about AMO-12?

A. No.

MR. CONDON: Okay, I'll tender AMO-12 at this time.

MR. HALL: No objection.

CHAIRMAN WROTENBERY: Okay, AMO-12 is entered into the record.

Q. (By Mr. Condon) I'll hand you what I've marked as AMO-13 and ask you to take a look at that and ask if you can identify that.

A. This exhibit is a plot of the P/Z, or pressure-over-compressibility factor, versus cumulative production on the Chaco Plant Number 5 well. This is known as the material-balance method of calculating gas in place and/or reserves of a conventional sandstone reservoir.

Q. And at what point were you looking in terms of preparing this chart?

A. This data is limited to the pre-1993 restimulation of the Chaco Plant Number 5 well, so all the pressure data shown here is from, I believe, July -- I'm sorry, June of 1993 back to the initial completion of this Pictured Cliff well.

Q. Do you know when that was, approximately?

A. I believe it was 1977, but it could have been earlier.

Q. Have you reviewed the Chaco Plant file that's available, at least, the parts that were provided by Pendragon and what we have available through the Division records?

A. Yes, I have.

Q. All right. And what does that chart tell us?

A. This chart indicates that there is roughly 160 million cubic feet of gas in place in the Chaco Plant Number 5 well. As of the last date of production prior to the stimulation in 1993, the well had produced about 63 million cubic feet of gas, and it had been shut in for approximately five years prior to the restimulation in July of 1993.

Q. Have you plotted a production history for the Chaco Plant 5?

A. Yes, I have.

Q. Okay. Could you just tell the Commissioners -- Compare it with the production history on the Chaco 5 that's up there on that poster. How does the Chaco Plant 5 production history compare?

A. It looks very similar to that.

Q. And what is your opinion about where that well is producing from?

A. I feel that it is currently producing from the Fruitland Coal gas formation.

Q. Why is that?

A. Well, there's additional evidence from exhibits I've prepared that show, number one, the gas in place from the Pictured Cliff formation agrees fairly well with the material-balance calculations. This well has cum'd more than 320 million cubic feet of gas to date, so it's made nearly twice the gas in place calculated both from material balance and from volumetric calculations of the gas in place. So that gas cannot be coming from the Pictured Cliffs zone.

Now, Mr. Nicol along with several other witnesses for Pendragon made the argument that there are additional reserves in the lower part of the Pictured Cliffs formation. But if you look at Mr. Nicol's Exhibit -- I believe it was N-7 -- or it was an exhibit presented by Mr. Gallegos, showing the log characteristics.

Can we re-present that?

Q. Well, first, while I'm looking for that, let me ask you -- let me hand you what I've marked as AMO-14 and ask you if you can identify this exhibit that we've prepared.

A. This is an exhibit showing the shut-in casing pressure at various times in the history of the Chaco Plant Number 5 well. And you can see that the pressure had been declining at a fairly steep rate during the early life of the well.

And the final pressure that is noted on there was taken on June -- I believe it was 26th of 1993. It was recorded shut-in tubing and casing pressure of 102 p.s.i. Just a few days before that, on June 23rd, that pressure was recorded as 109 p.s.i.

The well was then frac'd, and after the frac pressures were noted at 150 p.s.i. Pendragon tried to characterize the after-frac pressures as being the average reservoir pressure in the Pictured Cliffs formation at the time of this frac and tried to also show that it was the formation pressure in the Pictured Cliffs prior to the Chaco Number 5 -- I'm sorry, the Chaco well fracs.

Q. Mr. O'Hare, let me hand you -- I believe everybody's previously received copies of this; this is the log that was characterized as N-7-1 -- and ask you if that's the log you're referring to.

A. Yes, it is. You can see that the Pictured Cliffs zones is colored in yellow here, and the green are the Fruitland Coals, approximately five feet above the top of the Pictured Cliffs perf, top perf in the Pictured Cliffs in this well.

If you take and you calculate, based on the parameters that Mr. McCartney presented, the water saturation and the volumetric amount of gas in place on this well, it comes out to about 155 million cubic feet of gas, from seven feet of pay.

If you go down into the lower bench of the PC, there is no indication of any kind of gas reserves in that lower part of the Pictured Cliffs.

Now, Pendragon might argue that there is no porosity log available for this well, and therefore you cannot calculate the water saturation or the gas content of that formation. So what we did was assume the highest porosity that they noted in their Pictured Cliffs wells in the area and used that number to calculate a water saturation. And it came out to about 80 percent.

Q. Mr. O'Hare, on your Exhibit AMO-13, why wouldn't you use the post-frac production to plot that curve?

A. Again, we believe, based on Exhibit AMO-14, that the post-frac production includes reservoir pressures from a formation other than the Pictured Cliffs, and the only formation that is in close proximity to the Pictured Cliffs formation in this well is the Fruitland Coal formation.

So if you use, as Mr. McCartney did and maybe one or two other of the Pendragon witnesses, the after-frac pressures here, you're not looking at Pictured Cliffs reserves; you're looking at reserves that are combined with some other formation.

MR. CONDON: At this point I would move the admission of AMO-13, -14 and N-7-1.

CHAIRMAN WROTENBERY: I would just like to first make clear, do we -- I don't remember getting N-7-1, but I may have just misplaced it. Lyn, do you have --

MR. CONDON: Well, I have --

MR. GALLEGOS: I handed it out during the cross-examination of Mr. Nicol, but --

CHAIRMAN WROTENBERY: Okay.

MR. GALLEGOS: -- these things --

CHAIRMAN WROTENBERY: You do have it? Okay, yeah, we've got a copy up here, so thanks. Great, thank you.

Any objection?

MR. HALL: No objection.

CHAIRMAN WROTENBERY: So we've got AMO-13 and -14 and N-7-1 that are admitted into the record.

Q. (By Mr. Condon) Okay. Then is there anything about the volumetrics on the Chaco Plant 5 that leads you to the conclusion that it's a coal well?

A. Again, the production since the frac in July of 1993, the cumulative production far exceeds the gas in place calculated from the volumetrics, as well as that calculated from the material balance on that well. And I thought we had an exhibit showing the volumetric calculations.

Q. Okay, yes, we do. I hand you what I've marked as AMO-17 and ask you if you can identify that.

A. Yes, these are the volumetric calculations for the Chaco Plant Number 5.

Q. And what do those show you?

A. These show that the recoverable gas is only 51,000,550 [*sic*] cubic feet of gas out of a gas-in-place total of 93,210,000. And I misquoted earlier the gas-in-place calculated from the volumetrics.

Now, these -- The assumptions are shown on the left-hand side of this exhibit, with 160 acres. The abandonment pressure is the pressure that was noted on June 23rd, prior to the frac work, of 109 p.s.i. The water saturation was calculated using Mr. McCartney's numbers, along with the 25-percent porosity.

Q. How is the Chaco Plant 5 set up? Is it a well that separately produces, or is it set up on a CDP?

A. As far as we can tell, it is currently producing through a CDP with the Cowsaround 21-1 well.

Q. And what kind of well is the Cowsaround 21-1?

A. That is a coalbed methane well.

Q. Who operates that?

A. Pendragon.

Q. Is there anything else that you want to say with respect to the Chaco Plant 5 well and the analysis of that well that was offered by Pendragon?

A. We have performed a field inspection of that well here very recently. One of my employees took some pictures of that, and those pictures will be introduced as evidence through another witness.

Q. And have you seen the pictures?
A. Yes, I have.
Q. All right. Let me just ask you if you can identify those as the pictures of Chaco Plant Number 5 -- or Chaco Plant 5 location.
A. Yes, the upper right-hand picture shows the well sign on the wellhead, and it very clearly shows that is the Chaco Plant Number 5 operated by Pendragon Energy Partners.
Q. Okay. Do those pictures show evidence of water in the pit?
A. Most definitely. In fact, in the picture on the bottom right you can see a stream of water going into the pit.
Q. Now, this well was restimulated when?
A. In July of 1993.
Q. All right, what -- Does the evidence of current water production from that well indicate anything to you?
A. We have seen no recorded evidence of water production, but obviously from these pictures the well does make water.
Q. Okay, when you say recorded evidence of water production, what are you referring to?
A. The State reports.
Q. Is that the C-115 reports?
A. Or the computer-generated reports off of ONGARD,

which I believe come from C-115 reports.

Q. Is there anything else, then, about the Chaco Plant 5 that you want to add?

A. Just the conclusion that this well is currently, and has been, producing from the Fruitland Coal Gas formation since July of 1993. There was a relatively small frac placed on this well, about a third -- half to a third of the size of the fracs that the Chaco wells -- that were employed on the Chaco wells. And in my view, that was too large to keep it from communicating with the Fruitland Coals.

MR. CONDON: Okay, I'd like to offer AMO-17 and N-7-A-3 at this time.

MR. HALL: No objection to AMO-17.

May I voir dire on N-7-A-3 briefly?

CHAIRMAN WROTENBERY: Yes.

VOIR DIRE EXAMINATION

BY MR. HALL:

Q. Mr. O'Hare, did you take these pictures?

A. No, sir.

Q. Do you know when they were taken?

A. Yes, sir.

Q. When?

A. Last Friday.

Q. Bottom right-hand corner, it shows water coming from the pipe. Would you say that's a stream or a trickle?

A. Define stream or trickle.

Q. That's what I'm asking you to do.

A. My personal definition would call that a stream, a steady stream of water.

MR. HALL: No objection.

CHAIRMAN WROTENBERY: Okay, AMO-17 and N-7-A-3 are admitted into the record.

DIRECT EXAMINATION (Resumed)

BY MR. CONDON:

Q. Next, Mr. O'Hare, I'd like to turn to the Lansdale Federal well, which has come up during Pendragon's case, and I believe there was testimony that was given that you cannot expect commercial production from a coal well without a frac or artificial lift. Do you recall that testimony?

A. Yes, I do.

Q. Okay. Have you reviewed the well file for the Lansdale Federal Number 1 well?

A. Yes, I have.

Q. Okay. Is there anything about the well history in that case that leads you to believe that you can get commercial production from coal without a frac?

A. Yes, there is quite a bit of information in that well that would lead to that conclusion.

Q. Okay, and what is that?

A. In December of 1994, that well was perforated intentionally in the coals, and it was acidized with 500 gallons of 7.5-percent HCl acid, which incidentally is the same amount of acid that was used on the Chaco restimulations.

Subsequent to that acid work, that well was eventually put on production and reached rates of as high as 300 MCF of gas a day, and produced for an extensive period of time. I believe it produced well over 100 million cubic feet of gas over about a two-year period before those perforations were squeezed off.

Q. Okay, and does the performance of that well with the acid job at the perfs and the coal indicate that you could get commercial quantities of gas from the coal without a fracture job?

A. Most definitely. 300 MCF a day, especially at today's prices, is very economical production.

Q. All right. Now, did you see any evidence in your review of the Lansdale Federal Number 1 well file that the well was on artificial lift?

A. I did not.

Q. Okay. Do you know for a fact one way or another whether it was or was not?

A. I do not.

Q. And would you just point out for the Commission exactly where the Lansdale Federal well is?

A. It's located in the southeast quarter of Section 7, 26 North, Range 12 West, directly east of the Chaco 2-R and the Gallegos Federal 7 well.

CHAIRMAN WROTENBERY: Would you also point out the Chaco Plant Number 5?

THE WITNESS: The Chaco Plant Number 5 is actually located just off the edge of this map in the northwest quarter of Section 21, Township 26 North, Range 12 West.

Q. (By Mr. Condon) And now, you have reviewed the well file and also the filings with the BLM on the Lansdale Federal Number 1 well?

A. Yes, I have.

Q. Okay. And when do you understand the perfs in the coal were closed off?

A. A week before the Division hearing in July of 1998.

Q. All right. And what was the effect on production from the Lansdale Federal Number 1 well of shutting off the perfs in the coal?

A. It was a very dramatic effect. Production went from more than 100 MCF of gas a day to zero, even after the Pictured Cliffs perforations that were remaining were acidized with 250 gallons of 15-percent HCl acid.

Q. Okay. When were the Pictured Cliffs acidized?

A. My understanding is, right after the squeezing of the Fruitland Coal perfs.

Q. Now, I've handed you what I've marked as Exhibit W-28-A and ask you if you can identify that.

A. This is a production history of the Lansdale Federal Number 1 after the acid stimulation and perforating work in December of 1994.

Q. And that includes the period when the perfs to the Pictured Cliff formation were open?

A. Yes, it does.

Q. Okay, and what does that show you? What does that tell you about the performance of that well?

A. It shows that the peak production on that well was somewhere around 9000 MCF for the month, or 300 MCF per day, and that after the squeeze work was done in mid-1998, the production went to zero.

Q. Okay. Let me hand you what I've marked as Exhibit W-9-A and ask you if you can identify this packet of documents.

A. These are the sundry notices that were submitted to the BLM regarding the work that was performed on the Lansdale Federal well, along with some plats and an application for commingling of that well.

I guess in general this exhibit shows regulatory filings for that well.

Q. And are these the kind of documents that would have been available for an operator in the area such as yourself to go take a look at the public record documents to determine where this well was producing from?

A. Yes, they are.

Q. Now let me hand you what we have previously marked as Exhibit W-9, which is the Lansdale Federal well file that was provided to us by Pendragon before the Division proceeding. I'll ask you if you can identify that.

A. Yes, this is the well information provided by Pendragon prior to the 1998 hearing.

Q. Now, there is a -- Are there workover and completion reports in this file?

A. Yes, there are, daily reports.

Q. I'd like to call your attention real briefly to the workover and completion reports for December 19 and 20, 1994, which I believe are about -- what? Four or five pages into the exhibit?

A. Yes.

Q. Okay. Does this indicate that Pendragon indeed did perforate the Fruitland Coal and acidize it in December of 1994?

A. It shows that work was done on December 20th, 1994.

Q. Would an operator acidize a well like the Lansdale Federal Number 1 well in the PC perfs in order to remedy damage in the PC?

A. It would depend on the type of damage. If it was caused by scale, that would be a remedy for that type of damage. Again, it wouldn't be -- Generally, scale does not occur out in the formation; it is at the wellbore or at the perforations themselves.

MR. CONDON: At this point I'd move the admission of W-9-A and W-9.

MR. HALL: This is W-9-A? Mine was not marked. Is that correct?

MR. CONDON: It should be down at the bottom, at the very bottom.

MR. HALL: I'm sorry, thank you.

No objection.

CHAIRMAN WROTENBERY: W-9 and W-9-A are admitted into the record.

And I apologize for this already, but did we do W-28-A? I still have that one.

MR. CONDON: Let's do it right now. I'll move the admission of W-28-A.

MR. HALL: No objection to that.

CHAIRMAN WROTENBERY: Okay, it's admitted into the record too.

MR. HALL: May I briefly voir dire on W-9, correct the record on something?

CHAIRMAN WROTENBERY: Okay.

VOIR DIRE EXAMINATION

BY MR. HALL:

Q. Mr. O'Hare, you indicated that the Exhibit W-9 showed completion reports for the Lansdale Federal that were filed by Pendragon. Isn't it correct that the filing was by J.K. Edwards Associates, Inc.? W-9.

A. There was no filing of these records in any of the regulatory agencies. I'm sorry, is there --

Q. Let's look at...

A. You're not talking about the workover and completion report?

Q. The sixth page is the C-104. Do you see that in front of you?

A. Yes.

Q. It shows filed September 29th, 1995, at the OCD, filed by Edwards, correct?

A. That is correct.

Q. I thought I heard you indicate it was filed by Pendragon.

A. I apologize if I made that statement.

Q. You agree it's filed by Edwards?

A. Yes.

MR. HALL: That's all.

CHAIRMAN WROTENBERY: Thank you.

DIRECT EXAMINATION (Resumed)

BY MR. CONDON:

Q. In 1995, would you describe for the Commission -- and I'm talking about the period, you know, January through May of 1995, when the work was performed by Pendragon on the Chaco wells -- what was the status of the production from the Gallegos Federal wells that are at issue in the Application?

A. I don't have the specific rates in front of me, but generally speaking the Gallegos Federal 6-2 well, Gallegos Federal 12-1 well and the Gallegos Federal 7-1 well were in a fairly advanced state of dewatering. And by that I mean that there was a very steady and significant incline on the gas production and a steady and significant decline on the water production. We cannot say that they were dewatered at that point, but they were well along on the dewatering curve.

On the other side, in Section 1 of Township 26 North, Range 13 West, the 1 Number 1 well and the Gallegos Federal 1 Number 2 well were both still in the very early stages of dewatering. Both of those wells were still making very significant amounts of water, and their inclining gas rates were still fairly low.

Q. Did you experience any kind of a production glitch or a problem that you identified in 1995 with your Gallegos Federal wells?

A. Yes, sometime in 1995, we felt that the production of our wells was no longer inclining and that there had to be some kind of field problems we were experiencing, and so we started making a diligent effort to find those problems and to correct them.

And some of the things we did were to change out what had been tubing pumps to insert rod pumps. We thought that perhaps we were pulling too much water, pulling the water level down so far that we could not keep the wells from gas-locking. So we installed smaller pumps to handle the smaller volumes of water.

We also looked at reducing the back pressure on the individual wells to maintain the lowest back pressure on the coals and enable us to get as far down on the desorption curve as we could, to maximize the desorption of gas and the inclining gas rate.

Unfortunately, none of the work that we performed seemed to have any kind of, at least long-lasting, benefits for us.

Q. All right. What did you do at that point in terms of investigating causes?

A. Just what I currently stated. We focused on our wells and all of the operational things that could be done to minimize back pressure and maximize the desorption of gas from the coals.

Q. At what point did you begin to focus on the Chaco wells?

A. We didn't start focusing on the Chaco wells until late 1996. In the summer of 1996 we began a small drilling program offsetting our Gallegos Federal project that we called the Gallegos Federal 2 project. And during the drilling of those wells, we noticed some rig activity very close to our Gallegos Federal 6 Number 2 and 7 Number 1 wells. And it wasn't until that point that we began an investigation into the offset PC and other wells being drilled in the area.

Q. Did you know that the work on the Chaco wells that are at issue in this Application was being done at the time it was done?

A. No, we did not. Or I did not anyway.

Q. All right. Let me hand you -- it's already come in, but I've got copies here for everybody -- Exhibit C-48 [*sic*]. Have you looked at that?

A. Yes, I have.

Q. All right.

Q. Have you heard the testimony that's been offered by Pendragon in this case that the production from the Chaco wells doesn't look like coal well production?

A. Yes, I have.

Q. All right. Is there something about this exhibit that you believe refutes that contention?

A. In a roundabout way, yes.

Q. Okay, could you explain that?

A. I think this is a very good exhibit to show exactly what time frame we were looking at as to what we just discussed was happening to the Gallegos Federal wells. You can see at the beginning of 1995, our production was on a very pronounced incline.

Q. Okay, just for the record, the coalbed wells are designated as what on this chart?

A. Little green dots.

Q. Okay.

A. And the PC wells are shown in red.

Q. Okay.

A. The Chaco wells, I should say, are shown in red.

Q. All right.

A. And you can see that in the early part of 1995, perhaps March, there is a breakover in the production, the gas production rate, of the Gallegos Federal wells. And the total gas production continues to incline at a rate that is slightly steeper than what we had exhibited on the Gallegos Federal wells.

That is to be expected when you have extra wells pulling from a Fruitland Coal formation. The rate of incline will increase dramatically because what you've effectively done is reduced the spacing. And so you have a more effective dewatering, desorption mechanism in place to get more of the gas in a shorter amount of time out of the reservoir.

Q. Just for the record, for the period in early 1995 there, was that production decline that you were experiencing in the Gallegos Federal wells -- had you anticipated that based upon your projections of production for those wells?

A. No, sir, we had expected at that point in time for our production to continue to increase at least to the point in time when our water production broke over from the steep decline to a relatively flat decline.

Q. And had that happened as of that point in time?

A. It had not.

Q. Okay. And so what do you conclude from looking at that graph and the production incline that you would get if you combined the production from the three coal wells and the Chaco wells?

A. Well, I conclude that we were very effectively removing coalbed methane gas between a total of nine wells on this plot, instead of the three wells that had been producing only from the Fruitland Coals up until January or February of 1995.

There's two other pieces of information on this graph I'd like to call the Commissioners' attention to, and one of those starts in January of 1998. We put our Gallegos Federal 7 Number 1 well on compression in mid- to late November of 1997, and coincidentally there was a rather steep decline in the Chaco well production corresponding to that installation of compression.

We installed additional compressors in January and February of 1998, and our production from the three coalbed methane wells responded very well, as would be expected. When you're pulling down the reservoir pressure in the Fruitland well, you are enabling additional gas to be liberated from the coals and desorbed, travel to the wellbore and be produced.

The other point I wanted to make -- Actually, there's two other points. One is, when the Chaco wells were shut in by order of the Court in late June of 1998, there was an immediate and very noticeable increase in production from the Gallegos Federal wells. Again, this would be expected if production that had been previously produced from the Chaco wells was now coming solely from our wells.

The third and final point I wanted to make is that the last four points on this curve indicate a very marked and steep decline in production from the Gallegos Federal wells. The coal gas wells in this area are on decline, and we expect to see very short remaining lives on those wells because of that steep decline.

Q. Now, Mr. O'Hare, you've heard the charge Pendragon has made in this proceeding that Whiting is producing Pictured Cliff gas through its coal wells. What is your response to that charge?

A. There is very little likelihood, in my opinion, that we are producing Pictured Cliffs gas, for a number of reasons.

To begin with, there is not much Pictured Cliffs gas in the area to be produced from any wells.

Number two, our gas analysis on our wells shows very consistent low-BTU gas over the lives of our wells. There may be an occasional blip on a well, but for the most part our BTU contents are in the 1000-to-1030 range.

In addition, there is very significant -- Contrary to Pendragon's testimony, there is very significant gas in place in the Fruitland Coal. In fact, there is more than enough gas in place to be -- to produce from our five wells, especially when you take into account the current decline rate of those wells. And the fact that the gas content that has been used by all the Pendragon witnesses was provided by me as a minimum value of gas content in the coals at the 1998 hearing, if you consider that the maximum value would probably be in the range of 130 to 140 standard cubic feet per ton, you see that we will be recovering somewhere on the order of 70 percent of the gas in place in the Fruitland Coals.

Q. Now, as your -- Is your conclusion also supported by your investigation of the timing correlation between when the Gallegos Federal wells were fracture-stimulated, when the Chaco wells were fracture-stimulated, and which wells showed response to those respective fracture-stimulations?

A. Yes, it is.

Q. All right. Let me hand you what I've marked as AMO-11 and ask you if you can identify that. Now, please check that, because I found a typo in the third box down, and I want to make sure that it now reads correctly.

A. This is a table that just shows the dates of the various fracture-stimulations in the Gallegos Federal wells, the distance from those wells to the offsetting Chaco wells, and the response that we noted at the Chaco wells. It also shows the stimulations, the date of the stimulations in the Chaco Wells Number 1, 2-R, 4 and 5, the distance to the closest Gallegos Federal well or wells, and the result of the stimulation on those wells.

Q. Why is this kind of analysis important as opposed to -- to you, as opposed to looking at something like fracture simulations?

A. Well, as Dr. Lee pointed out, fracture simulations are a tool that can be used for helping us to design fracs. They have very strong limitations from the standpoint that they will not give you a unique answer if you're trying to model what happened in a formation because there are too many variables that can be tweaked, so they're not a definitive answer to what has gone on.

What we're looking at here are facts. This is what we noted when the fracture-stimulations were performed on the Gallegos Federal wells, and what we noted when the fracture-stimulations were performed on the Chaco wells.

Q. Okay. There in the far right-hand column, when you get down to the last -- the bottom half of that chart, on the Chaco wells, it's indicating water production on those wells, at least as to the 1, the 4 and the 5, at or about the time of the fracture-stimulations. Does that have any significance to you?

A. We believe it does. Some of these water production numbers were as much as two months after the fracture-stimulations were performed on the Chaco wells. I believe one of the Pendragon witnesses alluded to the fact that they couldn't be coal wells, because there was not significant water production. Another one may have tried to allude to the fact that they were recovering load water.

But these water volumes are much greater than the load volume would have been if those volumes were produced for two months. Generally speaking, the load volumes on the Chaco well restimulations were on the order of 100 to 150 barrels of water. Well, if you produce 40 barrels of water a day for two months, you've produced a whole lot more than 100 barrels of water or 150 barrels of number.

So we believe these numbers indicate there was very significant water production coming from the Chaco wells after the stimulations on those wells, contrary to the testimony provided by Pendragon.

Q. Okay. Did you see any evidence on any of the C-115s or the other production reports that you looked at, that Pendragon had reported even the water production that their own records show?

A. On one or two occasions after the February, 1998, inspection by the New Mexico Oil Conservation Division's Aztec office, yes. Before that --

Q. What about the period 1995, for instance, for the Chaco 1, 4 and 5 wells?

A. Not that I recall.

Q. Okay. Would you explain to the Commission why it is the Chaco 2-R shows a response not at the time that it was fracture-stimulated in 1995 but in mid-1996?

A. Again, the reports that we have are fairly sketchy, but generally they address the problem of unloading water from the Chaco 2-R. That well evidently did not have enough gas production to lift the water, and so it was logged off, and they were unable to produce it for many months after the fracture-stimulation in January of 1995.

When they finally put it on compression, then it was able to lift the water, and they saw significant increases in the gas. They also reported significant water production on that well, as late as September of 1996.

Q. Okay. Would that be consistent with Pictured Cliff production at that point in time --

A. No, sir.

Q. -- in the life of that well?

A. No, sir.

Q. Okay. Would any of the water-production reports that you've seen, sporadic though they may be, be consistent with Pictured Cliff production?

A. No, sir.

Q. Okay, why not?

A. Generally, Pictured Cliff production, as I testified earlier, water production will be, at most, five or six barrels of water a day. Generally speaking, these were fairly dry gas reservoirs with decent permeability that never produced, never had a history of producing significant water volumes.

Q. Does the presence of 1-1/4-inch tubing in these wells bear on the ability to lift the water?

A. Yes, sir. The smaller the internal diameter of the tubing, the less gas is required to lift water from the well.

Q. All right. Now, I believe you've prepared another exhibit in addressing this contention that Whiting is producing Pictured Cliffs gas through its coal wells, and if you could identify what I've marked as AMO-15?

A. I believe this is a mimic of the Exhibit N-15 that was presented by Mr. Nicol in his testimony. The only difference is, Mr. Nicol started this curve from January 1st of 1998 and brought it forward. We went back another six months to show the effect of the installation of the compressor on the 7 Number 1 well.

And I believe Mr. Nicol testified there was little or no impact of the installation of the 7-1 compressor on either the Chaco Number 4 or Chaco Number 5 production history. But we believe this curve shows a significant impact on the installation of compression on the 7 Number 1 well.

It also shows that when the 6 Number 2 well compressor was installed, that there was an additional impact on production from both the Chaco 4 and the Chaco 5 wells, and also an impact when the Gallegos Federal 12-1 compressor was installed.

You can see that either one or both of the production curves -- these are daily production numbers from the Chaco wells -- showed either an immediate drop in production or a change in the slope of the production. And it was more dramatic on the Chaco Number 4. In fact, it was so dramatic that that well nearly ceased production before they installed a compressor on it in April of 1998. And immediately after compression was installed on that well, production came back up to a level of about 250 MCF per day.

Again, that is an indication that that well is producing Fruitland Coal gas. If the well had been put on compression on a conventional gas reservoir, generally what you see is that production following the installation of compression jumps up to a certain point and then follows a steeper decline in production than what it exhibited prior to the installation of the compressor.

This doesn't show that. The Chaco Number 4 actually gained production for a number of weeks, or a number of days, anyway, after the installation of the compressor.

MR. CONDON: Okay. Let me just offer at this point, before I forget it, AMO-11 and AMO-15.

MR. HALL: No objection.

CHAIRMAN WROTENBERY: AMO-11 and -15 are admitted into the record.

Q. (By Mr. Condon) Now, we have presented through Mr. Brown's testimony a number of these gas production histories for the --

CHAIRMAN WROTENBERY: Mr. Condon --

MR. CONDON: Yes, ma'am?

CHAIRMAN WROTENBERY: -- how much longer do you have? I'm trying to figure out whether to break for dinner now or --

MR. CONDON: I think probably about 20 minutes.

CHAIRMAN WROTENBERY: Twenty minutes. And then, Mr. Hall, do you have any estimate on your cross-examination?

MR. HALL: Certainly in excess of an hour.

CHAIRMAN WROTENBERY: Okay.

MR. CONDON: Maybe we ought to just go ahead and break.

CHAIRMAN WROTENBERY: I think we should break for dinner now.

MR. CONDON: Sure.

CHAIRMAN WROTENBERY: And then what do we need for dinner, how long? Come back at --

MR. CONDON: What time is it now?

CHAIRMAN WROTENBERY: -- eight o'clock? Goes fast, doesn't it?

MR. GALLEGOS: It's quarter till seven.

CHAIRMAN WROTENBERY: Quarter till seven?

MR. GALLEGOS: Come back at eight?

CHAIRMAN WROTENBERY: Come back at eight o'clock? Okay, and then we'll finish Mr. O'Hare's testimony and cross-examination before we finish and quit for the day.

(Thereupon, a recess was taken at 6:45 p.m.)

(The following proceedings had at 8:04 p.m.)

CHAIRMAN WROTENBERY: Ready when you are.

MR. CONDON: All right.

Q. (By Mr. Condon) Mr. O'Hare, we were talking when we broke about the bases for your opinion that your coal seam wells did not communicate with the Pictured Cliffs formation, that you were not producing Pictured Cliffs gas through those wells, and you talked about the timing of the fracs and response and nonresponse to the Gallegos Federal fracs, and the production response of the Chaco wells.

Now, you've already mentioned the gas analyses from your Gallegos Federal wells, and I believe you said that they have remained fairly consistent throughout the course of production; is that correct?

A. That is correct.

Q. If you had communicated with the Pictured Cliffs and were producing Pictured Cliff gas through your wells, would you expect a change in the gas analysis?

A. Yes, we would expect to see a higher BTU content in our gas than what we have seen.

Q. Now, did you also consider the pressure data that we had on the Chaco wells in reaching your conclusion?

A. Yes, I did.

Q. And we've got a couple of exhibits. First let me hand you what I've marked as W-7-A and ask if you can identify that.

A. This is a well deliverability test report for the Chaco Number 4 in 1983, along with workover and completion report information in January and February of 1995.

Q. And let me -- I'm going to hand-mark this, because I thought we had it in already, but I do not believe that we do. It's -- I'm marking it AMO-23. Let me ask you if you can identify that.

A. This is the Walsh Engineering workover and completion report that's included as page 2 under Exhibit W-7-A.

Q. Okay, what is the significance of those two documents as they relate to your observations of pressures in the Chaco wells?

A. Well, the 1983 well deliverability test report shows a shut-in casing pressure in 1983 of 97 p.s.i. for the Chaco 4, and that is generally taken after a seven-day shut-in.

The January 30th, 1995, workover and completion report shows a shut-in casing pressure of 119 pounds, or a 22-p.s.i. difference, in about a twelve-year period.

Q. Okay. What does that tell you about the condition of the well at that point in time?

A. I would venture to say that in 1983 the 97-p.s.i. pressure may not have been the representative pressure of the Pictured Cliffs formation. But I would think the 119 pounds twelve years later, before any simulation work was performed, would be more representative of that formation pressure.

Q. Okay. We heard testimony from one of Pendragon's witnesses that there may have been water in the well that might explain the 119-pound pressure. Let me ask you, is water in a well something that an operator would normally note on a workover and completion report if it was out there?

A. Not always, but occasionally, yes.

Q. Okay. Do you see any indication in this report that there was water in the well or that the operator had any reason to doubt that 119-pound shut-in casing pressure?

A. No, not before the acid job was pumped.

Q. Now, there's been an explanation offered about the production and pressure history of these Chaco wells that there was damage to the wells or the reservoir that explains the pressures. Would you address that, please?

A. Yes, as far as damage goes, I feel from the volumetric analysis that we performed on both the Chaco Plant Number 5 and on the Chaco Number 4 that there may have been some small component of damage. And the reason I say that is because typically these types of formations will recover somewhere between 60 and 70 percent of the gas in place.

The numbers that we saw, that we calculated from our volumetric and material balance analyses, indicated that those wells had recovered about 55 percent of the gas in place.

So there may have been a small component of damage in the Chaco wells prior to this stimulation, but I don't believe it was significant enough to triple the reserve recovery on these wells after it had been removed.

Q. Okay, why not?

A. Again, the gas in place indicates that there was not enough gas there initially to be able to recover the volumes that the Chaco wells have recovered, and so even if you remove all the damage in the world, it does not add reserves to your well, to your reservoir.

Q. The production histories that we've previously brought out for the Chaco wells, up to 1995 are those graphs indicative of typical Pictured Cliff wells?

A. Yes, they are.

Q. Okay. What about the graphs after Pendragon fracs those wells?

A. Generally speaking, those are not indicative of Pictured Cliffs well production.

Q. Now, we also heard evidence in Pendragon's case that you were producing more coal gas from your wells than there was gas in place for those wells to produce, and I'd like for you to address that claim if you would. And I believe we've got at least one exhibit on that.

Before I forget, I would like to tender AMO-23 and W-7-A.

CHAIRMAN WROTENBERY: Mr. Hall, do you have any objection to the introduction of AMO-23 or W-7-A?

MR. HALL: Not to -7-A. This is -23; is that correct? Mine's not marked.

CHAIRMAN WROTENBERY: Yes.

MR. CONDON: Yes.

MR. HALL: No objection.

CHAIRMAN WROTENBERY: So those two exhibits are admitted into the record.

Q. (By Mr. Condon) All right, Mr. O'Hare, can you identify what we've marked as Exhibit AMO-16?

A. Before we go to AMO-16, could I direct the Commissioners to Exhibit M-1?

Q. Sure, absolutely. That is McCartney's M-1. I'm sorry, I don't have extra copies of it. It was in Mr. McCartney's material.

What is it about that exhibit that you'd like to point out?

A. This is a basically reconstructed isotherm trying to honor the 110-standard-cubic-feet-per-ton minimum-gas-content value that we provided before last year's hearing that Mr. McCartney presented, and he used a 40 p.s.i.a. abandonment pressure for his calculation of the original gas in place that would be produced by a coal well honoring this isotherm curve.

However, Mr. Cox presented data that basically indicated that the abandonment pressure, or actually the current flowing bottomhole pressure, in our Fruitland Coal wells was more like 5 p.s.i.a.

So I'd like to direct the Commissioners to look at a pressure of 5 p.s.i.a. and see what kind of recovery factor that would give us, using Mr. McCartney's isotherm curve.

The 5 p.s.i.a. basically shows that we will be recovering somewhere on the order of 90-plus percent of the gas available. In other words, the difference between 110 standard cubic feet per ton and the resulting standard cubic feet per ton number, if you go up from the bottom of the chart at 5 p.s.i.a. to the red line and then over to the left, it would be less than probably six or seven standard cubic feet per ton. So that difference, 110 minus six or seven, is actually quite a bit more than 90 percent of the gas in place.

Now, that assumes that we are able to draw down the reservoir pressure to 5 p.s.i. with our compressors. Our engineering manager tells us that -- tells me that our compressors are designed to pull a vacuum on our wells and discharge at the current El Paso line pressure.

So that's probably not an unreasonable assumption, that we will be able to recover more than 90 percent of the gas in place, provided that the 110-standard-cubic-feet-per-ton number is a correct number.

Q. Well, is that -- is the 110 cubic feet per ton -- is that a conservative or a liberal measure?

A. I feel personally that that is a very conservative number. When I estimated that number I said it was a minimum gas content of these coals. I believe the actual number is going to be closer to 130 to 140 standard cubic feet per ton.

Q. And what is that based on?

A. Well, it's based on -- especially some recent literature by the GRI, even a book put out by GRI, Matt Maver and Mr. Nelson, that indicates all of the gas-content measurements that have been provided on San Juan Basin, Black Warrior Basin, the various coals around the country have been dramatically underestimated. And they actually provide examples in the Black Warrior Basin where a field of 23 wells had an estimated gas content that was -- where the recovery factor was in excess of 200 percent of the original calculated gas in place based on that gas-content number.

So we think it's been a very consistent, at least nationwide, phenomenon that the gas content of the various coals has been underestimated.

Q. Okay, and then what is AMO-16?

A. AMO-16 gives three different cases showing our calculated gas in place. The first case assumes 110 standard cubic feet per ton, and under that bar graph I show a maximum gas in place and a most likely gas in place.

The maximum gas in place was determined using the assumption that our fracture stimulations, if Pendragon can assume that they frac'd down, I thought we could assume that they frac'd up, communicated with all of the coals, the Fruitland Coals, available in the wellbore, not just the ones that -- the main one that we had perforated. And if you use the entire coal thickness in each wellbore, under the 110-standard-cubic-feet-per-ton category you would have 12.2 billion cubic feet of gas in place.

I'd like to refer the Commissioners to AMO Exhibit 2 again, and I'll just hold that up for your convenience. Basically, those gas-in-place numbers encompass everything outlined, along with an additional 160 acres around the Chaco Number 1 well. And the reason I included that gas-in-place value is because in the ultimate Fruitland Coal production recovery numbers shown there, the 7.6 billion cubic feet of gas, I included the billion cubic feet of gas that has been recovered from the Chaco wells in that number. Okay?

And if you take and divide that 7.66 BCF of gas ultimate recovery from our Gallegos Federal wells, inclusive of the Chaco well, post-1995-stimulation production, the recovery factor amounts to 94 percent.

The ultimate Fruitland Coal production recovery is based on the actual decline rates that we are currently observing on our Gallegos Federal 7 Number 1, 6 Number 2 and 12 Number 1 wells, and those decline rates vary from about 25 percent up to 55 percent for those three wells.

Q. Okay. Not 20 percent?

A. Not 20 percent, substantially more on average than the 20 percent quoted by the Pendragon presentation.

If you move over to the right, I give two other cases, one at 130 standard cubic feet per ton. And you can see that our estimated ultimate recovery number does not change, but the percent of the gas in place changes. It drops down to 80 percent. And again, that is on the most likely gas in place. It's about 50 percent of the maximum gas in place.

Mr. Cox included a number in his report that showed on average the maximum gas content determined from the Lansdale Federal 4 work would be 166 standard cubic feet per ton, and so I used that as the outside range. And again, on the most likely case that results in a recovery factor of 62 percent of the gas in place.

So that basically shows that there is more than sufficient gas available in the Fruitland Coals, in the area that we're discussing, to account for all the gas that has been produced both by our Gallegos Federal wells and the Chaco wells, plus the remaining gas to be produced from our Gallegos Federal wells.

Q. Now, we've talked about water production from the Chaco wells. Do you believe that the evidence that we have on water production from the Chaco wells indicates that those Chaco wells communicated with the coal formation when they were frac'd?

A. Yes, I do.

Q. All right, and why is that?

A. Again, the typical PC well in this area generally did not produce more than five or six barrels of water per day during its entire life, and for the water production that we have noted here to be coming from the PC is not very likely.

Q. What did you personally observe regarding water production from the Chaco wells, and when did you observe it?

A. In late 1996, after we started our investigation of the Chaco wells, I made a visit to the wells in the field and actually went around to each of the Chaco wells and noted that there was water standing in the pits. The Chaco 2-R especially stands out in my memory. That well at that time had a compressor on it, the compressor was running while I was there, and that well was making a lot of water. The earthen pit was completely full, and the well was dumping continuously into that pit.

Q. Okay. And just so the Commission realizes, are there some pictures of the Chaco wells as exhibits to your testimony?

A. Yes, those are Exhibits AMO-8.

Q. And is there anything aside pictures themselves that you want to add about them?

A. The pictures were taken prior to the 1998 hearing, and at that time there had already been a field inspection by the NMOCD. The wells -- or the pits, had been drained and the water hauled off to disposal facilities by Pendragon or their contract water-hauler. And so at the time the pictures were taken, obviously, there was no water in the pits. But there was definite evidence, water lines around the pits, showing that at one time they had held substantial amounts of water.

MR. CONDON: Before I forget, I'd like to move the admission of AMO-16.

CHAIRMAN WROTENBERY: Any objection?

MR. HALL: I'm sorry, what was --

MR. CONDON: AMO-16.

MR. HALL: No objection.

CHAIRMAN WROTENBERY: It's admitted.

Q. (By Mr. Condon) Mr. O'Hare, next I'm going to hand you two exhibits -- the first I've marked AMO-18 and the second is AMO-19 -- and ask if you could take a look at these and identify them for us if you can, please.

A. AMO Exhibits 18 and 19 are the Chaco 1 production, daily production, history and the Chaco 2-R daily production history, from January, 1995, on the Chaco

2-R, through January -- or, I'm sorry, through the time the wells were shut in, in 1998, and from July of 1997 on the Chaco Number 1 through the shut-in date on that well.

Q. Do these exhibits indicate that the Chaco wells, these two Chaco wells, are responding to compression?

A. Yes, they do. The Chaco Number 1, Exhibit AMO-18, had a compressor installed on it in March of 1998. Prior to that time for several months, there was very erratic production. It looked like the well was loading up and being unloaded occasionally. Production would come up to a peak and decline fairly rapidly as the wellbore evidently loaded up again.

And then after the compressor was put on the well, there was an inclining production rate of roughly 50 MCF per day over a period of about a month's time, and then a fairly stabilized production rate for some period after that until the wells were shut in.

Q. Okay. And what is the significance of the fact that the Chaco wells were responding to compression?

A. Again, if they are connected to the Fruitland Coals, the lower the producing bottomhole pressure, the more gas that can be desorbed from the coals and used to help lift the water that is typically produced by the coals to keep the wells on production.

Q. Is there anything else you want to add about

AMO-18 or -19?

A. AMO-19 also shows some water production. Those are the black square boxes shown on that graph. Again, it was spottily reported. There were not continuous reports either from the field or from regulatory reports, but we did indicate water rates as high as 45 barrels per day on that well during 1996.

Q. Okay. Prior to April of 1998, from your observations of the Chaco well files, did their daily reports even include a column for reporting water production?

A. No, they did not. It was usually just noted in the comment section of the daily report.

Q. Do the daily reports currently have a column for reporting water production?

A. Yes, they do now.

Q. Okay. There's been testimony from Pendragon witnesses that the recognition that Pendragon has come to at this stage of the proceeding that there is communication was the result of the availability of shut-in pressure data and the availability of data showing the response of the Chaco wells to when you put your Gallegos Federal coal wells on compression in late 1997 and early 1998. Did you have data prior to the 1998 Division hearing on the effect on the Chaco wells of putting your wells on compression?

A. Yes, the daily production was available starting in November of 1997, showing the effect that our compression on the 7-1 had on the offsetting Chaco well production. And of course the compressors that were set in early 1998 also had production data available to both Pendragon and Whiting and Maralex months before the 1998 hearing.

In addition, the Court-ordered shut-in on June 30th of 1998 was nearly a month prior to the hearing in front of the Examiner, and --

Q. What kind of arrangements were made between Whiting and Pendragon to monitor the pressures of the wells after the shut-in order was entered by the District Court?

A. By the end of the first week in July we had agreed to have both field pumpers going around on a daily basis, concurrently checking well pressures on both the Chaco wells and the Gallegos Federal wells. So I believe from the 7th of July to the present, basically, with the exception of the weekends, there is a daily pressure that is monitored by both -- representatives of both companies.

MR. CONDON: I'm sorry, now I've forgotten if I've moved the admission of AMO-18 and -19 if I haven't already.

CHAIRMAN WROTENBERY: You haven't yet.

MR. HALL: No objection.

CHAIRMAN WROTENBERY: Okay, they're admitted.

Q. (By Mr. Condon) Now, Mr. O'Hare, I want to hand you what's going to be a series of three exhibits, which I believe are exhibits you've prepared in response to Exhibit N-10 --

A. Yes.

Q. -- and they are AMO-20, -21 and -22. I probably ought to do them in order. Can you identify these three exhibits, AMO-20, -21 and -22, for me?

A. These are attempts to correct Mr. Nicol's Exhibit N-10 for the fact that there is another well present in the system that he merely pointed to when he was presenting his Exhibit N-10. Basically, these are cartoon diagrams of the pressure relationship in the reservoir.

And the first one shows that if there is total isolation of the Chaco well, which would be the well in the middle of the diagram there, and if we assume Well Number 2 is the Gallegos Federal 6 Number 2 well -- I'm sorry, the 7 Number 1 well, and Well Number 1 on this diagram is the 6 Number 2 well, it might assist us in understanding what we believe is occurring in the reservoir here over the last year or so, since the shut-in of the Pendragon wells.

This first one is the case where if Pendragon is correct in assuming that there is no communication in the Chaco wellbores, then the pressure represented by the square block would be the pressure in the Chaco well after shut-in, it had built up to its stabilized Pictured Cliffs formation pressure. I believe Mr. Nicol called these the tornado- or the whirlpool- or something -in-the-bathtub effect on the other two wells, would be the pressure regime at the wellbore, emanating back away from the Gallegos Federal wells.

And basically we're assuming -- we believe this to be the case -- that the flowing well bottomhole pressure, reservoir pressure, of the Gallegos Federal wells, is lower than the shut-in pressure of the Pictured Cliffs wells at this point in time.

So we see those pressure numbers coming to a point below the top of the box representing the pressures in the Chaco well. That is if Pendragon is correct in assuming that there is no communication between the two formations in their wellbore.

On the other hand, if we look at the next exhibit, AMO-21, this is what we believe is happening and how we can easily explain the fact that the pressure at the Chaco wells is lower than the pressure at the Gallegos Federal wells, or at least it was several months after shut-in of the Chaco wells, than the pressure that the Gallegos Federal wells built up to after shut-in of those wells.

And the reason we can say that is because during the flow regime -- I'm sorry, the flowing period of the Gallegos Federal wells, there is a loss of gas to the Pendragon Chaco -- I'm sorry, Pictured Cliffs formation if, out away from the wellbore any distance from the Gallegos Federal wellbores, the Fruitland Coal Gas pressure is greater than the Pictured Cliffs pressure. Okay? If the pressure in the Fruitland Coal formation is higher in the Chaco wellbore, or at the Chaco wellbore, than the pressure in the Pictured Cliffs formation, that pressure will cause crossflow in the Chaco wellbore into the Pictured Cliffs zone.

And if you shut in the Gallegos Federal wells so that that pressure builds up and exceeds the pressure -- the shut-in pressure on the Gallegos Federal wells exceeds the pressure in the Pictured Cliffs formation at the Chaco wellbores, the Chaco wellbore pressure will never build up to the Fruitland Coal formation, even though it's a significant distance away from the Fruitland wellbores. And the reason, again, is that there is crossflow from the Fruitland formation into the Pictured Cliffs formation at the Chaco wellbore.

And so that pressure -- That is a pressure sink, and it is pulling gas from the Fruitland Coals down into the Pictured Cliffs formation. You basically have a downhole valve that is open, preventing that wellbore from building up to the same pressures as what you see in the Gallegos Fruitland wells when they're shut in.

Now, as I said on Exhibit Number 20, we believe that the pressure at this point in time in the Fruitland Coal formation is either right at or just below the shut-in pressure on the Pictured Cliffs formation. And what that implies is two things.

Number one, gas that had previously been going from the Fruitland formation into the Pictured Cliffs formation and pressuring up that formation is now going in the other direction. Gas at the Chaco wellbores is now either static or moving from the Pictured Cliffs formation back into the Fruitland Coal formation.

And there's two incidences that Pendragon presented that verify that this is what's happening now.

Number one has to do with the Chaco 2-R buildup. That long-term buildup over a 10-month period is indicative of crossflow from the Fruitland Coal formation into the Pictured Cliffs formation at that wellbore. The pressure was continuing to build because Fruitland gas was continuing to crossflow into the lower-pressured Pictured Cliffs formation.

At some point in time -- and I believe they stated the last two months -- that trend ceased, and we started to see a reduction in the pressure at the Chaco 2-R. Now, it's a very slow reduction, and if you think about it, it's something that you would expect.

The gas that is flowing from our wells, being pumped with compressors out of our wells at very aggressive rates, is on the order of 500, 600, 700 MCF per day. In order for us to fill up the reservoir, as Mr. Cox assumes, from our wellbores -- to fill up the Pictured Cliffs reservoir from our wellbores to the Chaco wellbores in as short amount of time as we are seeing pressure -- or as we were seeing pressure responses upon shut-ins back in 1998, we would have to be putting into the Pictured Cliffs formation millions more cubic feet of gas per day than what we are currently producing -- in fact, more than the peak rate of production from all of our Gallegos Fruitland wells on compression -- to see the kind of pressure response that we saw at the Chaco wellbores.

There is not a way for that to happen downhole, for a couple of reasons. Again, the pressure -- The higher the pressure that the Fruitland Coal has to buck, the lower the desorption rate of the gas out of the Coals. And we know that the reservoir pressure in the PC was probably higher close to our wellbores than the flowing bottomhole pressure from our Fruitland Coals because of our compression. So the gas was preferentially flowing to the surface in our wells, rather than trying to charge up the Pictured Cliffs formation.

The only time our pressures would have exceeded the Pictured Cliffs formation pressures would be when our wells were shut in. And as you saw on Mr. Cox's exhibits, and I believe a couple other Pendragon exhibits, there were only very limited times when our wells were shut in, and I believe the longest shut-in time was about nine days. So there was not sufficient time nor rate to charge up the Pictured Cliffs formation at our wellbores when our wells were producing.

However, there was some crossflow at the Chaco wellbores, and that would explain why the pressure was increasing in the Chaco 2-R, without having to move the wellbores 500 feet away from one another to get Mr. Cox's example to work.

Another convenient that this explains, or helps to explain, is the Chaco gas analyses returning to the Pictured Cliffs 1100-plus BTU analyses. If our gas is now moving -- I'm sorry, if the Fruitland Coal reservoir pressure is now below the Pictured Cliffs reservoir pressure in the Chaco wellbores, gas is flowing in the other direction from the PC into the Fruitland Coals.

Q. Would it help if you drew a little diagram for the Commissioners to explain this?

A. I'm not a very good artist, but if the Commissioners would like, I'll be happy to try. Please don't expect three-dimensional.

If we have a Chaco wellbore, just label it Chaco, at some point away from the Gallegos Federal wellbore, and if we have basically a very continuous coal reservoir between the two wellbores and we have basically a very continuous Pictured Cliffs sand reservoir between the two wellbores with smaller coals and smaller sands -- I'll just put an extra line in there to signify coal, write "sand" there, between the wellbores. And say we have a pressure scale here that maybe goes from zero to 100 p.s.i. We'll do the same thing on this side, zero to 100 p.s.i.

If the Pictured Cliffs pressure is -- we'll pick a number of 85 p.s.i. -- is above the Fruitland Coal pressure of, say, 80 p.s.i., and there is communication in the Chaco wellbore between the PC sand and the Fruitland Coal, gas will be coming out of the PC sand and going into the coal. Okay? And over a significant amount of time that can be a significant volume of gas. Is it 100 MCF per day? Probably not. Is it 20 or 30 MCF per day? In my view, no. It's probably more like 5 or 10 MCF per day.

Okay, this zone was fairly well depleted and, in fact, showed, in the case of the Chaco Number 4, what we believe to be a representative pressure of about 119, 120 pounds, in 1995. It has -- That zone has been open to the wellbore, and we believe in conjunction with the Fruitland Coal, some gas was being pulled out of the PC, although the vast majority of that gas was Fruitland gas.

So the rates coming out of this sand may only be 5 MCF a day or less. But it is sufficient to displace whatever gas was in that wellbore at the time it was shut in, and so eight months after the shut-in, when they pull gas samples unbeknownst to us or, in my view, in violation of the shut-in order, they get BTU gas contents of 1100-plus at that wellbore, indicative of Pictured Cliffs gas, which we believe is now flowing back into the coal.

Are we seeing that Pictured Cliffs gas yet? I don't think so. And I don't think it's likely we will for another month or two or three or more, because it takes, as Mr. Cox testified, a lot of time to move that gas that distance through the reservoir.

But more importantly, once it gets into that reservoir it is competing with the desorbed gas from the coal, and I don't know how that competition is looking. You know, there definitely is higher-BTU-content components in that gas, but it's being mixed with a large volume of low-BTU components from the desorbed methane coming out of the coal.

So with such a small volume, I don't know that we will ever see, until the coal is completely desorbed, a higher-BTU content in our gas at the Fruitland wellbores.

Now, if we turn it around and say, let's look at the case where the communication, as Pendragon alleges, is at our wellbores, and look at what happens under the same scenario, the same conditions, again, if we're shut in -- I'm sorry, if there is no communication here, the shut-in pressure at the Chaco wells will be a fixed pressure. Will it be higher than the Fruitland Coal gas pressure on our shut-ins? Initially, probably not. Eventually, yeah, it will be. There will be a change in the relative pressures between the two formations.

If there's no communication here, we may be pulling a little bit of PC gas out of here, we may be draining 5 MCF a day of gas out of the Pictured Cliffs formation. It's going to take a lot longer to draw the reservoir pressure down in the Pictured Cliffs formation than it is in the coal formation where we're producing 600 or 700 MCF a day of coal and methane gas out of our wellbores.

So we will be pulling the pressure down in our coals faster than we're pulling the pressure down in the PC sand. So relatively speaking, we should see a fast decline in the coal wells and a stable, relatively stable, pressure in the PC wells. But that's not what we're seeing.

Q. Mr. O'Hare, why would the pressure levels change over time in the Chaco, or the Pictured Cliffs formation, versus the Fruitland formation in that last example you just gave?

A. Again, because we are probably pulling -- If it is communication at the Gallegos Federal wellbores, we would probably be pulling some gas out of the Pictured Cliffs sand. And again, we believe that would be a very small amount of gas, not the volumes that Pendragon alleges.

Q. Is there anything else about Exhibits 20, 21 and 22 that you want to add?

A. Not that I can think of.

MR. CONDON: We would offer AMO-20, -21 and -22.

MR. HALL: I don't think the proper foundation has been laid to -- Did Mr. O'Hare create these exhibits?

Q. (By Mr. Condon) Were these under your supervision or at your direction?

A. At my direction. I couldn't draw these, but...

MR. CONDON: Okay.

MR. HALL: No objection.

CHAIRMAN WROTENBERY: AMO-20, -21 and -22 are admitted.

MR. CONDON: And Mr. O'Hare will stand for cross-examination.

CHAIRMAN WROTENBERY: Mr. Hall?

CROSS-EXAMINATION

BY MR. HALL:

Q. Mr. O'Hare, I wonder if you'd care to explain to the Commissioners, why isn't it -- you didn't want them to see this case?

A. Again, we want them to see the case, but we want them to put it in the context of ownership. My understanding is that the Commission does not have jurisdiction over ownership. So when Pendragon mischaracterized the case as a -- again, it's in my understanding -- the Application states that both the Pendragon wells and the Whiting wells are producing from the appropriate common source of supply, that neglects the fact that ownership is different from the common source of supply.

Q. Let me make sure I understand your answer. Isn't it true that Pendragon's Application in Case 11,996 is almost identical to your application in Case 11,921?

A. That's not my recollection.

MR. HALL: At this point, Madame Chairman, I'd ask the Commission to take administrative notice of the Application in Case 11,921.

Q. (By Mr. Hall) Why is it that you went to court to try to prevent this Commission from hearing this case?

A. We went to court because we believed that that was the appropriate venue for determining ownership issues.

Q. You don't think the Commission is capable of determining the issues that are set forth in the Applications of both Pendragon and Maralex?

A. I think the Commission is very capable; I've been very impressed with that.

Q. And isn't it true that you tried not once but, indeed, four times, four separate times, to prevent the Commission from hearing this case?

A. Not to my knowledge, no.

Q. Mr. O'Hare, there was -- You spoke of an agreement between Pendragon and Maralex where both sides would exchange data during the course of these proceedings. Let me ask you about something.

Are you familiar with the injection falloff tests that Maralex conducted in July?

A. Yes, I am.

Q. Would you explain to the Commission why the data from that test was not shared with Pendragon?

A. I thought it was.

Q. It wasn't until it was requested through counsel; isn't that correct?

A. Not to my knowledge, no. We submitted the data directly to our attorneys once we had it in house and assumed that they had directed it to you.

Q. But prior to that, you were exchanging pressure data on the coal wells and the Pictured Cliffs wells directly, on a regular basis, weren't you? You didn't have to go through counsel to do that?

A. No, sir, our pumpers were jointly observing data.

Q. I see. Did you invite Pendragon's pumper to jointly observe your injection falloff test?

A. Yes, in fact, I was there when the Pendragon pumper came up, when we started the injection test.

Q. Did you invite him before he came up?

A. That was the first opportunity I had to invite him.

Q. I see. Would you explain to us the array for -- Well, let me back up a minute. Is it an injection falloff test or is it a slug test?

A. We called it a slug test.

Q. What's the difference?

A. To be honest, I don't know that there is a difference.

Q. Okay. Would you explain the equipment array for conducting the slug test?

A. Basically, we pull the rods out of the hole so that we will have a clear pathway down the tubing to inject gas, we pull the check valve that prevents gas from going back down into the wellbore, and we reconfigured the discharge on our compressor to take gas from other wells and inject it into the wellbore.

Q. Why don't you sketch out the plumbing array for us, if you could? You turned out to be a pretty good artist after all. If you would sketch out the wells the test was performed on, how you set up your pipes, everything.

A. There was a single well, the Gallegos Federal 26-13-1 Number 1, which is located in the northeast quarter of Section 1, Township 26 North, Range 13 West. And I'm not sure exactly what Mr. Hall is looking for, but I'll show a wellbore here, basically, that has piping set up from the wellhead to the separator. We have a meter run on the location. And then the piping takes that gas back to a central compressor facility about -- nearly a mile away from this well.

Q. Let me interrupt you just briefly, Mr. O'Hare. I apologize. Why don't we turn this this way, for a change, so the audience can see it?

A. Is this what you're looking for?

Q. You tell me.

MR. CONDON: I object, I don't think Mr. O'Hare is required to guess at what Mr. Hall is looking for.

Q. (By Mr. Hall) I'm looking for the array. Show us where the compressor was installed. You showed us where the meter is located. What other equipment is involved?

A. The compressor is again about three-quarters of a mile away from the well location. I'll show that as "compressor", and this is the separator -- I'm sorry, this is "meter run", "separator". There's a string of tubing in the wellbore and perforations.

Q. Was the meter run at the 1-1 location?

A. Yes, it is an allocation meter.

Q. Where was the meter that -- where you took the measurements on the circle chart?

A. On this location, where it says MR for "meter run".

Q. All right. What type of pipe was used from the compressor to the meter run?

A. The existing pipe that we have for production of the well.

Q. What diameter is that?

A. There's actually three different diameters. That line has been looped, and I believe we used the 4-inch diameter pipe.

Q. All right, can you draw the loops on your array there?

A. It's basically just -- We have a 2-, 3- and 4-inch line running from the Number 1 well to the compressor site.

Q. Were they plastic or steel pipes?

A. I believe they're all poly-pipe.

Q. Why did you use the 4-inch line?

A. It has the greatest capacity.

Q. I see. How did you decide the injection rates for the test?

A. I guess that was our consultants -- the pressure-transient consultants recommended a rate, and that's what we set our compressor up to inject.

Q. Is that Mr. Robinson?

A. Or one of his colleagues.

Q. When you shut in, did you also shut in at the wellhead?

A. We actually attempted to shut in at the compressor first and then drive down and shut in the well at the wellhead, and that did cause some problems with our analyses on the falloff side. It took about from seven to twelve minutes.

And our goal was to try to keep from shutting down the compressor, to be able to turn it into the sales line and then simultaneously isolate the line that went to the 1 Number 1 but allow the remaining wells behind the compressor to continue to produce. And it was about a 12-minute process, during which we had basically this whole line open, all the way down the wellbore, so we did have some storage effects that did have an impact on the analysis of the test.

Q. Tell us about those effects. What happened?

A. To be honest, I did not know. I did not analyze the test. I was only informed of those problems.

Q. So you weren't on site when the test was conducted; is that correct?

A. I was on site to start the test, but somebody else actually did the shut-in portion of the test. This was a test that I think spanned four days, total time.

Q. So the injection and then the measurement of the falloff took four days; is that accurate?

A. Well, to start with, again, we had rods in the hole, we had to get a rig on location and pull the rods out. Then we rigged up a pressure lubricator and ran bottomhole bombs to take bottomhole measurements of the pressure while we were conducting the test. Initially, we shut in the well until it built up to what we thought was a stabilized surface pressure, and then we started the injection. And I was on location when we started the injection.

The injection period, I believe, lasted 36 hours. I take that back, I think it was 24 hours, and then we had a 36-hour falloff, if I remember correctly.

Q. Okay. Thank you, Mr. O'Hare, go ahead and sit back down.

Let me ask you, why didn't you perform the pressure-response test that Mr. Robinson had designed back in April?

A. What pressure-response test was that?

Q. The one that Mr. Robinson designed that you went to court to try to stop.

A. I'm sorry, I'm drawing a blank.

Q. Mr. O'Hare, I want to talk to you about your evaluation of the Pictured Cliffs in 1994. You first formed your opinion about the Pictured Cliffs in the subject are back then, in 1994; is that correct?

A. I would have to say yes.

Q. And back then, that's when you first concluded that the Pictured Cliffs was a depleted reservoir?

A. Yes.

Q. And you stuck by that conclusion you reached in 1994 and ever since until today, including today?

A. Including today, I have not seen any data that would indicate that the Pictured Cliffs reservoir in this area is anything but a depleted reservoir.

Q. Do you have your Exhibit W-35 handy there?

A. Give me a hint as to what that looks like.

Q. It's this.

A. Yes.

Q. Now, these are the materials you used to do your evaluation of the Pictured Cliffs in 1994, right?

A. Let me qualify my answer by saying these are the materials that remain in our files from the work that was done in 1994. I'm sure there were a lot of handwritten notes, scribbles and other sheets of paper that are no longer in this package.

Q. All right, let's see what this consists of. The first page is a cash-flow discount rate, correct?

A. It's a summary of the economics that were run on each of the wells.

Q. All right. The second and third page here is a list of all the wells you evaluated, correct?

A. These are the -- It appears that these are the working interests and net revenue interests that we were evaluating on at least most of the wells, along with the lease numbers.

Q. And in addition to the Pictured Cliffs wells, there are Fruitland Coal wells as well?

A. I believe so, yes.

Q. And then you have some production data. It's hard to tell what year this is from. Can you tell us that?

A. The first page looks like 1989, in the upper right-hand corner. The next page is 1990. The following page is also 1990. Then a 1991, another 1991, 1992, 1992, and then we go to C-115 reports.

Q. And those are 1993? I have a poor copy, I apologize.

A. I do too. It looks like 1993.

Q. And you have some production charts following the C-115s; is that right?

A. I haven't gotten there yet. Yes, production histories on several wells.

Q. We can't consider your evaluation a comprehensive evaluation, can we?

A. I guess you're free to consider it whatever you like. At the time that we did this, we felt it was a fairly comprehensive evaluation.

Q. Well, did you do any log analysis?

A. I believe we did look at logs in this area, primarily for the thickness of the sand that was currently producing, and to calculate a volumetric -- a rough calculation of volumetrics. I do not recall doing any kind of water-saturation calculations for those wells. And I know we also looked at logs to determine coal thickness in these wells.

Q. All right. Did you look at the annual deliverability test reports?

A. I do not recall if we did or not. There --

Q. Did -- I'm sorry, were you finished?
A. I don't believe there are any in this package.
Q. Did you attempt to evaluate the possibility of reservoir damage in the Pictured Cliffs?
A. Other than doing a real rough volumetric calculation and comparing that to the cumulative production on the wells, no, there was not any attempt to model the production on the wells or type-curve match the production on the wells to see if we could arrive at a skin factor or any other quantification of damage.
Q. Now, last year you said when you looked at these wells in 1994 you didn't look at the perforations. Do you recall that?
A. No, I don't recall that.
Q. There's a question from Mr. Chavez to you:

QUESTION: Wouldn't it have been important to know that there had already been production from properties that you were purchasing, that might have come from those wells?

ANSWER: Well, we looked at the production information from those wells --

MR. CONDON: I'm sorry, could I have page and line from the --

MR. HALL: Page 731, beginning line 5.

MR. CONDON: Thank you.

MR. HALL: With me?

MR. CONDON: Uh-huh.

Q. (By Mr. Hall) ANSWER:

Well, we looked at the production information from those wells as part of our analysis of the Fruitland Coals, to determine whether or not Fruitland Coal gas had been produced from those wells prior to our taking of the project.

But I did not look at the perforations in those wellbores.

Do you recall saying that?

A. Again, I agree that I said it. I don't recall saying it.

Q. That continues to be your testimony here today? You did not look at the perforations in the Chaco wells?

A. Probably not.

Q. Okay. At the same language I read to you from last year's transcript you said that you'd looked at the PC wells before you bought the coal gas rights in the area in 1992, to see if they had produced Fruitland Coal gas, right? Do you have that in front of you there?

MR. CONDON: I'm sorry, could we have a page and line?

MR. HALL: Same page, language. Same line and page.

THE WITNESS: Yeah, again it was our practice whenever we were going into a low-pressure area to try to determine if significant volumes of Fruitland Coal gas had been produced from PC wells.

Q. (By Mr. Hall) Why did you suspect that these Chaco wells may have been producing coal gas as early as 1992?

A. Again, I didn't suspect it, I just said it was common practice for us to look at that because even before 1988 we knew that fracs in the Pictured Cliffs zone tended to go into the Fruitland Coals and drain Fruitland Coal gas, especially in the underpressured areas of the San Juan Basin. Therefore, we were very careful to look before we got into a Fruitland Coal project to determine whether or not there would be sufficient reserves remaining in the coals to allow us to make a commercial Fruitland Coal gas project.

Q. Well, you just said you were being very careful. Tell us how careful you were in examining these Chaco Pictured Cliffs wells in 1992 to see if they were producing coal gas at the time. Tell us about that.

A. Again, we did a very rough calculation of the volumetric gas in place in the Pictured Cliff formation and compared that with the cumulative production from the Pictured Cliffs wells in this package.
Q. Do you still have that information?
A. I don't believe so, or it would have been provided with this. That was probably a hand calculation, handwritten calculation, that was discarded when the final summary was put together.
Q. Can you recall what you calculated back in 1992 for these Chaco wells?
A. You mean numbers?
Q. Yes.
A. No, I can't recall individual numbers. But I can tell you that if we had seen excessive recovery factors on the Pictured Cliffs zone, we would not have pursued this project.
Q. Okay, you said you were being careful, because of what you -- you had some apprehension that Pictured Cliffs wells in the area were producing coal gas, potentially --
A. No, I didn't say in the area.
Q. I'm sorry, straighten me out. What did you mean?
A. I said that it was our practice, whenever we evaluated a coalbed methane project in the San Juan Basin, especially the underpressured areas of the San Juan Basin,

it was our practice to determine whether or not Pictured Cliffs wells had produced Fruitland Coal gas reserves before we entered into an agreement to develop Fruitland Coal gas reserves.

Q. Can you cite me an example of any other Pictured Cliffs wells in 1992 or before that you understood was producing coal gas?

A. You mean individual well names?

Q. Yes.

A. The one that sticks in my mind is the Elliot Gas Com W Number 1.

Q. And where is it located?

A. It is located north of Blanco, New Mexico. I don't have a township or range or section.

Q. Who's the operator of that well?

A. It was Amoco Production Company at one time. I don't know if they still operate it.

Q. Were you involved with that well when you were with Amoco?

A. Yes, I was.

Q. Why were you let go by Amoco?

A. I was laid off during their 1986 restructuring when gas -- or oil prices dropped to ten dollars barrel.

Q. What were gas prices about that time?

A. I don't recall.

Q. About three dollars an MCF?

A. Not -- Again, I don't recall.

Q. In your evaluation of the PC, 1994 now, you said you did a simple gas-in-place calculation. Where is that reflected in the materials?

A. Again, it appears to have been discarded.

Q. I see. And tell me how you did that. Did you extrapolate from the current production, from these production charts? Is that how you went about it?

A. For gas in place?

Q. Yeah.

A. No, sir.

Q. How did you do it?

A. Basically, we looked at the logs, determined what we felt was the pay thickness and the -- I think we probably assumed a relatively low water saturation, 35 percent or something, and then assumed a drainage area of 160 acres and calculated the gas in place.

Q. Now, why did you assume a drainage area of 160 acres for the Pictured Cliffs?

A. Because they were spaced on 160 acres.

Q. The spacing, you mean?

A. Right.

Q. Did you map any boundaries for a 160-acre drainage?

A. No.
Q. Let me get this straight. You said just now that you looked at the logs for the Chaco wells, right?
A. Yes.
Q. But you did not look at the perforations?
A. I don't believe so, no.
Q. When you did your gas-in-place calculation, what reservoir pressure did you use?
A. The volumetric gas-in-place calculation does not require a reservoir pressure.
Q. Did you consider reservoir pressure at all in your analysis of the Pictured Cliffs wells?
A. No.
Q. So you didn't check any pressures in the field?
A. No, not at that time.
Q. And you didn't attempt to evaluate any fluid levels in the wells, correct?
A. In 1994?
Q. That's right.
A. No, sir.
Q. In your experience, I assume you've done acid jobs in the San Juan Basin. Is it safe to assume that?
A. Yeah.
Q. Why do you generally do an acid job on a well?
A. To clean up scale, downhole scale.

Q. Do you also do it to overcome formation damage?

A. No.

Q. If the acid jobs are successful, wouldn't you expect flowing pressures and production to improve?

A. Flowing pressures maybe would improve, but not shut-in reservoir pressures. If you remove damage, you do not increase the volume in that tank, in that reservoir. Okay? Pressure is a measure of the volume of the reservoir.

Q. Thank you. Would you expect production to improve after an acid job?

A. If there was scale inhibiting production, yes, I would expect it to improve after an acid job.

Q. And you're aware that other operators in the San Juan Basin are doing acid jobs on PC wells, aren't you? Dugan, Giant, Merrion?

A. I believe that is a true statement, but I wouldn't swear to it.

Q. Well, may we suppose that they're doing that to try to overcome reservoir damage?

A. I wouldn't suppose that, no. Acid generally does not attack things like drilling mud or other inhibitors like polymers to flow in the reservoir. It attacks carbonates and other types of scale.

Q. Let me refer you to page 8 of your testimony. Do you have that in front of you. Not from last year, the prefiled.

A. Yes.

Q. Lines 1 through 4 there, you speak of the Gallegos Federal wells. At line 3 you say you "believe the shut-in pressures in these wells were in the 175- to 200-p.s.i. range" in January of 1995. What's your basis for that statement?

A. Without having all the information in front of me, I would have to guess that it was based on shut-ins as recent as August of 1994, during the Chaco Plant turn-around.

Q. So you're guessing that these were the pressures?

A. Correct. I believe I state, "We believe the shut-in pressures..."

Q. And those pressures, the 175 to 200 p.s.i., that's still higher than any pressure in the PC, isn't it? Except for -- The pressures you reference on page 8, you say that the shut-in pressures for the Gallegos Federal wells were between 175 and 200 p.s.i. Aren't those pressures still higher than any of the pressures in the Pictured Cliffs wells at the same time?

A. I believe your witness has indicated that there were pressures in the Chaco 1-J and/or 2-J that were in this same range at that time.

Q. Excluding the 1-J and the 2-J, these pressures are still higher than pressures in the other Chaco Pictured Cliffs wells, correct?

A. With the exception of the February 14th pressure in the Chaco Number 4, that is correct.

Q. Lower down on page 8 you say, around lines 11 through 13:

> ...no production by the Chaco wells because the formation pressure was not high enough to overcome the sales line pressure. The wells were essentially logged off or shut-in.

What is the meaning of that term, "logged off"?

A. If a well is producing continuously, generally speaking, you could have some water vapor flowing with your gas into the wellbore, and as that water vapor comes through the perforations, there's a chance that it starts to condense on your tubulars, and that vapor stacks up over time, builds a water level in the well, and the hydrostatic pressure of that water level overcomes the formation pressure, and you have what is known as a logged-off condition and the well is unable to lift the liquids out of the well and to blow to the surface.

Q. So to a non-engineer like me it means loaded up with water? Is that the same thing?

A. Yes.

Q. Back to your 1994 evaluation of the PC, you say you looked at logs, as I understand it. Did you evaluate the thickness of the pay zone?

A. Yes.

Q. And did you limit it just to the perforated intervals?

A. No, I believe we -- and again, I'm trying to recall here after five years, but I believe in general we look at what we consider to be pay, whether it's open to the wellbore or not. And since I didn't look at perforations, the only thing I had were the logs, and I'm sure we looked just at what we considered to be pay.

Q. Can you recall now what thickness you assumed for one or more of the Chaco wells?

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

Q. So you can't specifically identify the zones you were including in the pay?

A. No, specifically at this time I cannot. Without going back and re-looking at the logs it would be impossible for me to say how much pay I gave each well.

Q. Okay, we know you didn't include the lower bench; is that correct? Or can you recall?

A. If the lower bench contained what we would consider pay, it would be included in our calculations of gas in place.

Q. Did you consider the lower-bench pay?

A. Again, I can't recall.

Q. Your testimony, page 14, line 18, it says mid-sentence there:

> ...no operator in the Pictured Cliffs formation to my knowledge has ever perforated a Pictured Cliffs well in this "third bench" formation. I am unaware of any Pictured Cliffs well that has ever produced from this "third bench."

Do you see that there?

A. Yes, I do.

Q. This means you overlooked the High Roll Number 4 in Section 35, 27 North, 13 West; is that right?

A. Well, until I got your exhibits, I was not absolutely sure what you were referring to as the third bench. Again, I consider the top of the PC to be what you call the second bench in the PC, and so I was probably looking two benches -- or one bench down from what you have labeled the third bench. And at the time this was written, I did not know of any well that was perforated two benches down from the top of the Pictured Cliffs, what I considered to be the top of the Pictured Cliffs.

Q. Now, how about the Dome Navajo 12-26-13 Number 1? You're familiar with that well now, aren't you?

A. Yes, I am.

Q. And that well is perforated where?

A. In what you call the third bench of the PC.

Q. Is it perforated anywhere else?

A. I don't believe so, no.

Q. Last year when you said you were evaluating the coal rights for acquisition in 1992, you mapped the top of the coals and the top of the Pictured Cliffs. Do you remember saying that?

A. Again, not specifically, but I may have.

Q. Also last year you acknowledged that you did not look at what other operators in the area had identified as the top of the PC for many years; isn't that accurate?

A. I believe that comment was in answer to Mr. Chavez's question, and I think my response was that in our evaluation there was no need for us to determine what other operators were calling the top of the Pictured Cliffs.

Q. Well, didn't you say that you had overlooked it, and it was unfortunate that you had?

A. I don't recall saying that, but...

Q. Let me just read your answer to save time.

MR. CONDON: Could we just have a page and line number so we can refer to it?

MR. HALL: Page 732, line 3. I'll just read it into the record:

ANSWER: -- I didn't. Actually, when we built our maps of this area, we mapped the coal thicknesses, we mapped the tops of the coals, and we mapped the top of the PC. And we did not look at, unfortunately, what the other operators had been calling the top of the PC.

Do you recall saying that now?

A. Yes, can I finish the quote?

Q. Yes, please do.

A. "I actually made those picks myself, based on the definitions that were provided by the State in the 1988 ruling."

Q. Isn't it true that there's some 34 other wells in close proximity to the subject area here where the operators have identified the upper Pictured Cliffs sand and reported that to the Oil Conservation Division?

A. I don't know the exact number, but I do know there are other wells in the area that have been misreported to the State, yes.

Q. Look back at your due-diligence materials here, your W-35, your evaluation of the Pictured Cliffs. It looks like there's a number of what have since turned out to be excellent coal wells on here, aren't there?

A. Again, I believe so. None of those appear to be identified on the front page, but I think the second page identifies some as -- possibly identifies some as coal wells, just because it shows those on 320-acre spacing.

Q. Well, how about the Fusselman Fed Number 1? Are you familiar with that well?

A. Yes, I am.

Q. Is that -- Would you consider that a good coal well?

A. I would consider it a decent coal well, yes.

Q. How about the Sullivan 9?

A. I would consider that a decent coal well.

Q. And how about the Susco 3? It's on your list, isn't it?

A. It is. I am not -- not recalling that well in Section 9.

Q. Well, if you don't recall it, you don't recall it.

A. I'm sorry, I don't recall that well.

Q. How about the Pete 1-R? Are you familiar with that well?

A. I'm familiar with the name. I cannot recall any details about its production.

Q. Okay. But there are a couple of wells on there that it appears you evaluated incorrectly. Is that safe to say?

A. As far as the present worth at the time of this evaluation, no.

Q. And it was from this evaluation in 1994 that you formed your opinion that the Pictured Cliffs was depleted, correct?

A. Yes, at least initially.

Q. Do you believe you did everything that a reasonably prudent operator would have done in evaluating the Pictured Cliffs in 1994?

A. I believe so, yes.

Q. Is there anything in addition you wish you could have done, that you didn't do?

A. Yes, I wish I would have bought the wellbores so we wouldn't have the problem we have now.

Q. With respect to your evaluation, is there anything in addition you wish you could have done that you didn't do?

A. No, not that I can think of.

Q. Page 26, line 1 there, you say in your opinion "the pressure increase on the Chaco 4 was due solely to the fact that acid communicated with the Pictured Cliffs formation with the Fruitland Coals." And you go on to explain that the acid had etched a channel a fraction of an inch wide and about two feet long.

A. No, I don't think I said that it did that. I said it would only need to do that to have an effective channel.

Q. Can you show us any example where that may have happened in another well?

A. Where the cement would have been etched? There is a paper that was done by ARCO Alaska on the Prudhoe Bay field back in the early 1990s, I believe, or the late 1980s, that documented their efforts to squeeze off a growing gas cap and then to come back in and re-treat the producing -- the lower, deeper producing formation, to re-establish oil production, that was very explicit in describing channels that had been etched by the acid they were using to re-establish communication.

Q. Was that a communication with the coal?

A. No, sir.

Q. Well, in this case if we presumed that the acid did create a fracture through the cement up into the coal, what happened when the acid reached the coal?

A. Number one, it doesn't have to create a fracture. All it has to do is etch the cement, to create a channel where pressure can communicate back between the coal and the perforations. It doesn't have to be a very effective channel for that pressure communication to be established.

A more effective channel would allow you to have some gas production from the coal. But we're not claiming that the acid job effectively stimulated the coal, only that it established communication with the coal. Do you understand the difference?

Q. I do. Are you contending that -- You're not contending, are you, that acid can stimulate the coal to produce, are you?

A. No, sir, I'm not contending that the acid's primary purpose is to stimulate the coal. Its primary purpose was to establish communication with the coal.

Q. If communication was established to the coal through the cement, as you say, why didn't the pressures in the Chaco 4 reach the coal pressures that were being seen at the time?

A. Because that pressure was leaking off into the Pictured Cliffs formation, which was much more -- much lower pressured than the Fruitland Coal. So basically, you had a pressure sink that was sucking the Fruitland gas into the Pictured Cliffs formation. There's no way that pressure can build to the pressure in the coals when you basically have a downhole valve open that is allowing that gas to escape into the Pictured Cliffs formation.

Q. And was that gas being produced through the Chaco 4 well at the time?

A. At the time of the acid job or after the acid job?

Q. Immediately after.

A. There was an attempt to produce that gas, yes.

Q. This is the same well, the Chaco 4, that you said on page 8 was logged off, correct?

A. No, sir, I did not say the Chaco 4 was logged off on page 8.

Q. You say Chaco wells; is that correct? Is that more accurate?

A. I say, "The wells were essentially non-productive."

Q. Here, look at lines 12 and 13: "The wells were essentially logged off or shut-in."

A. Yes, some of them were shut in, some of them were logged off.

Q. Let's talk about the Lansdale Federal just briefly.

MR. CONDON: Excuse me, if we're moving on to a new subject, would it be possible to take a short break?

MR. HALL: Like about 18 hours?

MR. CONDON: Thinking more along the lines of 18 minutes, but...

CHAIRMAN WROTENBERY: How much longer do you think --

MR. HALL: It's going to be substantially longer. Close to two hours I would say, realistically.

(Off the record)

CHAIRMAN WROTENBERY: Yeah, I think we'll go ahead, then, and shut it down for the evening and start back up at -- what? 8:30? I know some people are coming in from Albuquerque; is that right? 8:30 sound okay with everybody?

MR. CONDON: Sure.

CHAIRMAN WROTENBERY: We'll start back up again at 8:30. Thank you.

(Thereupon, evening recess was taken at 9:30 p.m.)

* * *

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 10th, 1999.

STEVEN T. BRENNER
CCR No. 7

My commission expires: October 14, 2002