Order No 440-12
479-2



01146112

BEFORE THE OIL AND GAS CONSERVATION COMMISSION

OF THE STATE OF COLORADO

139.12

| | |
|---|---|
| IN THE MATTER OF THE PROMULGATION AND ESTABLISHMENT OF FIELD RULES TO GOVERN OPERATIONS IN THE PARACHUTE AND GRAND VALLEY FIELDS, GARFIELD COUNTY, COLORADO ) | Cause No. 440 and No. 479 |

PURSUANT TO NOTICE to all parties in interest, the above-entitled matter came duly on for hearing at the State Education Building, Room 101, 1580 Logan Street, Denver, Colorado 80203, on Thursday, April 19, 1990.



BEFORE:

Commissioner Ed McCord

Commissioner Truman Anderson

Commissioner Rogers Johnson

Commissioner Gretchen Vander Werf

Commissioner John Welborn

Commissioner Max Krey



Dennis Bicknell, Secretary

CHAIRMAN WELBORN: We're in Cause No. No. 440 and 479, Parachute and Grand Valley Fields, Garfield County, Colorado. The subject is an application to change Order No. 440-11 and No. 479-1 to establish a 160-acre unit for production for the Mesaverde formation in a specified area. The applicant is Barrett Resources Corporation through its counsel, David Knowlton. Protestant, United States Department of Energy through its counsel, Mary Egger and Mr. Yannock. This is a hearing that was ordered at the last meeting of the commission on March 19, 1990. First, let's take appearances of counsel, if we could.

MR. KNOWLTON: David C. Knowlton, appearing on behalf of the Barrett Resources Corporation.

MS. EGGER: Mary Egger. I am with the Department of Energy, Office of Naval Petroleum and Oil Shale Reserves. With me as cocounsel is Michael Yannock.

CHAIRMAN WELBORN: Thank you. Anybody else who wishes to enter a appearance in this proceeding or is going to make a statement? All right. If not, let's proceed. Oh, do you want to begin with an opening statement? Mr. Knowlton, why don't you do that. Then, if you want to follow with a statement you are welcome to, or you can reserve it until later. It's up to you, Ms. Egger. All right.

MR. KNOWLTON: Thank you. I know most of you have heard some of my comments that I'm perhaps going to cover briefly, now, but just to refresh a few memories, perhaps, including my own, I would like to cover what it is we are asking for. We're asking for modification of two previous orders that were rendered in the February hearing. One order we're not asking for any modification on; that's the Rulison order which is 139-14. We are asking for a modification of Order 440-1, which is, for purposes of discussion, is the Parachute Field; however, in that area, we're not asking for any modification of the Mesaverde spacing. You recall the Allen Point area is to the north of the DOE acreage. And I think probably you know what area that is.

We're asking for modification of Order 479-1, as it applies to the Mesaverde. We're not asking for any changes in the Wasatch, so I think this hearing is going to be more simple in that respect. We're not going to confuse the Wasatch with the Mesaverde.

CHAIRMAN WELBORN: What changes are you asking for in 440-11?

MR. KNOWLTON: We're asking for a change of the Mesaverde spacing from 320 to 160.

CHAIRMAN WELBORN: In 440-11?

MR. KNOWLTON: Yes.

CHAIRMAN WELBORN: The same in 479-1?

MR. KNOWLTON: Yes.

CHAIRMAN WELBORN: All right. Thanks.

MR. KNOWLTON: Having read and reread the transcript of the February hearing, it is our conclusion that the DOE experts have either seriously misread their own research and their own papers, or have just incorrectly analyzed the studies which their own consultants have made and issued in formal papers. Their testimony, at best, has to be limited to the Rulison Field, which is the field, as you will recall, to the east. The furthest area to the east where we have the two red lines outlining -- running parallel to each other. That is, for discussion purposes, known as the Rulison Field.

The record tells us that there is real confusion in the testimony dealing with the fracture system in the Wasatch and the Mesaverde, particularly, in reading, for about the third time last night, the cross-sectional analysis, I think there was confusion and we hope that maybe we can clarify that and perhaps DOE can too, because at the time of their application, we were mixing the two discussions together, and I don't think it came out quite the way it maybe can or will today.

Obviously, the fracture system in the Wasatch is significantly different than the Mesaverde. We do have new and additional evidence. We have had five rigs working over the past two months, which continues to confirm our conclusion that there is no communication of fractures in the Parachute and Grand Valley Field. The fractures simply are not the same. They don't have the same intensity in the Parachute and Grand Valley as they do the Rulison. Our case is limited, again, as I say, to the Mesaverde formation, specifically to the Parachute and Grand Valley fields.

Substantially all the DOE testimony concerned was their three exploratory wells described as the MWX wells in the Rulison. Those are closely clustered, experimental project wells that we're drilled some time ago. The assumption by DOE that natural fracturing does exist for the wells of the Rulison was neither proven nor based upon any studies or experience available to the DOE in this area. By interpretation and by analysis of other areas, such as in Wyoming, they so concluded that the same fracturing does exist to the west, and that is not based upon the testimony which we gave, which, I think, was based on our actual history in the area. Our testimony was personal. It wasn't based on studies or analogy. That is to be given a considerable amount of weight.

We, however, would note that the DOE's own published studies confirm the conclusion that we're making; that the Mesaverde can and should be spaced on with more density than 320, 160 or even a different, more dense spacing might even be indicated, and their own studies will tell us that. They offered no evidence regarding the drainage radius of a Mesaverde well in the Rulison Field. They didn't offer any evidence on the drainage in Parachute or Grand Valley either. Our evidence, on the other hand, indicated that most of these wells, these Mesaverde wells, at best, would drain 50 to 60 acres. They implied, but no proof was submitted, that it would perhaps drain a larger area. Our testimony was clear and uncontroverted that the drainage would not take place on DOE acreage. I know that concerns some of you. And we say, even on 160s, we're not going to be draining the DOE acreage at all. If however, if we're talking about the impact of drilling wells on a one-mile buffer zone, which buffer zone is desired by DOE, that's a different ball game completely.

In the area of economics, we didn't offer testimony regarding the coal bed methane tax credit, which we will offer today. We felt it wasn't necessary; however, the DOE, since they don't pay tax, we didn't think it was necessary. We thought the economics that we did introduce were persuasive enough. We're going to introduce this because now it takes a different form with a 160 limitation, perhaps indicating that there will be some wells which may not even be drilled if we're going to continue with 320 spacing, will not -- our testimony is going to indicate this tax credit will give us a rate of return of nearly 45 percent with payout in 2 1/2 years. And these wells, as indicated earlier, cost about $550,000 to drill and complete. And we aren't talking about unnecessary or uneconomic wells. If we are, we're in deep trouble. Our reserve estimates are different than theirs, which is understandable. Very few of the Rulison wells even penetrated the coal bed methane or Cameo coals. So they have no estimates, no reserves studies allocated to that interval.

Our testimony will reflect that approximately half of the reserves that we're talking about are going to come from the Cameos. Lieutenant Cowen didn't even consider this producing interval.

Waste -- we go to the real heart of any spacing application, which I think is basic, that's what is the concept of waste. We will discuss undrilled locations which are going to leave substantial reserves untapped and unrecovered. That's what I would call waste. We're going to suggest and hopefully prove to your satisfaction that on 320 spacing, we project as much as 90 to 94 percent of the unit reservoir being left intact after the drainage area is depleted. In regard to unnecessary wells and drainage, we have currently drilled about 11 wells on 160s in the Parachute/Grand Valley Field. With that kind of expenditure, we hardly feel that these are unnecessary wells. The suggestion or perception that our 160 location will drain the DOE is irrelevant, unfair, and totally without merit. The dispute here today and in February should not have been 320 versus 160. It should be 160 versus 80s. And in our opinion, someday all of the good locations will be drilled on 80s. We're convinced that this is the case and it's interesting that we will show that some of their own papers indicate the same possibility.

The production history in this area is not of short duration at all. There's been production from the Mesaverde for over 30 years. We've been in there for between four to five years. Spent over $40 million in this area. Other operators have been in there fairly active for over ten years. This kind of history and experience suggests that it's not premature to evaluate the Mesaverde production and to space it the way it should be spaced. That's why we're here.

CHAIRMAN WELBORN: Okay. Thank you, Mr. Knowlton. Do you wish to make a statement now or later?

MS. EGGER: Yes, if that's okay. Good afternoon. For the record again, my name is Mary Egger, with my cocounsel as Michael Yannock. We are both with the Office of General Counsel, U.S. Department of Energy. Together we represent the Department of Energy and the office of Naval Petroleum and Oil Shale Reserves. Again, it's a pleasure to be before the commission today. We have come here today to protest Barrett Resources application, March 5 application for modification of the orders issued by the commission on March 9, with respect to the Parachute and Grand Valley fields, as determined at the hearing on March 19.

Barrett's application, as we understand, is being treated as a new application. In effect, Barrett is asking for a downspace for Mesaverde wells in the Parachute and Grand Valley Field from 320-acre spacing, as just decided by the commission, to 160-acre units. As we understand Barrett, the Barrett application, in their opening statement, Barrett intends to put on some of the same evidence presented to the commission at the February hearing, as well as some additional evidence not presented in February. I am intentionally not using the term "newly discovered evidence" for, as I understand, Barrett's additional evidence does not meet the standards of that legal term.

The Department of Energy has made good use, I think, of the additional time allotted it as a result of delaying the hearing until today. We have with us today several distinguished geologists from -- two from the U.S.G.S., one from Sandia National

Laboratories. To a large extent, these geologists are the very experts whose publications DOE has been relying on. We also have with us the two expert witnesses who testified at the February hearing on behalf of DOE, and they are prepared to testify to some additional matters they have had an opportunity to analyze.

Barrett's application for modification, as we understand it, appears to be based on four major points: One, that natural fracturing does not exist west of the Rulison Field. Number two, that any fracturing that does exist is oriented east west. Number three, that the drainage area for the Mesaverde wells and Parachute and Grand Valley Fields allegedly would not exceed 50 to 60 acres. And number four, that coal bed methane tax credit should not be considered by the commission as a factor in the spacing. The evidence which we will present today is designed to rebut each of these points.

With respect to the coal bed methane tax credit, we believe the tax credit is not appropriate for consideration by the commission in these deliberations for the effective drainage area. In our view, consideration of such tax credit would be akin to examining the profitability of particular companies and, on that basis, making technical decisions on spacing. Notwithstanding our view on the tax credits, however, we believe that the DOE witness will confirm that with or without consideration of the tax credit, the economics of the situation support 320-acre spacing and our economic analysis will show that.

Therefore, the DOE witnesses will address all of the bases for Barrett's application and we believe will show convincingly that Barrett's request should be denied and that the 320-acre spacing should remain.

Let me just address for a moment a theme that Barrett keeps repeating, apparently believing if it's repeated often enough, it will become fact. Barrett, I think, would have the commission believe that DOE is requesting -- asking the commission for special protection because of the federal deficits. I think that's ludicrous. However, we do expect and know we will be granted equal protection as mineral owners in the state of Colorado. By saying that DOE does not have money to waste on unnecessary wells, DOE had hoped that Barrett would be able to understand that we're responsible for judicious expenditure of public funds and the development of our resources pursuant to the statute. It's from this perspective we so vigorously maintain our position before the commission.

We would like to take this opportunity to address briefly the one matter concerning Barrett's other application that will be heard tomorrow. We have asked -- filed a protest in that area. We have asked that evidence presented here today be considered by the commission in its deliberations on tomorrow's application. In our view, reintroduction of the same evidence and witnesses would be the same, unnecessary to the efforts -- commission's efforts at this point. That's all I have. We would be happy to answer any questions.

CHAIRMAN WELBORN: All right. Thank you. What is your reaction to the last point in terms of the evidence here and the hearing tomorrow, Mr. Knowlton?

MR. KNOWLTON: Well, I will make a comment -- I don't really think I should do it now, but I will make a comment tomorrow, depending a little bit on what happens today as to whether or not I think it's appropriate that you consider it. It's pretty hard for me to block out of your ears what you are going to hear today. So I know you are going to consider their testimony anyway. But whether or not it's appropriate and whether or not the DOE has standing is something which I would have to seriously question. They are not an interested party as defined by our statute, so, I guess, knowing your freedom in allowing anybody and everybody to testify, you're probably going to consider it, but I would say they are not an interested party and I don't think their testimony should be heard tomorrow, and should be considered, so I would like to ask that because I think I am going to have difficulty if all six of you not hear it and not --

CHAIRMAN WELBORN: Subject to the determination on that issue, which is a separate legal issue, unless there's an objection from the commission, I'd just as soon say that the evidence is presented today can also be considered tomorrow for a couple of reasons. We don't have time tomorrow to hear it all over again. We are limited in the time that we can spend on this matter tomorrow. And it's just an expedite -- we have all of the commissioners here today, so for us to consider what we've heard today and deliberate tomorrow as well, unless there's any objection to that -- any other commissioners -- I'd just as soon do it that way.

COMMISSIONER ANDERSON: No objection. I think Mr. Knowlton can be assured to the extent anything we hear tomorrow, we decide wasn't relevant, we won't take it into account.

MR. KNOWLTON: If it will make you feel any better, we don't intend to go through this whole thing tomorrow.

CHAIRMAN WELBORN: I didn't think you did. I knew it was a bluff.

MR. KNOWLTON: If you wanted to hear it, we would be ready. Otherwise, we won't do it.

CHAIRMAN WELBORN: Proceed to your evidence.

MR. KNOWLTON: First witness is Mr. Kurt Reinecke, who has testified before. And his credentials as petroleum geologist have been recognized before. I think he should be sworn in again.

CHAIRMAN WELBORN: Who else would be a witness?

MR. KNOWLTON: Ralph Reed.

CHAIRMAN WELBORN: All right.

(Thereupon the witnesses were sworn.)

CHAIRMAN WELBORN: All right. Please proceed.

MR. KNOWLTON: Do I understand that his credentials are accepted?

CHAIRMAN WELBORN: Are accepted, that's right, as expert petroleum geologist.

EXAMINATION

BY MR. KNOWLTON:

Q Mr. Reinecke, before you approach the maps, I know you were in attendance at the February hearing. And I know that you have examined the transcript of the record of that hearing; is that correct?

A That's correct.

Q And I know that you also have been monitoring the drilling activity of Barrett in the past two months, and I would just ask that you take the information you have, that which you have gathered from the original transcript, and I think just talk to the commissioners in a general way and cover the areas that you think you would like to clarify and discuss at this time.

A Okay. Very well. I am going to be speaking today mainly from the Exhibit 2 that I handed out to you. I just want to orient you on this

Exhibit 1, just sort of refresh every one where we're talking about, what all of the symbols mean and so forth.

CHAIRMAN WELBORN: Now, Exhibit 1 is the map that's on the wall.

THE WITNESS: That's correct.

CHAIRMAN WELBORN: Do we have a copy of that as well? A smaller one? Is that the one that we're --

THE WITNESS: I can give you an exhibit --

CHAIRMAN WELBORN: We don't have to. I am just asking.

THE WITNESS: I have an Exhibit 3, which is basically this map, is a land grade. I've seen some of them floating around in here from previous hearings.

CHAIRMAN WELBORN: All right. Let's just focus on this Exhibit 1 is the one on the wall. Exhibit 2 is the entire packet of materials.

THE WITNESS: That's correct. Just to give you guys an orientation here. The town of Rifle was located --

MR. KNOWLTON: Kurt, I wonder if -- Mr. Johnson can't see too well. Is there anything we can do?

COMMISSIONER JOHNSON: I can go over in this corner.

MR. KNOWLTON: Would you mind, sir? Thank you.

A All right. The town of Rifle, Colorado is located here. I-70/Colorado River runs generally northeast to southwest across the map. The Rulison Field is located primarily in the 6 South, 94 West area. Parachute Field is located primarily in 6 and 7 South of 95 West. Grand Valley Field primarily in 6 and 7 South, 96 and 97 West. The spacing area that we're discussing today is shown by the upper yellow or green outline.

The symbols here are, the pink is the Grand Valley gathering system installed by Barrett to gather the Mesaverde gas in the area. We have two types of gas symbols: One is just a plain symbol which represents the original 22 wells that were drilled in Grand Valley prior to our accelerated drilling program, which began late last year. Those wells, if they are drilled and logged, are shown with the gas symbols with the black stars located in there. The black rigs with the black stars over them indicate the next series of locations that we're proposing to drill. Barrett's acreage position is shown in the gray; the DOE is shown in the blue.

The Rulison Field -- I will be referring to an area which I call a highly fractured area. That will be the area that is located inside the two northwest/southeast trending lines. I will say right now, for the record, I think last time there was an attempt to say that we do not believe there are fractures in the entire area. That's not correct. We recognize the area is fractured, Grand Valley is fractured, Parachute is fractured, Rulison is fractured. What we are saying is, the area bounded by the two red lines is highly fractured. It is different than Grand Valley, it's different than Parachute. And it's even different than some parts of Rulison Field. There is a unique area of high fracture intensity which is bounded by red lines.

Q (By Mr. Knowlton) Does that include the MWX experimental wells?

A Yes. The MWX well is located in the northwest corner of Section 34, 6 South, 94 West. You can see it lies just inside the red bar on the left-hand side. Now, last time I think there were two implementations -- indications from the DOE testimony. One was that the geology, the rocks, the way they were deposited, was the same across the area, the Parachute/Grand Valley/Rulison area, and therefore the reservoir properties must be the same across the area also. That's not so.

The second was that the fractures in the Mesaverde fracture everything -- they fracture the sands, they fracture the shales, anything that was encountered by that well bore was fractured. Therefore you could drill a well, hit a sand and drain that sand because it was fractured. You wouldn't even have to hit a sand, according to their testimony, to drain the sand. All you really needed to do was drill a well on 320-acre spacing and you are -- you were going to drain everything in that 320 acres, whether it was encountered in the well bore or whether it was not. That is also not so.

I am going to go through, if you will, just look on Exhibit 2, there are Items A through E which I am going to review to try and prove these points and some others here. Let me just review for you the points that I am going to cover today and then we'll just take each one individually and look at them in a little bit more detail.

Point A was SPA Paper 15248 that was cited by the DOE on the last testimony. This paper does, in fact, state that 160-acre spacing is correct for the Mesaverde. And even in the highly fractured parts of Rulison Field it states this. Point B, in Rulison Field, the entire stratigraphic column, including sands and shales, is not highly fractured, only the sandstones are.

Point C, sandstone reservoir geometry indicates a more dense well spacing is needed to encounter all of the long, narrow, discontinuous sands that occur in a square-mile section. Point D, the highly fractured area of Rulison is restricted only to a portion of that field and is not pervasive over the Grand Valley/Parachute area. It is not even pervasive over the entire Rulison Field itself.

The Point E, the fractures that do exist are -- trend dominantly east/west; therefore, even if they do exist, and they do to some degree in Grand Valley and Parachute, all of the south offsets to the DOE boundaries will not drain the DOE significantly. The fracture trend of boundary with the DOE is roughly east/west. And any south offsets are not going to have a significant component of north -- northerly drainage to them. The -- really, the bottom line, which I am going to try to get across today, is that you need to encounter these sands to drain them, and that the sands were deposited in such a manner you are going to need a dense well spacing to encounter all of those sands. And then, today, as I speak of page numbers, you will have to look in the upper right-hand corner of the page. That will be the exhibit pages that I will be referring to. There are other pages that come from the various articles, but the upper right-hand corner is the page numbers I am referring to.

So if you just turn to exhibit -- page 2. You will see that this is the title page from the SPE Paper 15248. Now, if you will just turn quickly to the conclusions on page 4, it's in the lower left-hand corner. I will just read the conclusions for you that was made by this paper. This paper was written by DOE personnel. "Reducing current spacing from 320 acres to 160 acres or less for the Mesaverde wells through infill drilling or by placing four wells or more per section in undeveloped sections is a viable development strategy for Rulison Field."

It's the first conclusion of this paper. It's the primary conclusion made by this paper. This paper was cited in the February testimony by the DOE. They came across with some logic that said, well, we have some subsequent data here that indicates that the area is highly fractured, even more so than was thought at the time this paper was published.

There are two points to make with that statement. One is, this paper was published in 1986. I have a study here. It's Open File Report 84-757. On pages 11, 75, and 87 of this study, there are three separate papers in here. All of these papers recognize the core from the MWX site was highly fractured. This was a recognized document in the literature two years before this paper was published. Second point is, this model was derived using the wells' production history from the Rulison Field. They went in and did this modeling based on the production of the wells located primarily in the 6 South, 94 West area north of I-70, north of the Colorado River.

Now, the implication was that their paper did not include or address fracturing in some fashion. Well, if you look back on page 3, on the upper left-hand corner, the first highlighted area says, "Data from 12 of the 14 available Mesaverde wells were used to history match actual four-year production against simulated production by varying kf, Lf and phi f."

If you will turn to the comments on page 4, look on the right side of nomenclature, where they define kf, Lf, phi f. Kf is natural fracture permeability. Lf is induced fracture winglength and phi f is natural fracture porosity. Indeed, this paper, when it created its model, did take into account the natural fractures in the area. Now, what's interesting is that this paper modeled wells -- modeled production from wells that are claimed to be highly fractured; that the wells are highly fractured and the model that is, you know, the model that was generated was from wells that take -- are highly fractured. The production is from wells that are highly fractured.

The model was matched to -- I mean the model was matched to wells that are highly fractured. The model was saying what these highly fractured wells will do. I mean, it doesn't matter what the core said in MWX, the core could come out in rubble, it doesn't matter. It doesn't matter the well was modeled against wells that are highly fractured.

It just -- the conclusion was reached through this paper that 160-acre spacing is correct. Previously to this hearing, this is -- the standing recommendation of the Department of Energy is 160 acres or more or smaller spacing, four wells or more, is the proper spacing for the Mesaverde.

There was one additional comment I would make on this paper. And this is just a -- to show there was some confusion last time with mixing Wasatch and Mesaverde data. If you will turn on the exhibit to page 3, look in the lower right-hand corner, there was a mention made that somehow if you drill the wells and you hit a sand, and you were able to drain sand that was not in contact with the wellbore through some sort of sand-to-sand contacts, if you will note the subtitle of that section is Wasatch Characterization Case 2. You will see that says, "Case 2 assumed the lenses were in hydraulic communication through natural fractures in the shale." The statement applies to the Wasatch only. It does not apply to the Mesaverde. Really, the conclusion is, from this Part A of the testimony, is -- or my testimony is that 160-acre spacing is recommended by the Department of Energy studies.

The second item I will address is Point B, which there was implication that the entire geologic column is fractured. I will cite a couple of papers here. If you will look at the exhibit, page 6, this is a paper that occurs in a publication, U.S. Geological Survey Bulletin 1886, entitled, "Geology of Tight Gas Reservoirs in the Pinedale Area, Wyoming, Multiwell Experiment Site, Colorado." In this paper, if you will look on page 7, there will be a paper quoted by John Lorenz. John Lorenz has done much work on the core, the multiwell experiment. This is just a title page from one of his reports. Characterization of Natural Fractures in Mesaverde Core From the Multiwell Experiment. On page 8 is the title page of the article I am -- or title page for the quote I am going to cite to you, Reservoir Sedimentology of Rocks of the Mesaverde Group, Multiwell Experiment and East-Central Piceance Basin, Northwest Colorado by John Lorenz.

All right. On page 9 there's a highlighted area. Remember, the DOE is claiming that the entire section from top to bottom is fractured, sands and shales are fractured. I'll read to you from the highlighted areas: "These mudstones are composed of mixed clays and silt and should also provide good reservoir seals, even in fractured reservoirs, because the fractures that dominate the reservoir permeability commonly terminate at contacts with these adjacent mudstones in both core and outcrops."

In other words, the fractures that are contained in the reservoirs do not -- and the fractures that enhance the reservoir's permeability do not connect or do not migrate out of the reservoirs. They are stopped by the lithologic change when you go from sand to shale.

Turn to the next page, which is page 9A. This is a very recent publication that's been received probably in the last three weeks, even though it is dated January of 1990. This is one of the three or four volumes that were produced as summaries from the multiwell experiment. This particular volume is entitled, Multiwell Experiment Final Report IV. The Fluvial Interval of the Mesaverde Formation.

If you will turn to page 9B and look down at the highlighted area, "Inspection of core in this zone has shown that most natural fractures terminate at shale/mudstone breaks, so interconnectivity between adjacent point bars may not be aided much by these fractures."

In other words, if you have a point bar reservoir in close association with a point bar reservoir that has encountered in the wellbore, the one that is not encountered in the wellbore should not be expected to be drained through the one that is in contact with the wellbore. In other words, if you were not in contact, you haven't drilled through it on -- with the -- your drilling, then you should not really expect to be able to drain it.

The one thing I would like to show you a little bit more of is, this is my Exhibit 4A here, which is an electric log, mud log, from one of the Barrett wells that was drilled five years ago, five or six years ago. All right. This log is from the MV4-3, which is located right here, which is in the southeast quarter of Section 3 of 7 South, 96 West. This log is a -- what we used to help us evaluate each individual well. We create a log like this for each well that we drilled out there.

CHAIRMAN WELBORN: You are welcome to move over here. Or else you can turn the other way.

A We're going to be coming up here periodically. What this composite log shows is a number of things. One is, it shows that a -- particular sand reservoirs that are defined on the basis of gamma ray character, we highlighted those in yellow. Just to give you a feel of depth here, this interval between my fingers is a 100-foot interval.

You are looking at a total interval from about 3400 feet down to 7300 feet.

Another property of this log or characteristic of the log, it shows the areas of gas reservoir which are denoted in red. They are areas of higher porosity. They are coincident with the yellow areas or the sand areas. The right-hand portion of this log is a mud log, which simply indicates the amount of gas that is coming from each one of these sandstones. One thing you will notice right off is that in every case where you show this porosity E log response, you have gas. You see where you do not have this porosity, where it is shale, where there's no color yellow, where it's not sand, you had no gas.

If it was, as the DOE claims it to be highly fractured from top to bottom, you would expect these fractures to be giving you gas shows in the shales, in the sands. Essentially what you would have is, you would drill down here, you would have gas shows, very indefinite gas shows. Made basically a straight line all of the way down. You don't see that. All you see is, where you have sands, where you have porosity, you have gas. Where you have shales, you have no porosity, you have no gas.

COMMISSIONER McCORD: Where is the Mesaverde on this log?

THE WITNESS: The Mesaverde top starts at the 3400-foot level. This is the interval that's been lumped in toto. About -- the Mesaverde starts at 3400 down to about 5800, is what is being lumped into the fluvial interval. Below that we have the Cameo coals, you see, gives us gas kicks just like the sands do.

This is the top of the Rollins. This is the first well. As you are going down, the first marine sands, as it was deposited, it was -- last marine sands. This is the Rollins here. This is the Cozzette, and this is the Corcoran. This -- the other point making -- using this log is this sand, for example, you have have a porosity streak located about, oh 5,053. You have some that is about 4 feet thick. You have a porosity streak that's about 60 at 5,060 to -75. That's separated by a little tight zone in here of about 2 feet thick.

Again, if this was an -- as highly fractured -- the sand was as highly fractured as claimed by the DOE, then you would expect this entire sand unit to be fractured. You would expect, then, your gas in that sand to be the same amount. Your reservoir would be in communication. Well, it turns out the upper zone has a gas kick of about 400 units. The zone that is separated only by about 2-foot shale, it's almost just a 2-foot tight sand, is -- only has a gas kick of 200 feet. If the sand was highly fractured you would have had a single gas kick. It would have been -- you wouldn't have been able to distinguish the two sands. It just isn't highly fractured. For you get two separate reservoirs there, essentially, you are only separated by 2 feet of sands, or 2 feet of shale, whichever it is.

Q (By Mr. Knowlton) Mr. Reinecke, this is what kind of a log?

A Well, it is a composite log. It is a density neutron log with mud log attached on the right side.

Q Well, aren't we seeing, in effect, a column that indicates there's multiple pools or reservoirs in there, maybe as many as 30 or 40?

A Yes. It's quite obvious. You can -- varies from well to well, but 20 to 40, 20 to 30 is the typical number of reservoirs you have. Each reservoir is unique. It depends on how fine you want to get. We can sit here and count every one of them from about, oh, 4300 feet down to total depth. There is -- every one of those reservoirs is a, you know, viable reservoir. It's economic to try and complete the well.

Q There are shales encountered all of the way down?

A Well, yes, I mean each sand body. One way to imagine the way these sands are deposited is to imagine spaghetti, the sands being the spaghetti and then encased in mud. Each one of the spaghetti sands trends through the area encased in mud. Another one is on top of it. Well, how far, it depends, or how much shale, it varies. Here you have got 40 feet of shale, here 20 feet of shale, here 10 feet of shale. Here there are multiple reservoirs encountered in this reservoir.

COMMISSIONER McCORD: Was this well completed?

THE WITNESS: Oh, yes, this is one of -- this is actually one of the initial discovery wells for Grand Valley Field. It was completed initially in the Cozzette, Corcoran; that it was completed in the Cameo section and then it was completed in the -- this lower fluvial interval here. Now, due to pressure, this interval here was produced interval. And the completion people allow me anywhere from 18 to 23 perfs. You select highly perforated sands, generally, look for the highest porosity. You put a perforation in the sands. The thicker the sand, the more perfs it gets. After that you hydraulically fracture the entire interval. You inject into these sands the slurry of water and sands to help induce fractures, to help improve the productivity of the wells.

Q (By Mr. Knowlton) Do you do the same in your fluvial zone?

A We do the same in any zone we encounter in the Mesaverde, the Cozzette, Corcoran, Cameo, the fluvial zones, all similar techniques.

MR. REED: We'll cover that with our primary engineering in a little more detail.

A I believe a final comment on this pervasive fracturing throughout the section and its known existence. This is a tracer log that was run --

CHAIRMAN WELBORN: Is that marked.

THE WITNESS: Can we leave it?

MR. REED: Yes, sure.

THE WITNESS: This will be an exhibit. I will write it on there. I think it's going to be Exhibit 4E. This is 4A here.

CHAIRMAN WELBORN: You are marking what you were referring to -- the log you were referring to originally was 4A. You are now marking this as 4E.

THE WITNESS: 4E. I have some other logs I may or may not introduce.

CHAIRMAN WELBORN: All right.

A This is a tracer log that was run very recently and the results were obtained after our February hearing. Tracer log was run on our GV3-11 well which is located in the southeast of Section 11 of 7 South, 96 West. This interval from here to here is quite similar in position as the interval -- the Cameo interval on Exhibit 4A. What you are -- as far as where you are located in the stratigraphic column, this interval on 4E that we're going to be looking at is very similar to the Cameo interval in the 4A exhibit.

What this log shows or how this log is generated, essentially, is, in our completion techniques we inject a slurry of gelled water and sand. Well, in order to tell where the sands and water goes in the particular perforations, we'll perforate the sands and see if the -- and inject the sands and water gel into the formation well to see where that goes.

We put a little radioactive tracer -- we actually put three different elemental isotopes in the gelled water slurry, and you put them in at different concentration. You put in one isotope when you are just putting in the water. Then you put a second isotope in at one concentration of a sand and third isotope at another concentration of sand.

Although what -- the point of this log is that if we were highly fractured, the response that you see is the relative concentrations of each isotope adjacent to those perforations -- if the area was as highly fractured as you would -- as the DOE is trying to suggest -- we put 379,000 pounds of sand into this completion interval here.

I think if it was highly fractured -- as highly fractured as they would like you to believe, you would have expected this entire log to be this orange color or this yellow color or this purple color. You would have expected massive vertical communications in this well by putting 379,000 pounds of sand in it. You don't see it. You see very limited areas where that sand was in place, it isn't up and down a wellbore, it's just in very selected intervals. Not every one of the perfs even took the sand. There are only some perfs that took the sands.

COMMISSIONER McCORD: If I have missed this, forgive me. Looking at 4E -- can you show me on 4A where that is. In other words, correlate the two.

THE WITNESS: Well, now, these are different wells.

COMMISSIONER McCORD: I am sorry.

THE WITNESS: They are different wells. Four -- that's why -- the 4A well's located here.

COMMISSIONER McCORD: Thank you.

THE WITNESS: The 4E well is located here.

COMMISSIONER McCORD: Okay.

THE WITNESS: The interval that is being covered by this is this Cameo interval, but it isn't in this well, but this is the stratigraphic position in the well.

COMMISSIONER McCORD: So you are below the Mesaverde in this left-hand exhibit.

THE WITNESS: No. This is the Mesaverde. I mean, everything that you see in front of you is Mesaverde. Now, there are finer divisions of the Mesaverde where we're calling this area the fluvial, this area the Cameo, the marine section, which is broken up into Rollins, Cozzette and Corcoran. Simply, this log is one of the completions that we did in another well across this Cameo interval. So, I mean, we didn't see -- we don't do this on every well. I mean, this cost us $15,000 to do this. So it's an additional expense. You don't want to do it on every well.

But we were wondering where do our fracs go when we perforate these wells and we complete in them. This is one tool to tell you how that works. You can look at the response you get in this well and try to infer how you have treated your 47 other wells in the area. We intend to do some additional tracer work out in the area. This is the only one we have done to date.

COMMISSIONER KREY: Why don't you give us the overall thickness of the Mesaverde as you are considering it there, from top to the bottom, and it might help.

THE WITNESS: Well, that this -- the interval from the top of the Mesaverde to the top of the Rollins and Grand Valley area is about 3,000 feet thick. The thickness increases as you go to the east or to Rulison. You have about 3800 feet of Mesaverde section on the eastern side of the Rulison. That does not include an additional part of the Mesaverde which is called the -- which is referred to as the marine section and that is averaging about 1,000 feet with what you are looking at on this part of the log here.

COMMISSIONER KREY: What kind of injection pressures do you use on your tracer?

THE WITNESS: I would have to refer to Ralph for that.

MR. REED: May I answer?

CHAIRMAN WELBORN: Sure. Might as well.

MR. REED: The material goes in the -- with frac jobs, pressures as high as 6,000 pounds have been seen on frac jobs out here than one -- there is a shallower well and a lower order of magnitude, probably on the order of about 5,000 pounds for frac treated, and the tracer material, simply, as it goes in, as you do the whole frac job, you get a look at the various placement areas throughout the job.

COMMISSIONER KREY: Per square inch?

MR. REED: Pounds per square inch at the surface.

COMMISSIONER KREY: There isn't any great big cavity down there?

MR. REED: No, sir.

COMMISSIONER KREY: I thought oil and gas always came in big pools.

MR. REED: I know. That's a common belief, but that is not correct. It's very difficult to find oil and gas in the continental U.S. these days because most of the areas are mature areas. They are not -- they have been drilled and large areas of unexplored acreage just really do not exist in the continental 48, and really not even in the, especially in the state of Colorado and especially in the Piceance basin.

A All right. The conclusion from all of this testimony, you need to encounter this sand to drain the sands. The section is not fractured. The log responses I have shown you here are the same that I have seen in the 50 some-odd wells that we have drilled to date in the Grand Valley/Parachute area.

Next subject I want to address is this sand body geometry. The sand body geometry is important because, as I said, you need to encounter these sands to drain them. Fracture system is not going to do it for you. If you turn to page 10 of your Exhibit 2, you will see that this is just a schematic of an ideal 320-acre well spacing. You can see that on an ideal 320 pattern you could not get wells closer than 3733 feet to each other. You need to keep that number in mind, as we go to page 11. We review some of the geometry widths that have been documented in this area by data from the MWX site.

If you look on page 11, there's a highlight area on the right side or upper part of the page which reads width. And the width of the various reservoirs were determined by three methods: One based on probability, one based on sedimentologic calculations, one on observed out -- observed extent in outcrop. You see there's a footnote to that last outcrop statement. If you look down at the lower part or on the left side, you can read, says, "Outcrop dimensions are apparent widths that may include a significant portion of length." In other words, you are not measuring, in some cases, the true width. You are -- the outcrop is skewed somewhat for the reservoir. You have a component of length entering into the numbers. Remember 3733 feet. I will just go through some of the widths that have been documented in the literature. Paludal zone, 370 feet to 520 feet. The Coastal zone ranges of 120 feet to 600 feet. Note there's a Footnote 4 adjacent to the 600 feet. The Fluvial zone, the lower portion ranges, it looks like from 205 feet to 1,050 feet. Then the Upper Fluvial zone ranges from about 330 feet to 10,000 feet. Again, there's that Footnote 4 reminding there may be a significant length component into that width estimate. Again, most, if not all of those widths are significantly less than the 3733 feet that you have under an ideal 320-acre spacing. You need to encounter those sands to drain them.

On page 12 is another piece of evidence for the widths of the various reservoirs. This comes from the American Association of Petroleum Geologists Bulletin. The paper I am going to cite is shown on Exhibit 2, page 13, Determination of Widths of Meander-Belt Sandstone Reservoirs from Vertical Downhole Data, Mesaverde Group Piceance Creek Basin, Colorado, again by John Lorenz and others.

John Lorenz and others attempted to do some correlations between the closely spaced MWX wells. I have gone through there and highlighted some of his attempts at correlation. If you just want a range in there, you have well spacings between

132 feet and 285 feet. There was sand-to-sand correlation of 94 percent to 70 percent.

Well, what that means is, in wells that were as far apart as 285 feet, there was an -- only a 70 percent correlation. That means one out of three sands or one out of -- well, three sands out of ten did not correlate in a distance as close as 285 feet. If you were to straight line extrapolate that data you would, by the time you got to 3733 feet, you would expect no correlation whatsoever between the wells. In other words, if you were on 320-acre spacing, you would have no sand correlating between each wellbore on an ideal 160-acre spacing. I believe the optimum distance is half a mile. Still, you know, 285 feet, you only have 70 percent correlation of the sands, I don't know what you would have half a mile apart. So one thing, just to sort of help you visualize this a little bit before I go to that. Page 15, the bottom line from the John Lorenz article was that the average reservoir width from his technique was 1500 feet. That's what he thought the width of the reservoir would be, well below the 3733 feet optimum spacing that you have under 320 acres.

On page 16, it's just sort of a

diagrammatic sketch to help you visualize what I am saying here. I have gone in there and put a nine-section grid together. In there you see wells that are ideally spaced on 320. They are the wells that are in gray, both with the gas symbol around them and without. The gray wells are on the 320-acre spacing. The spacing is 160 acres, you can add into that the open or clear circles in the diagram.

COMMISSIONER KREY: Question: Is this part of the previous article or is this your own?

THE WITNESS: This is my own sketch. You can see that each channel is 1500 feet wide. It was scaled correctly. And you can lay these things any way you want. There was no attempt on my part to purposely try and avoid wells or whatever. There is no need to do that. You can go ahead and you can sketch this channel in there of that width, if you like, see how many sands that you can encounter. You need to keep the sinuosity about the same. You can't go convoluting the channel so it goes in there and encounters every well. That's not the way it's deposited. But, no, this is something that I just hand drew myself. It was simply for representative demonstration.

It shows, for example, on the green

Channel A, under 320, you can count three of the dots that were encountered -- that encounter the channel, three wells encounter the channel. Under 160-acre spacing, you get an additional two or total of five wells penetrating that particular sand. It's pretty significant. On the blue channel you only have two wells encountering that channel under 320-acre spacing. Under 160-acre spacing, you do encounter that channel six times. The last go in the red channel, you can go from two to four. So, in other words, you can go anywhere from double to triple the number of potential encounters of a particular reservoir by increasing your well spacing to 160 acres.

What you have to remember about this diagram is, this is just one slice out of those 30 reservoirs that exist in that well. This is a -- taking a depth examination out of that well. There's probably a repeat of this scenario 30 times in this area. This holds for Grand Valley, holds for Parachute, holds for Rulison. The depositional environment is the same.

COMMISSIONER KREY: What's the significance of the picture on your Exhibit 12 -- page 12.

THE WITNESS: Well, I think that is a good representation of the type of depositional environment you are looking at. I mean, you can see that it's a highly irregular environment. You see the channels aren't nice blanket sands, as are the marine sands. They are highly variable, they are -- change in extremely short distances. If you can look under the second "l" in bulletin, you can see a little ship passing in there, just to give you an idea of scale. So that is just a -- that's one of the many types of depositional environments that are occurring in this nonmarine or fluvial section of the Mesaverde.

When -- one point I would make here is reference to the testimony I gave back in February where I attempted to try and find out what would be the number of -- or how much pay would you bypass by having 320-acre spacing versus 160-acre spacing. And I am not going to go through the whole demonstration as I did last time, but I am simply going to refer or refresh you on numbers that I found in the study.

And in that study, I found under 320-acre spacing, an individual well will have 500 feet of pay in it. That only occurs in that wellbore that was the third -- the potential pay in that wellbore, that was only encountered in that wellbore under 320-acre spacing. It was not encountered in any other wellbore. So I wondered what would happen if you increase the number of wells to 160 acres. Would you see all of that pay appear in the additional two wells, or would that -- those wells, with four wells per section, would they have some still unique pay remaining in them. And the numbers that I came up with were there were still 250 feet to 383 feet or roughly 37 percent to 51 percent of the pay that was still only contained in a single wellbore under 160-acre spacing.

So, in other words, you can have 320-acre spacing out there and drill your two wells per section, the two remaining 160-acre tracts that are not drilled are leaving untapped 250 to 383 feet of pay that you are not draining, you are not encountering in the other two 320-acre spacing wells. They are there. They are full of gas. They are good objectives but they are not being encountered in the wellbore. You are not draining them through fracs, they are left in the ground, they are not being drained. We have drilled now 11 wells that are on 160-acre spacing, and they are in the Grand Valley Field. They are located in the south part of 7 South, 96 North, part of, excuse me, the south part of 6, 96, the north part of 7, 96 are located right in here. And those 11 wells, I have seen nothing to change my opinion of the study that I have performed for the February testimony. One additional point I will make about --

CHAIRMAN WELBORN: Let me understand that. So you are saying that means that in your opinion, if you didn't drill that well in your 160-acre example, there would be 250 to 380 feet of pay, depending upon which well it was, that would not be tapped.

THE WITNESS: By no other well. That is correct.

CHAIRMAN WELBORN: You didn't drill that well?

THE WITNESS: It's still there. So -- it's not there. It's just -- you just have to imagine this diagram on page 16 repeated 30 times, stacked on top of each other. I think it's quite clear how that can be so.

CHAIRMAN WELBORN: Okay. By pay, you mean an economically drainable reserve?

THE WITNESS: That's correct. My study last time, I only counted pay that had porosity, and that had gas show, that I would have perforated and completed in. There were, in the exhibit, there were two sands that were, I believe, each 40 feet thick, which were only present in that one wellbore. That's 80 feet of pay that is, if you happened to drill that well, you wouldn't have encountered that sand.

Now, one thing I want to say here is that in this correlation that I have done, I was correlating sandstones. And I was correlating them based on their gamma ray character, which is the highlighted yellow area on Exhibit 4, and I was correlating based on their stratigraphic position. I would make sure they were following in the same part of the section, and I correlated based on thickness. So if they had to have a similar gamma ray character, they had to have a similar stratigraphic position, they had to have a similar thickness for me to consider that they correlated. That was just a -- sandstones. I am not implying that these reservoirs correlate.

Again, as the testimony in February said, there were -- there was an example cited there where there was a sand that I had correlated across. It was -- I know it is the same sand but the problem was that the porosity and permeability changed in that sand so that, in one well, the sand was tight, the other well, the sand was porous, and would have been a productive or a more productive reservoir. So, you know, even these correlations here, you need to be aware that, yes, the sands correlated, but the reservoir quality changes; therefore, you may encounter that sand in a particular well, but it's not necessarily, you know, the same quality as the sands in the additional well. Meaning, even if they are the same sands, it doesn't necessarily mean that the reservoirs are in communication.

CHAIRMAN WELBORN: So communication is the word you folks are under -- not necessarily the communication, even though in the same sand.

THE WITNESS: Meaning you can drill one well, drain that sand, but encounter in another well, it will not have been drained. It's the same sand but the reservoirs are not in communication. So the conclusion of this testimony is that you need a dense well space to encounter all of these sands. You need that dense well spacing to drain the sands or encounter the sands because the fractures are not pervasive in the shale, so you, if you don't encounter the sands, you are not going to drain the sands.

Point D is to address this conception that the entire area, Grand Valley/Parachute/Rulison, is highly fractured. There's no difference in it. That's not so. The geology in the area is the same, the rocks were deposited the same way, but the reservoirs are different based on the degree of fracturing. Grand Valley is fractured to a degree. Parachute is fractured to a degree. Rulison is fractured to a degree. Rulison is more highly fractured than either Parachute or Grand Valley.

In other words, a cooperative effort between the Department of Energy, through one of its contractors, CER Corporation, and Barrett recently where we cored our MV-84 well, which is located in the southeast of Section 4 of 7, 96. There was 106 feet of core taken in that well in an attempt to see if indeed the reservoir characteristics in Grand Valley had any relationship to the reservoir characteristics seen at the MWX site. And I briefly mentioned that, I believe in the February testimony, it was all preliminary data. We have had some additional data done, and again it was primarily done by John Lorenz, who -- the part I am speaking of anyways.

In the core it was recognized in the 106 feet -- let me back up a second. In the MWX core, it was cited in the February testimony that there were 450 fractures seen that were important to permeability in the 4200 feet of core that was cut in the MWX site. There's a -- published numbers on that. That works out to an average of about one frac per ten foot. That's just a rough average. In the MV-84 core where we had 106 feet --

CHAIRMAN WELBORN: This is the cooperative effort.

THE WITNESS: This is the cooperative effort. In the one -- in the 106 feet of core, they found two natural fractures. Now, if we had the same frequency of fractures as was at MWX, you would have expected 11 fracs, one frac per ten feet. 106 feet, you would have expected 10.6 or 11 frac. We had two fracs. So there's one thing to consider for the frequency of the fractures being different in Rulison and in Grand Valley. Again, remember that the MWX site is located inside an area that, recognized by Barrett, anyway, by some authors that I will quote to you, as being a high frac area.

Now, on exhibit -- page 17, there's a paper, SPE Paper 12835. Page 18, there's a highlighted conclusion that I will read to you. "Characterizations of production from the Rulison Field area indicate that a trend" -- not an area -- "a trend of higher production from non-marine Mesaverde reservoirs may be controlled by natural fracturing induced by anticlinal structuring and is apparently independent of sandstone thickening trends."

Point of the conclusion is that somebody said there's an area of higher production that is inside Rulison Field. It's a trend of higher production. The entire Rulison Field is not alike. There is differences even within the field itself.

One other point to make is the anticlinal trends that they are referring to in the paper, this is a structure map on the Rollins formation so it's simply -- I went in there and contoured the depth with respect to sea level, the Rollins formation top. It's a very easy pick. Everybody recognizes that it's a very easily mappable horizon. This contour map shows --

CHAIRMAN WELBORN: You are talking about Exhibit 1?

THE WITNESS: Yes, I am sorry. This is Exhibit 1. The contour map shows a very prominent anticline that trends northwest/southeast plunging to the northwest in the Rulison Field. This map is recently constructed, based on all of the additional wells that had been drilled in Rulison/Grand Valley/Parachute, all of the data has been plugged in on this map. It's an extremely current map. You will notice in the Parachute Field, in the Grand Valley Field, you don't see any of this looping nature, which indicates anticline. You see very gentle strikes to the northwest/southeast, that dips over into the northeast. Same here in Grand Valley. Roughly northwest/southeast strikes, a northeast dip. Nothing to indicate this type of anomaly, this type of anticline in the Parachute area. It's different. Parachute/Grand Valley is different than Rulison.

CHAIRMAN WELBORN: So your point on the fracturing is that regardless of what anybody means when they say highly fractured or fractured or whatever those terms mean, on a relative basis, the Rulison area and then specifically what you would call the trends within the Rulison area is more fractured than the area to the west.

THE WITNESS: That's correct.

CHAIRMAN WELBORN: Would you say on a quantitative basis it's signficantly more fractured?

THE WITNESS: I would say it's significant enough to affect production of the wells, to affect the recoveries of gas that you will get out of the wells. I have additional exhibits here to show you. Maybe you will get a feel for the quantitative nature of this.

CHAIRMAN WELBORN: For my simple mind, the example that you gave was -- difference between 2 per 100 and whatever and 10 per 100 and whatever. So is it 5 times as much, then?

THE WITNESS: That's almost 500 percent difference. From -- going from 2 to 11. I am not in a position to give you a quantitative number for that. All I can say, relatively speaking, this area bounded by the two red lines in 6, 94 is significantly more fractured than areas outside those two red lines, whether it be in Rulison Field, Grand Valley Field or Parachute Field. There, you know --

MR. KNOWLTON: We do have some further occasion to quantify that might be of help to you.

A Okay. On Exhibit 2, page 19, this is a production list of well cums from the Rulison Field. It's intended to show you the effect of a natural fractured area. The higher fractured area, inside the trends -- you will see there are two columns, one for wells that fall inside this frac trend, and one for wells that fall outside the frac trend.

Now, if you will look on the Exhibit 1 map, I have a bunch of dots, either red or green dots. These dots are on wells that were drilled by Northwest Exploration between the years of 1980 and 1982. They were drilled by the same operator. They were drilled under similar -- the drilling conditions were the same. The marketing conditions were the same. There ought to be some relationship in here between the quality of the well, because, if everything is the same in here, you would expect all of the wells to have similar cumulative production.

The red dots are wells that have cumed over 200 million cubic feet of gas. The green dots are wells that have cumed to date as -- or as of November of '89, which was the most recent production, they have cumed under the 200 million cubic feet of gas limit. I, just looking at the columns there, I have totaled up wells.

First, let me address -- I think something that might be asked, why is there one green dot inside the trend; that is because that well was completed in one sand. It was not completed in the typical 500- to 800-foot interval. The typical 10 to 20 feet or 10 to 20 sands that is completed in the typical -- on Rulison, it was only completed in one single sand. That's the Clough 2 well that's listed under the inside fracture trend list.

You look at the total for the five wells, only five wells that are inside the trend, you see they have cumed 2.4 BCF on that list. You look at the 10 wells that are outside the trend, they have only cumed 1.1 BCF. The five wells that are inside the trends have cumed twice the amount of gas as the 10 wells that are outside the trend. They were all completed at the same -- they have been on production the same amount of time. The average cum of gas from the wells inside the trend is almost half a BCF. The average cum per well outside of the trend is about 100 million cubic feet. There's 332 percent more gas, 332 percent more gas on an average well basis that has been produced from wells inside the trend. There is something that is different between the wells that are inside the red lines and the wells that are outside the red lines.

Now, there's a list there. It says other wells drilled inside the fracture trend. It's simply of interest. They can't be compared because they weren't drilled by the same operator. They were drilled at various times. I just ran through these wells just to show you some of the wells that were drilled inside this fracture trend.

MWX 1, 2 and 3 were all drilled inside what we define as the fracture trend. The No. 1 Shot, which is the horizontal hole that -- drilling horizontal hole to encounter fractures, is being drilled inside the trend. Initial discovery well for Rulison Field, Juhan No. 2, that well cumed almost a BCF of gas. The highest cumulative from nonfluvial reservoirs in this area the initial development well, that Juhan 1 in Section 35 is cumed 800 -- almost 800 million cubic feet of gas.

The two Barrett wells, RMV-1 and RMV-2 were drilled inside the trend because Barrett recognizes it as a high frac trend. Barrett knows that's a place to drill the wells to get the best kind of wells. 1XM9, 1XM19, DOE wells that are on DOE acreage are drilled in those trends. They are currently on-line, producing. The data I have, they are both producing over a million cubic feet a day. I think there is, you know, seems to me there's something different, even in Rulison Field, based on production characteristics.

If you turn to page 19A of Exhibit 2, this is a paper -- this is actually the precursor paper to the SPE 15248. This well was done by the same authors, again working for the DOE. If you look on page 19B, you will see I have the two red lines highlighted on that page. There are two maps that were in this paper that were generated by the DOE: One is a fracture permeability map, the lower map is a cumulative production map.

Now, without trying to strain your eyes to look at the Figure 4 map or upper map on page 19B, the contouring of the data shows that the higher permeability falls inside the red lines. If you look at the lower map, the Figure 7 map where it shows the contour of 25-year cumulative production, you see right in the middle of those two red lines there's a billion -- 1.5 MCF well, 1.5 billion cubic feet. You look to the east, where they have the well controls, you see those numbers go from 1500 MCF down to as low as 100. I think it's clear, even the DOE papers modeled an area of higher cumulative production.

There is a difference in Rulison Field in that the area inside the red lines is different from any other area in Grand Valley Parachute or Rulison. If you would flip back to your exhibit, page 5, real quickly I wanted to show you -- this is again the SPE 15248. There's a Table 1 in the left side that has a highlighted title block. In there, there's some wells. They are the wells that are shown in the orange and green dots on the map. They -- the authors labeled them MV-1 through MV-26. I have handwritten in the numbers that are -- have handwritten in the names that the wells are commonly known by.

The table is the percent of sandstones drained at 25 years by Mesaverde wells. Percent drained -- the percent of sand that is being drained in those -- in that table or being drained by those wells. The little asterisk out to the right side of the numbers denotes the wells that are shown in red on the Exhibit 1. You will see that they have the highest percent drained numbers of the wells that are listed. So I think, again, another study, the same people did it, they came again to the same conclusions that there is some sort of difference. The highest recovery is coming out of wells that are located inside the red lines or inside the highly fractured area.

CHAIRMAN WELBORN: Do your red lines on page 19B correlate with the red lines --

THE WITNESS: As best -- they are intended to do that, yes. They were supposed to do that.

CHAIRMAN WELBORN: So that means, therefore, that this paper's conclusions as to where that trend lies is the same or roughly the same as your conclusion?

THE WITNESS: Well, I am saying, there was a recognition by this paper of an area of higher permeability and of higher cumulative production. They did not specifically define these red lines, but I am saying this is another piece of evidence to show that there is a difference in the field itself. And, yes, those areas of better production, better recovery, correlate to this high fracture area which is denoted by the red lines on Exhibit 1.

COMMISSIONER KREY: The red lines overlay a series of dotted lines. Now, you put the dots on there.

THE WITNESS: Yes, I did. All right. On Exhibit 2, page 20 is another study, another way to look at the difference between this high fracture area and the area that lies outside of it. This is a paper or it's actually a study that was done for the Department of Energy by the CER Corporation, July

1989 study entitled, Geologic and Production Characteristics of the Tight Mesaverde Group, Piceance Basin, Colorado.

On exhibit page 21, a map was generated using log calculations to look for natural fractures. The wells that were of interest that were used in this calculation are named on the exhibit. You see the Clough 21, the Langstaff 1, the 1XM19, the 1XM9, multiwell site, the two Barrett wells, MV-1, MV-4 then an old Northwest, now Fina, Well B1, which stands for Battlement No. 1. Well calculations show a definite or a distinct difference in the Rulison Field versus other areas in the Piceance Basin.

I think everybody recognizes the Divide Creek as being a highly fractured area. It's shown in both black -- which you look at the explanation, more than five fractures -- and orange which is two to five fractures -- the orange color is also shown in the Rulison Field area. Those are the only two areas of high fracture intensity shown through log calculations. The area of Grand Valley/Parachute is shown in the red outline. It's a rough outline of where both the Grand Valley and Parachute Fields are located. You can see that they are different than the Rulison Field. They lie in the one to two fractures per 1,000 feet, or the less than one fracture per 1,000 feet.

Something else to notice about the Rulison data is, every one of those wells that is used in the calculation falls inside the red lines on the map. So if they had gone through the trouble of taking log calculations from the wells outside of the trend, their little circular area of two to five fractures would most likely be even narrower than shown. Okay.

Another piece of evidence here to show there is a difference in the Rulison Field from any other area. Starts on exhibit page 22. This is a title block from a seismic line that Barrett has had since before it moved downtown. The address is still Lakewood, Colorado, so it's a five-year-old line. Interpretation is at least that old. If you look on exhibit page 23, which is the next page, you will see the Rulison Field again depicted. You will see a -- see the multiwell site highlighted down in Section 34 at the bottom or the right side of the page.

Two yellow lines correspond to the two red lines on the map. These are -- this is actually where the boundary for the red lines came from, was from a seismic line. The southwest line appears to be a syncline on this level. It's a fault at other levels. The northeast line, the same thing. It's a fault. That's where -- I didn't just arbitrarily draw those lines on there. I pulled them off of the seismic data.

The red line going from the left to the right side is the seismic trace. Now, it's a proprietary line. I would be happy to pass the line around. I cannot enter the data as an exhibit. I have simply gone in and traced out areas that are indicated in blue, yellow and red, and highlighted them on your exhibit page 24. So, if anyone wants to look at that, that is fine with me. No problem with that.

But the point of the seismic section is that the reflectors across Rulison Field and inside the red lines are discontinuous, simply indicating that the areas are different from either side. The anomaly may be due to fractures. It may be due to something else. I believe it is due to the fracturing. It is somehow causing a loss of reflectors across the area that is bounded by the red lines. The significant point is, it's different. The -- inside the core area is different from either side. There are -- reflectors are continuous all of the way to Grand Valley through Parachute. You see those reflectors when you get into the core area of Rulison, which is bounded by the red lines. You lose the -- you lose the reflectors. Something is different inside there.

COMMISSIONER KREY: Excuse me, one moment. Are you calling this a fracture line? It's at the bottom, two-section, east/west line. Is that a fault? What have you got there?

CHAIRMAN WELBORN: What page are you on?

THE WITNESS: Page 23 is what he's on. That is a simple thrust fault that is interpreted to exist there. It must be coming from a line that is not shown on this map.

COMMISSIONER KREY: You don't have that on your map?

THE WITNESS: No, I did not. Because this is taken on a Morrison level, which is some 6,000 feet deeper than the interval that's shown on that map, on Rollins map Exhibit 1.

Okay. Just a couple of more points on the differences of Rulison from other areas. Start on exhibit page 25. Now, this is a record of a drilling history of a well drilled by Northwest inside the fracture trends. You look down there, the common practice at Northwest was to air drill the Mesaverde in order not to damage the fractures that they might have believed were present. Also certainly enabled them to drill the wells in two or three days. When you mud drill them, it takes maybe seven to ten days to drill the same amount of section.

Important thing to note is the highlighted area on June 21, 1980. I will just read that: "Depth 7486 waiting for flare to decrease, rebuilding blewie line." Then the second highlighted area, "Drilled to 7486 and took gas kick. Kick blew blewie line apart underneath substructure. Blew down well through four-inch choke line. Estimate gas rate of five million a day." That's certainly, to me, would indicate fractures if you get five million a day natural flow out of the -- a reservoir you certainly would think you are fractured and probably highly so, to get five million cubic feet a day out of a well.

Q (By Mr. Knowlton) Would you point out the location of that well?

A It's this well here.

CHAIRMAN WELBORN: It's within the red line?

THE WITNESS: Yes. Page 26 is a page from a geologic report done for Barrett.

COMMISSIONER KREY: Who drilled that well?

THE WITNESS: Northwest. That was one of Northwest's wells. Page 26 is a page out of the geologic report done for Barrett on the only well that is air drilled in Grand Valley Field. This had -- there's a list of flares there; that links vary from as small as 2 feet. There's one that's 40 feet. There's 1,000 feet of section open in a similar type of interval. We have all heard the geology of the area is the same. So, therefore, you would have expected that kind of flow rate of maybe five million a day out of their well. I am sorry, 1,000 feet of the section was open. We had air drilled in a similar fashion to Northwest. We had a couple of flares going through there which probably indicates we have a couple of fractures. We certainly don't have the degree of fracturing that would give us five-million-a-day flow rate.

Couple more points. I have a couple of mud logs here that were done for Northwest by

Rocky Mountain Geoengineering Company out of Grand Junction. These mud logs come from the initial well drilled by Northwest. The Golding No. 1 which is Section 14 -- it's located right here outside of the trends -- and the Langstaff well which we heard quite a bit about, which is located inside the trend. I don't think I am really going to have to tell you which well is located inside the fracture trend, which well is located outside of the fracture trend. I think it's pretty obvious.

The well here is the Langstaff. The mud log is showing gas saturation all of the way down to TD, must be highly fractured in there. Gas is -- has saturated the mud system. There's just so much fracturing inside this trend that it just feeds into the wellbore and saturates the mud system. Same mud logging company, actually, same mud logger did the same -- the wells. This is the first well that was drilled, the Golding well, the Langstaff was the second well. They might have been a little bit discouraged when they were drilling the Golding well. I am sure they were quite happy when they were drilling the Langstaff well.

Q (By Mr. Knowlton) Do you want to introduce those?

A I have got these mud logs from the oil and gas commission, so they have copies. I prefer not to give those up. If I could --

CHAIRMAN WELBORN: Don't you -- you think that would be part of the record?

MR. MONAHAN: That should be part of the record.

THE WITNESS: Then you could have them.

CHAIRMAN WELBORN: Can we mark them Golding and Langstaff?

THE WITNESS: We can, yes. This -- 4F will be the --

CHAIRMAN WELBORN: Will be the Langstaff.

THE WITNESS: 4F will be the Golding well. The 4G will be the Langstaff well. I will have to come get some more. Okay. Final statement on this fracturing. Starts on exhibit page 27. Last time there was statement made by the DOE at the end of their testimony that, okay, MWX area is fractured, located in the 6 South, 94 area. De Beque Canyon, which is down the Colorado River Valley a few miles, that is also highly fractured based on outcrop studies. Therefore everything in between De Beque and the MWX sites must be similar.

The paper that was cited was a 1984 paper by Grout and Verbeek. The title page is shown on page 27. Read you one of their conclusions which is highlighted on exhibit page 28.

Q (By Mr. Knowlton) Excuse me. This is -- is this 1984? You said '84?

A The paper that was cited by DOE in February was a 1984 paper. This is a 1985 paper that I am about to quote from. "Mesaverde sandstones in the De Beque Canyon-Plateau Valley, however, contain only younger joint sets of the Piceance system and the fracture network there is wholly unlike that of correlative rocks along the Hogback and beneath the MWX site. No useful conclusions on reservoir performance near the MWX site can be gained by studying exposed strata in and near De Beque Canyon."

Q Would you be able to locate on our exhibit the area identified as the Hogback? Is that on the map?

A Yes. But -- barely clip the map. But would be located, really, it would be in the 5 South, 93 West area. And it would extend to the north and it would extend to the east of there. I think the next -- you will see it a little clearer on the last part of the discussion here.

So I want to -- just a quick summary on what we have talked about so far; and that is, the sands, I think, have been shown to be discontinuous. I think it's been shown that they are. What is fractured? The shales aren't fractured. You need to encounter those sands to drain them because you are not going to drain them through the shales. Reservoirs do change in the area. I think it's been shown by the core data, the structural control citing the Rulison anticline, the production cums, the log calculations, which was the natural fracture log, the seismic line, the drilling characteristics, mud logs, and one other thing I will mention that shows that reservoir is changed in the area is common knowledge that Rulison Field is an overpressured field. And Grand Valley is not overpressured. And Parachute is not overpressured. There's, again, a difference in the reservoirs in the area.

Final point to make is Point E. That is, even if fractured -- let's see -- even the fractures that do exist in the area, they exist in different degrees. I think we have tried to communicate to you. The fractures that I have seen documentation on all trend east and west. Now, what this does is, it gives you a symmetric drainage area. In other words, the data that's come out of the MWX site is shown that the primary orientation of the fracture is slightly to the north of -- or to the northwest of a true east/west orientation.

The fractures have an, incredibly, have quite a bit higher permeability than the matrix permeability. Essentially, they are cracks in the rock. They definitely help drain the reservoirs. What they do is they give you an elongated drainage pattern. There's a -- you can cite references that say that this drainage asymmetry is on the order of 100 to 1. In other words, you will drain -- for every 1 MCF you drain out of the matrix permeability, you are going to drain 100 MCF out of the fractures. So you get 1 MCF from the north and south, you are going to get 100 MCF out of the east and west.

I think you can all see that the majority of the DOE boundary with Barrett is an east/west boundary. Therefore, most of the south offsets that are shown were not going to drain the DOE through fractures. They are going to drain it through the matrix permeability. We'll get 1 MCF for every 100 that we drain off of our own acreage in an east west fashion.

COMMISSIONER McCORD: You are saying your ellipse has 100 to 1 ratio.

THE WITNESS: That's correct. The reference I read -- I will dig through and find, if you like. The range I saw was 30 to 100. So you go from -- anywhere from 30 MCF per 1 MCF to as many as 100 MCF per 1 MCF. I am sorry, if you would look at page 30, that gives you the -- exhibit page 30, you will see the orientation I am speaking of. Quite a bit of data to support that the yellow area that is highlighted, the yellow cross diagram shows the east/ west. It's not true east/west but it's pretty close to east/west. We, again, from the cooperative efforts with DOE on that MV-84 core, which was located in Section 4 of 7 South, 96 West, we got some, I don't know if it's preliminary or final conclusions. Their conclusion also came that there was generally an east/west fracture trend in the Grand Valley area. There weren't -- appeared to be not as many fractures, but they were oriented the same. So you can infer that probably the orientation in Grand Valley is similar to that in MWX and probably the same in the Parachute area too. The degree difference in the orientation does seem to be about the same.

So really, in conclusion, I think -- I hope I have demonstrated that parts of the Rulison are unique from any other area in this part of the Piceance Basin. It just happens that MWX is in this unique area. It happens that's where the mounds of information that have been published have come out of. I think I have shown you that the shales, through citing references here, are not fractured. And that if you don't encounter the sands, you are not going to drain it. These sands are extremely discontinuous. And you need a denser well spacing to get every one of them.

This applies in Grand Valley, this applies in Parachute, and even this applies in Rulison, it applies in any part of Rulison you want to talk about. You can talk about highly fractured area. Doesn't matter. The highly fractured area has high fracture in the sands but not in the shales. So you need dense well spacing to hit these sands to drain them. It's great to have high fractured sands. You can get a lot more gas out of them. You are not going to drain them if you don't hit them. And that's really all I have to testify to. I will be happy to answer any questions.

CHAIRMAN WELBORN: That concludes the direct examination?

MR. KNOWLTON: Yes, it does. I would like to get the exhibits.

CHAIRMAN WELBORN: Were these Exhibits 1 and what have we got, 4E -- 4A, 4E, 4F, and 4G and Exhibit 2, pages 1 through 30, I guess we were at, all prepared by you or under your supervision?

THE WITNESS: That's correct.

CHAIRMAN WELBORN: All right.

MS. EGGER: Mr. Chairman, I find it hard to believe that logs on wells donated by other companies were prepared by -- under his supervision and direction.

CHAIRMAN WELBORN: What he did was --

MS. EGGER: I see.

MR. KNOWLTON: Of course some of the studies conducted by DOE are not his.

CHAIRMAN WELBORN: The exhibits were compiled. Do you have any objection to the admission of these?

MS. EGGER: No, I don't. I have a -- similar exhibits, that I hope that's not going to be --

CHAIRMAN WELBORN: I clicked into an

old phrase. This is the government. We use phrases. All right. Those exhibits are admitted. I don't know if anybody else needs one, I need a quick break. Let's make it -- what time is it? Let's reconvene at 3:10 because we're going to run tight on the other side if we don't watch out. All right.

MR. KNOWLTON: Any of the commissioners wish to examine this proprietary geophysical data? This is available.

CHAIRMAN WELBORN: We'll reconvene at 3:10.

(Recess.)

CHAIRMAN WELBORN: Let's go back on the record. We have two hours of one witness. Can we extrapolate from that the way your witnesses -- extrapolate from their other evidence?

MR. KNOWLTON: Our engineering testimony is 30 minutes.

CHAIRMAN WELBORN: 30 minutes. How much time do you have, Ms. Egger?

MS. EGGER: We have five witnesses. I don't think they will be two hours apiece. I will assume maybe three to three and a half hours total.

CHAIRMAN WELBORN: So, in other words, we can't complete this by 5:15 tonight?

MS. EGGER: Not given this time. I will be willing, for the record, to continue on tonight rather than continue on to Greeley tomorrow.

CHAIRMAN WELBORN: The problem is, you lose me at 5:15. So it's sort of up to the rest of the commission. If the commissioners want to go ahead and finish up tonight, we will do it. If they would rather finish it up tomorrow, we'll do that. How many are available tonight? Of the three of you, would you prefer to go over to tomorrow or finish up tonight?

COMMISSIONER JOHNSON: The majority of the commissioners can be here. I think we want to make this decision right.

CHAIRMAN WELBORN: I think we'll go over to tomorrow. Finish it up tomorrow. All right. Let's proceed as quickly as we can.

EXAMINATION

BY MS. EGGER:

Q Mr. Reinecke, I just have a few questions. See if we can go through it quickly. With respect to the SPE Paper 15248 that you talked about, do you know how many years of production history were used to characterize the reservoir in that study?

A Four years.
Q Would you agree that ten years would provide a better characterization?
A I don't know if it was the initial four years of production or if it was the last four years of production.
Q Would you agree, in response to my question, would you agree that ten years of production would be a better basis?
A I can't tell you. Maybe if it's the last four years, then you do have your ten years of production.
Q So you are saying -- can you, again, answer my question: Would you agree that ten years of production would provide a better basis?
A Yes, I would agree with that.
Q To what extent was economics used in arriving at the conclusions of 160 acres in that SPE paper?
A I think -- I don't believe economics was considered.
Q Okay. Would closer fractures spacing and higher fracture permeabilities allow drainage of a larger area than was referred to in that study?
A No, it would not.

Q It would not?

A No.

Q Closer fractures spacing and higher permeabilty would not?

A Not -- fractures are -- have one direction. So, no, it would not.

Q So it's your testimony that higher fracture permeability and closer fracture spacing would not affect the drainage?

A No, because the sands are what is fractured, not the shales.

Q I think you talked a number of times about the DOE position; that we contend that the areas are highly fractured from top to bottom. Can you point specifically to what you're relying on?

A Sure. I can quote you from your testimony. Just bear with me until I find it.

Q Will this be in the March or February?

A This is August.

Q You only got the geology part.

A This is February. Let's see, it was in the second part of the testimony, I believe, if I can find it. Can we come back to that while I look for it? I don't have a problem finding it, just looking for it.

CHAIRMAN WELBORN: Can you give me the question again so I can --

MS. EGGER: Yes. His testimony was that the DOE's position was that the area is highly fractured from top to bottom of the Mesaverde interval. I asked him to point specifically to what he was relying on in making that statement.

MR. MONAHAN: Do you know -- do you have someone on direct that will indicate some contrary information?

MS. EGGER: Yes, I think so.

MR. MONAHAN: Probably easy enough to rely on that rather than have him search through that document to try to find the specific reference.

Q (By Ms. Egger) Mr. Reinecke, the tracer log?

A Yes.

Q Tracer log, Exhibit 4E, I believe that was run in the Cameo; is that correct? It was run in the Cameo. Isn't that a coal body out of sandstone?

A There are sands and coals in the Cameo, yes.

Q Would you expect something different in the different geologic units such as Mesaverde lenticular sands? Those were lenticular sands in the

Cameo?

A Yes, there are.

Q I think, in relationship to that tracer log as well, you indicated that not all of the perfs received tracer material. Do you know what percent was missed?

A Oh, maybe, probably 20 percent. You can count them, if you would like. 20 percent -- maybe five of them didn't take a frac. They were individuals perfs and tight zones. They give gas shows so you go ahead and perforate them anyway as you drill a well, gas is contained in the sands, whether it has 1 percent porosity or 50 percent porosity, as you drill out, you grind the sand up, you liberate the gas, so you give the gas show, you can put a perforation in it.

Q Refer for a moment to your -- I believe it's page 16 of your Exhibit 2. Do you have it there, page 16?

A Yes, it's this one, sure.

Q Was that discussion limited to width? Did you consider, for example, the length of the sands or does it assume that each wellbore is plotted to meet the one direction?

A The length is shown an is if in fit.

It comes off the page and over the page.

Q Is there a kind of control on the lense direction to miss the length at that time at all?

A I don't understand the question.

Q Okay. We can move on. I guess it refers back to page 11. And the -- just considering the width of the intervals there, is there a length dimension there?

A Is there what?

Q A length consideration there?

A No. I mean, the -- what you're considering here is the narrowest portion of the reservoir, which is the width. Length has -- I mean you can see on page 16, I have got as long as I drew it -- point is, the width is narrow. You could draw these things ten miles wide, if you like. The point is, they are so narrow they can slip through the wells if they are spaced on 320.

Q I believe you earlier testified on this seismic data. Do you believe seismic data is a reliable source for fracturing?

A No, I didn't, I didn't claim that either. I said it shows that there was a difference in the Rulison Field where the area is bracketed by the red lines and differences outside. I said this is maybe a -- simply an indication that the field is different and may be an indication that the area is fractured. Fracturing may cause a loss of reflectors.

The seismic is generated by sending an impulse into the ground and it reflects off of an interface -- velocity interface. In other words, if you have something that it -- you have something that the seismic waves will travel through faster, something it will travel through slower, at that interface you will get a reflection. I am saying maybe the fracturing in the area is one explanation for the loss of reflector. The point of the exhibit was to show that area was different from either side of it.

Q Do you view whether -- the logs as reliable method of identifying fractures?

A Apparently from MWX it's not.

Q So your answer is, no, you don't believe the log?

A Well, what kind of logs are you speaking of? I mean, those logs there -- depends on how you use them. The mud logs, I think, would be indications of fractures because in a fractured reservoir you have higher permeabilities; therefore, more gas is able to escape in the well as you drill the well. The entire reservoir, not as much gas would escape out of the reservoir; therefore, you wouldn't have as big of a show. Electric logs, apparently CER thought they were worth using calculation off of the logs to detect fractures. They created a natural frac log which I showed in the exhibit. They published that data, so -- page -- exhibit page 21 -- so they felt it was.

Q You are saying it depends on the type of log taken?

A Yes, there's probably 20 different types of logs you can run. Whatever logs were run to create this diagram, apparently the people who built the map thought that was correct, they were applicable.

Q Correct me if I am wrong, but did you state that the Grand Valley and Parachute Fields are not overpressured?

A Not significantly, so -- not that I have seen. They are certainly -- or not as overpressured as Rulison Field.

Q Could this be an indication that fractures connect the sand lense to some outside area relieving them of pressure?

A No, I don't think so. I think it's an indication that the Rulison Field was buried deeper, has been exhumed faster than either Parachute or Grand Valley. You have got gradual increase in your pressure gradient as you go from Grand Valley to Parachute. We have not drilled a well yet in Parachute. That's overpressured. As we get to the eastern side of Parachute, we may very well do so. We have not done so at this time.

Q I am going, for a minute, to coal bed. As I understand, most of your testimony, if not the vast majority of it, is related to the sandstone and I am wondering what -- whether your view is that the coal beds are fractured.

A Well, everybody recognizes the coals have cleat systems, so, yes, they probably have some fractures to. Whether that is -- the cleat system is effective in the permeability of sands, I don't think so, no. Yes, I think it's fractured, but I don't think the fracturing helps the coals as much as they do the sands.

Q So it isn't that the coal beds are more continuous than the sandstones?

A No, the coal interval is continuous,

just like the sand interval is continuous. The individual coal beds are discontinuous just like the individual sands beds are discontinuous. It depends on what kind of scale you are talking to. You cannot take a coal bed that is in Grand Valley and trace it over to Rulison.

Q But in answer to my question, would you view the coal beds are more continuous or less continuous than the sandstones?

A I have no idea. If you want a quantitative answer, I would say they are both discontinuous. It depends on what your definition of discontinuous is.

Q Has Barrett taken any core samples in the coal beds?

A Yes, we have taken three or four cores, I believe, with the coals.

Q With respect to fracturing, what was the result of that?

A Pretty dismal. Our basal coals, we find, are, when we core them, we come out as a very competent piece. They are solid. You can pick them out of a coal barrel. They sure show no evidence of fracturing. Some of the upper coals which are thinner come out of the core barrel in pieces. This may be due because they are thin and the core barrel has busted them out as you core them. Maybe due that they are a little bit more fractured. I would think the thinner coal beds are maybe a little more fractured than the lower ones. I don't think we found frac one in a thick lower coal bench in a core.

Q With respect to the February 20 hearing, do you recall testifying at that hearing before the commission?

A Yes.

Q Do you recall testifying regarding the core sample taken from MV-8 located in Section 4 of 7 South, Range 96 West in the Grand Valley?

A Yes, I do.

Q Do you recall your testimony, and I quote, "But it turned out upon comprehensive study of core that all of those fractures were drilling induced. They were not natural fractures. That's at page 87.

A Is there any other reference in that that I said it was preliminary data?

Q Do you recall that statement?

A In that testimony, if I didn't say so, I should have, that that was preliminary data. I stated today we found two natural fractures in that core.

Q So a comprehensive study is preliminary data?

A Yes, I guess.

Q Let me show you --

A Are you just leaving that out on purpose or was there something in there that said -- that I quoted preliminary data.

Q I believe later on in the testimony, in rebuttal testimony, talked about some preliminary data. That precise quote is in context and is precisely what you said.

A In the testimony as a whole I did indicate that was preliminary data.

Q Let me show you a document marked DOE Exhibit R. It will be in the DOE exhibit submitted later on.

A Yes.

Q It's entitled Core Frac Description Orientation Summary. It's pages 19 through 25 of the larger summary.

A I have seen the document.

Q I will represent to you and the commission, this is the summary portion of the core analysis report prepared by CER. On the MV-8 core sampling you were testifying to, isn't it true at -- described in pages 22 and 25 there were, in fact, four natural fractures found in that core?

MR. MONAHAN: Is the witness familiar with the exhibit?

THE WITNESS: I am familiar with it. This is the well. 24 and 25, natural fractures.

Q (By Ms. Egger) Page 22.

A Yes. 22. Fine. I don't know. Get John Lorenz up here and ask him. He's the one that did the study.

Q Well, the question is posed to you.

A I understand. Your three natural fractures occur between 5845.2 and 5848.1. Seems to me, it it may be the same fracture. You are talking about a difference of a foot and a half, two feet, whatever.

COMMISSIONER KREY: Did we get a copy of that?

CHAIRMAN WELBORN: I need to ask, are there pages -- is this a document, pages of which we already have in their Exhibit 2?

MS. EGGER: No, it will be in our exhibit package. I can provide it to you right now or later on.

CHAIRMAN WELBORN: However you want to proceed. I will leave it up to you.

A Let me quote you something from a paper that was dated March 27 --

Q (By Ms. Egger) Let me just ask the questions.

A Let me tell you right there, it said the only clear natural frac was found to strike 110 degrees, in a paper that postdates this study.

Q Your attorney have will an opportunity to ask questions after I get through.

A You are doing the same thing you did last time. You're leaving out significant data.

MR. MONAHAN: Please don't argue with counsel.

Q (By Ms. Egger) For the commissioners, it's marked there with a tab, Exhibit R, because of its length. And the CER report is the first of two core reports that we are talking about. To continue on, on February 20, did you also testify about a core sample taken from MV-5 in Section 10, Township 7 South, Range 9 West?

A I believe I did, yes.

Q Is this well also referred to or used to be identified as Grand Valley No. 2 Federal?

A That's correct.

Q I would like to show you another document. This is still part of DOE Exhibit R. At the top, left-hand side of each page, it contains a description: Good, very tight sands, gas sands, research core fracture description. It also contains selected pages of a larger core report. Have you seen that document before?

A Yes, about four or five years ago, I did.

CHAIRMAN WELBORN: What's the page number on the bottom of it? 53?

THE WITNESS: This is page 18 on this document.

CHAIRMAN WELBORN: Oh, all right. Okay.

MR. KNOWLTON: Mr. Chairman, my only trouble with this line of examination is that I think it's better introduced through their witnesses. The fact that he may or may not be acquainted with it makes it all the more remote for them, and unless he can take it and study it, I am a little troubled by this example.

CHAIRMAN WELBORN: If he's not acquainted with it, he can say he's not. If he can't answer, he can say he can't answer.

THE WITNESS: Let me ask what the line of questioning is leading to.

CHAIRMAN WELBORN: No, she's entitled to cross-examination. And as far as I am concerned, this is proper cross-examination. If you can't answer, just say you can't answer.

THE WITNESS: Okay.

Q (By Ms. Egger) Is the date on top of that page July 8, '85?

A That's correct.

Q The packet, your packet materials of DOE exhibit, the title page which is not included there, is dated November '85, just for reference. Could you indicate what well this document was reporting on?

A Grand Valley No. 2 Federal.

Q Again, as I think you indicated earlier, this is the same well you testified to about the core sample taken identified in the February 20 hearing at MV-5?

A Okay, yes, that's correct.

Q Do you recall testifying, Mr. Reinecke, or not, and I quote, this is also at page 87 of the hearing transcript, that "They core the marine interval which was the Rollins/Cozzette/ Corcoran, they took about 400 feet of core. They were so basically disillusioned at the result of the core being so tight they had initially intended on doing lease work for us. They basically backed off of it because it was just too tight for them. They didn't have any fractures at all." Do you recall that testimony?

A Again, if I said that, it was incorrect. I said that at the onset of my testimony today, we do have natural fractures. I am not disputing there are natural fractures in the area. I am disputing the degree of them.

Q Mr. Reinecke, isn't it true --

A Let me also answer that these are also marine sands. They are not nonmarine sands. I mean, we're not talking about apples and apples. We're talking about blanket sands versus lenticular sands with this particular testimony from this Grand Valley 2 Federal.

Q This was the same core sample that you were testifying to at the February 20 hearing; is that correct?

A Yes, that's correct.

Q Isn't it true, Mr. Reinecke, as

indicated in that -- on that document that there are, in fact, identified a total of 11 fractures in that core sample?

A Yes.

Q They are on pages --

A Yes, there are some fractures that are highlighted here as natural fractures, no question about it.

COMMISSIONER McCORD: Mr. Reinecke, just a matter of procedure here, can you wait until she is finished posing the question before you answer. Extremely hard to get it down.

Q (By Ms. Egger) In response, then, to my question, isn't it a fact that there were 11 natural fractures identified in that core sample?

A Yes.

MS. EGGER: Okay. That concludes my questioning. I would ask that those two exhibits be admitted into evidence.

CHAIRMAN WELBORN: These are portions of Exhibit R.

MS. EGGER: The total of Exhibit R, they are portions of larger core reports.

CHAIRMAN WELBORN: Okay. Do you have any objection to those been being admitted at this time, Mr. Knowlton?

MR. KNOWLTON: Beg your pardon?

CHAIRMAN WELBORN: Do you have any objection to this exhibit being admitted?

MR. KNOWLTON: I don't object.

CHAIRMAN WELBORN: The exhibit is admitted. This is all of Exhibit R. Do you have any redirect?

MR. KNOWLTON: No.

CHAIRMAN WELBORN: No redirect. Okay. Please proceed with the next witness.

MR. KNOWLTON: Our next witness, I think you have an outline of his qualifications.

CHAIRMAN WELBORN: Right, first he must be sworn.

(Whereupon the witness was sworn.)

CHAIRMAN WELBORN: Please proceed.

EXAMINATION

BY MR. KNOWLTON:

Q State your full name and present address and present employment.

A I am Ralph Reed of 1551 Larimer here in Denver. I am executive vice president of production for Barrett Resources.

MR. KNOWLTON: If the commission

please, we are submitting his qualifications. I think he has not testified before this commission before, so I would ask that his qualifications as petroleum engineer be accepted at this time and then I will briefly cover his area of interest in Garfield County.

CHAIRMAN WELBORN: All right. We have your resume and your qualifications are accepted as expert in petroleum engineer.

Q (By Mr. Knowlton) Mr. Reed, your -- it indicates that -- your biography here that you have held management positions in the Rocky Mountain area, at least since 1974. Why don't you just briefly tell them what areas you have worked in that would probably relate, if not definitely relate, to this area?

A Very well, sir. I was division engineer in the early '70s here for three years for Amoco. We did have operations throughout Colorado, Wyoming, Utah. I spent seven years as vice president of production and president of Cotton Petroleum. We had a Rocky Mountain Division office. We did develop Wasatch and Mesaverde properties in the Uanibiks (phonetic), which are similar to these. Following the sale of Cotton Petroleum, I spent two years as consultant, following Barrett's operation for the parties by whom I was employed. So I followed this field directly for some 2 1/2 years.

Q Although you did not testify in the February hearing, I know that you have examined a transcript of the proceeding; is that correct?

A That's correct.

Q And I think what the commission would like now to have you testify in the area that you think that should be -- clarify any of the testimony or give your comments regarding the best, most economical and efficient spacing for this area, particularly where we're talking about Parachute and Grand Valley Fields.

A All right, sir. I will do that. At the risk of a little bit of repetition, I need to show some intervals on this log that I will be referring to.

CHAIRMAN WELBORN: You are referring to what exhibit?

THE WITNESS: This is Exhibit 4A. 4A is indicative of the Mesaverde development that Barrett has conducted and is conducting at the present time. Mesaverde encountered as high as 3400 feet in this well and goes down to a top of Cameo still in the Mesaverde that's located at 6,000 feet. These darker intervals here are the coal zones. Beneath that we do have the marine sands. They are going to be an object of discussion a little later on. I want to emphasize those very clearly. In addition to what is shown on this log is a shallow zone called the Wasatch which has been discussed previously. There's a point or two to be made from that. This happens to be a well in the center of the Parachute Field located right here.

Q (By Mr. Knowlton) Which does, if you will, the log --

A The log --

Q -- reference?

A On this well -- Exhibit 5 is of this well right here. That is the Wasatch zone that's being proposed. At the current time, Barrett has about four Wasatch wells out here and approximately 50 Mesaverde wells with several in various stages of completion. Originally, the completions were made by -- in the sands section and the sands within the Cameo section. The sands in the lower approximate 1,000 feet were perforated in two intervals, as they were in this well, and when pressure would allow, these zones were commingled for producing purposes.

The first 26 wells that we drilled out here were done that way. That's important to reserve comments I will make later on.

CHAIRMAN WELBORN: Excuse me, can you see?

MS. EGGER: So far. I am not sure my cocounsel can see.

(Discussion off the record.)

A Currently, instead of completing in two sands intervals and then commingling the wells, the program that's been in effect here since about the first of the year, the five-rig program we have been referring to, we have completed in the zones all above the marine, but in the coal zones only we have perforated those and fracture stimulated them, set a plug down. The same thing up here in the first three or 400-feet intervals of Mesaverde sand. Left a packer between those. Established tubing into it. We produced the coals of the -- up the tubing, and the sands up the -- and in order -- we do that in order to segregate the production and quantify coal production. That's a difference of the two wells since the first of the year.

The Rollins out here, which is the first sands below the Cameo, is a -- first marine sands with everything above there being nonmarine. It's never been productive. It is tight, noncommercial gas shows. Sometimes contains some water. Those zones below it which are the Cozzette and Corcoran. The Cozzette, which this is the upper interval of the Cozzette, there are some lower intervals. This is the top of the Corcoran. Those contain gas, by Barrett's experience, both looking at logs throughout Rulison, by the wells we have drilled, they pretty much universally present as blanket sands across the interval and they contain gas.

We have never been able to find them commercially productive. We have tested them on numerous occasions. We do hope one day there will be a methodology to make them commercial, but so far they have not been. The Mesaverde sands have been qualified numerous times as tight gas reservoirs; that is, the reservoir properties are such that they are not commerically productive without some heroic stimulation efforts. That was the obvious federal incentive programs of setting up additional price in the gas shortage times, if you could come up with ways to make those commercially productive. The Mesaverde sands have been so qualified on numerous occasions.

Wasatch, which is producing here, has never been qualified as a tight gas sand. You can review numerous papers, and it is inherent throughout any reference that I have been able to find that this has a much greater matrix permeability. I have reviewed a paper that we can put in evidence that says it's 20 to 50 times as great a matrix permeability.

In the discussions at the first hearing, now, it got a little confusing at times. Testimony was offered that those Wasatch sands were highly fractured, that they drained large areas, that the sands themselves didn't have to be encountered in the wellbore, and Mr. Reinecke referred you to that -- 15248 -- earlier the sands that was found in the wellbore might be -- simply be in contact with sands some distance from the wellbore, and you still might get drainage out of the sands in the wellbore.

COMMISSIONER McCORD: Do you concur with that?

THE WITNESS: I think that's probably true from what I have seen, yes. What is interesting to me is that this zone here which has, I think, by all present, we'll check that in later testimony, has a much greater capacity to drain the reservoir, it's spaced on 160 acres, yet this would -- they are in here fighting over it, this one is admittedly tighter and -- much tighter, should not be spaced smaller than 320. That doesn't make a whole lot of sense.

We concur with 160-acre spacing. May be an economic question. We can approach that also. But in a pure drainage through matrix and fractures, why should the Mesaverde remain on 320 when the Wasatch is on 160.

CHAIRMAN WELBORN: Maybe the Wasatch is wrong?

THE WITNESS: I don't think so. Nobody else in this room, not so in the earlier hearings -- in fact, the DOE recommendation -- we were in here fighting for 320 at Allen's Point, only because the economics up here, we believe the drainage is going to be good up there. It will drain, certainly, 160s.

My next point goes back to several types of testimony in the past. We brought Allan Heinle here. He drew in circles representing some drainage areas and some recovery factors that he had worked with. That was difficult to understand, I think, did not get the point across that we were trying to make. Page 5 of 15248 that, as you have been furnished there, that is this page. Discusses the recoveries in the Rulison Field. These are the same numbers that Mr. Heinle generated. In fact, he said 10 percent on 320, which is identical to the percent drain number for the Langstaff, shown as the first well on this page. So, in effect, that testimony is in concurrence with what's in this 15248.

The problem I have got with all of these is, I firmly believe that this area of more fracturing definitely exists, for all of the reasons Mr. Reinecke has given you. When you get all of that looked at, the percentage that will be recovered from those 320-acre spacing units there ranges from 6 to 11 percent of the gas in place. I guess my question is, is leaving 89 to 94 percent of the gas in place effective drainage? If you look outside that area, in Rulison -- I am going to talk about some differences in Rulison and what we're doing -- if you look outside, this same paper shows 1 to 6 percent recovery of the gas in place on 320-acre spacing. That, conversely, means you are leaving 94 to 99 percent of the gas in place with those wells. Now, there's problems with those wells, but, again, I think 320-acre spacing is one of the problems of the recoveries we're getting out here, there's waste involved in those numbers.

What I really believe is happening, which Mr. Heinle tried to show with a graph, and I may not do any better with this. This is oversimplification. I readily admit it. What I am trying to tell you about here is, when you get all of these sands open, like this Langstaff well had open, there are ten sands perforated, ten of these yellow intervals are perforated in the Langstaff. In that same interval, fracture treatment may have opened 20 more reservoirs so there's 20 reservoirs in there operating. I strongly believe that each of those is draining, effectively, a different percentage.

So what we're doing when we take the recovery of a well, and we quantify that to one number, then we take it and calculate gas in place in these 20 reservoirs, we're just putting an average in there. For what -- all that represents, what this is trying to do is to take that average and show you what these percent recoveries are trying to lead you to believe. This is a 320-acre spacing unit. And the yellow part including -- down to and including the well, the whole 320 acres.

CHAIRMAN WELBORN: You are referring to Exhibit 6.

THE WITNESS: I am referring to Exhibit No. 6. But the numbers that were presented both by Mr. Heinle and this paper we have just reviewed show 10 percent recovery from 320 acres by the Langstaff well, which is located in a position like this in the proration unit. It is awful difficult for me to believe that 20 sands are draining the same amount, in each sand, this entire area here. They are draining no better from a position here, close to the well, than they are from a position up here, close to the well. In fact, I don't believe it's true at all. I think we have an ellipsoid around the fracture. This is the way the spacing works out. This is the way all of these theoretical recoveries are being presented to you. This is what they mean.

What I really believe is happening in the highly fractured area, we're more likely to be recovering 20 percent of gas in place out of an area like that. Probably we're getting 40 percent recovery out of 80 acres like that. We're really not affecting the 160. That's the one I really believe. And you can carry this on down further so that the typical good permeability gas well gets 60 to 80 percent recovery. Some of the good coals, in the 90 percent area. If we were doing an effective job of hydraulically fracturing and connecting up to good permeabilty, you would get 80 percent recoveries, this thing would be recovering something like 40 acres.

What does it mean? You're on the outside of a fractured area. Well, out there you have got numbers of 1 to 6 percent recovery, again, leaving the 94 to 99 percent of the gas in place. And I don't think we're getting an even 3 percent recovery over 320 acres out of 20 sands in the Langstaff well, the best well out there.

In fact, I go through the same process with you and say outside that area, a well at this position is more likely getting 48 percent of 20 acres. That's what Mr. Heinle tried to tell you with the graph he had, which is an engineering device, a little bit hard to follow. Hope I haven't confused it more with that. I thought this demonstrated this issue better.

CHAIRMAN WELBORN: Those percentages are of gas in place?

THE WITNESS: Of gas in place.

CHAIRMAN WELBORN: Not of economically recoverable gas.

THE WITNESS: That is of gas in place. Economically recoverable gas is the 1.4 BCF ultimate recovery that everybody who has looked at the Langstaff has used for the recovery from that well. That's what determines this recovery factor. If you put the same gas in place over 320, or the same gas in place over 160, just doubles the recovery factor necessary every time you have the spacing area or the drainage area.

Couple other issues comes out in this that I think need to be made clear. At least my thinking is, as to what makes them clear. Again we are dealing with a number of reservoirs here. Each well that we drill we believe has got up to 20 coal benches in it. The way we're completing, that we're producing, they will have up to 30 individual sand reservoirs, we're going to have 50 reservoirs open in a producing well; through fracturing, we may have other reservoirs open that we're not even perforating. It's possible we could be fracturing into something we don't see at the wellbore.

How are we ever going to get absolute spacing knowledge from that type of situation? One of the ways that you try to do that is to see by drilling the well on this 160, and one here, if you got enough production out of this one, that you think it could have affected one that you drill up here, you look for a pressure differential. All right. We got reservoirs that have as much as 2,000 pounds of virgin reservoir pressure difference. And we're stimulating those and fracturing them and putting them together, in effect. How do you ever get a stabilized pressure out of that situation?

The next thing that we're doing -- lost my train of thought -- we do have reservoirs that have some better permeabilities than others. We have said -- we have got a belief that there will be a -- zones that do have highly effective fractures in them. This is highly fractured, but how effective is it when you are only going to get an average of 10 percent recovery out of 320-acre spacing, not enough to justify that spacing for sure, and effectiveness. I think you can have individual sand that will have much better permeability, be it natural matrix permeabilities or more likely be it a natural fracture that goes through there. So here we are with a single zone that, in effect, could thieve pressure from the offset wells that you are trying to get a pressure in.

We attempted to get these pressures. We submitted that in evidence through Mr. Heinle the first time. We had a well, in fact, it is this well, offset well which had produced about half a BCF. And we drilled the offset 160-acre location right here. There's the two wells. Their reservoir was able to show that two sands were correlative from one zone -- from one well to the other. We went in and isolated those, attempted to get bottom hole pressures. We had pressure failure of the pack off in the tool at 2300 pounds, which is about 90 to 95 percent of original bottom hole pressure, so I can't tell you for sure that there was no communication there. I can tell you as far as I was able to get data there wasn't. And 95 percent of the pressure was still there in the second well. I don't know where the gas came from in this well.

What I am saying is, I am not sure we can ever get to a point of absolute surety of what drainage we're making through the normal procedures of gathering pressure out here. We're trying, we'll continue to try, we don't see that as the ultimate long-term. If you had one zone which was fractured enough to communicate to one offset well, does that determine what you ought to do in spacing some four or 500 wells that we expect to drill out here and those that have 50 reservoirs, 49 of which are not being affected by that type of thing? It's a very complicated question. I will show you how we're trying to deal with that.

One other point I would make in going through here, I don't believe we're the only ones that question 320-acre spacing, even in the highly fractured area. This commission at the last hearing approved that well right there. It is the 160-acre offset to the Langstaff well, the best well in this field. The reason for drilling, it was given as a topo up here on the north half with -- where the well should be drilled is too rough to be up there. I have looked at that topo. I think it is a little rougher. It might cost you an additional $15,000 to go up there and drill that location.

But I guarantee you, if I was concerned that there was going to be drainage, and appreciable drainage at that location, which is on the east/west trending fracture, natural fracture orientation out here, I would doggone well spend $15,000 to be sure I got more gas out of the ground up here. So I don't think we're the only one questioning. We're not questioning what ought to be done now over here. We say it's different. We think we can present information and have presented information that shows that we are different over here. So let that be and others will decide whether that's right or not, but that's the long-term data that's available to be dealt with. The rest of it is fairly short-term.

I now need to get into what do we think the reserves are out here. I refer you to page 31 in Exhibit 2. The title -- it's the title page of an SPE paper that was entered in evidence by the DOE at the last hearing. You see, I have highlighted a -- it's a case study of upper Cozzette blanket sand. In the abstract, also highlighted, it says, "The model utilized in this study possesses proven predictive capabilities, an essential ingredient to production forecasting and hence used as a framework for the development of optimal production strategies for the upper Cozzette blanket sand."

This mathematical simulation, which I have no problem with that having validity and being accurate, it certainly describes and scopes what could be there. But it is telling you the reserves that might be available in this 30-foot blanket marine sand that has never been intitially productive in this area. I submit to you that reserves for that interval right there have nothing to do with the reserves that we would expect to get from those intervals up here. And we do have production history from Rulison, we got it from four years of production at our wells.

In presenting this the DOE is either dangerously naive, they purposely misled the commissioners in using these economics to get to optimal 320-acre spacing. Mathematical models like the one they quote are useful. They require many assumptions. Those assumptions are then matched to production, but if you have got 40 variables that you are making assumptions -- they are guided assumptions, and trying to match that production by varying various of those assumptions, you can change the answer. In effect, you can get the things to show you what you could have assumed in the first place. I think they are very a valuable tools for modeling in cases like the Cozzette, which is not commercially productive, doesn't have anything to match to, but they begin to lose their effectiveness when I get down to having to develop something and spend money to do it.

I would like to tell you what I think Barrett's reserves are. Go into our economics at that point. I told you that the 26 wells which are marked only by the orange, the old wells that had production enough by January 1, 1990 to have reserves assigned were completed by producing only sands in this interval, they were not coal completions. Those 26 wells, as of January this year, had reserves assigned of 1.469 BCF per well, nearly 1 1/2 BCF per well. That's greatly different than what we see over here at Rulison. I will give you some information about comparison there.

Before I do that, the production there is up to four years old, and that's an important thing in a tight reservoir, if you are trying to do it off a production curve analysis. We do have some wells that we have got four years of production on. We have also tried to match that with the appropriate parts that you can match to in Rulison, and our reserves are audited at least annually by Ryder Scott. Ryder Scott does not say that our reserves are accurate, they cannot and will not in this case. But they do say the methodology is correct. It's as good as any that's available. And when really pressed, you can get them those, they are within 10 percent one way or the other. They are not our own reserves.

Mr. Heinle, who we had as consultant witness at the last time has also already -- also looked at those wells independently. We're concerned about reserves also and his reserves estimates came up 2 to 3 percent off of what we had and what Ryder Scott had estimated. We feel fairly comfortable with the reserves as they relate to the 26 wells that were completed in sand and commingled. Unfortunately, we're not doing that now. In these new wells, what we are doing, as I told you earlier, we're drilling the well down to the 200 feet of Rollins, no rathole, we complete in the coal, set a packer complete in the lower interval of the sands, and then dually complete that. We do it to segregate the production and quantify the coal bed methane tax credit volumes from the lower interval.

What does that do to our reserves of the well? To the extent that we're still producing these like we were in the original 26 wells, and because the Rulison wells are also completed in similar sands like that, we feel like that gives us a pretty good handle on the Mesaverde sand reserves.

Why are our reserves here so much

different than what they are saying in Rulison? Well, in Rulison, hardly any of these wells even penetrated the Cameo section. We're anticipating that approximately half of the reserves, whether we're in the coals or whether we are in the sands down here as we are in the older wells, but half the reserves have half of the 1 1/2 BCF. The old well is going to come out of these Cameo sands down here.

In the older wells up here, they perforate -- where we limit our perforating intervals, our completion intervals to 3 to 400 feet, they perforated 700 to 1100 feet. Where we put a nominal 400,000 pounds of sand out in a fracture job, they are designed to get 500-foot frac length two directions from the well, but which the surface coals will tell us is, theoretically, you're probably more on the order of half of that distance, so we're not crowding any 160-acre limits when you got half mile across there with 1,000-foot fractures length. If we are getting theoretical, when you do that, we're putting four to eight times as much stimulation in this interval as they put in comparable intervals in Rulison.

Studies have been done by Western, who is the surface company that's helped us design this, that show that we're getting 19 of our wells through nine months of production at 1.8 times the production from this same interval as did the wells in Rulison. So there's a reason why this is about twice as good, and we're saying that half of the reserves come from here. So we only have an average of half million recovery here. You are probably looking at less than a BCF average, even in that highly fractured area, we're predicting 1 1/2 BCF in our old wells.

Back to the problem of, now we're completing in the coals down there. We readily admit that we got to learn about these coals. We been 18 months in two wells that we went back and recompleted individually in the coals. We got the curves that show where they start out flat, a decline curve you get. Unfortunately, or fortunately, this is not like San Juan coal. It's not like Black Warrior Basin coal. We don't make the water out of these zones that they make. We got to create that ability to get the gas out by hydraulic fractures. We don't know how effective that's going to be.

What we have done in this case, we have, again, in consistence with Ryder Scott and their coal people, using those two curves that we got 18 months on, and now up to three months on some of the new wells, we have put down some curves that we think are reasonably accurate. You will see those as page 32 in your exhibit. The black line is the Cameo coals. This represents the typical well as the two wells we have got are showing us 18 months production and as the multiple wells are showing us three months of production, this black curve is still holding up. If it holds up throughout that, which is still questionable at this point, we will produce nine-tenths of BCF.

If in 20 years -- we cut our economic programs off at 20 years because that's really the significant present worth production, we have run them to 40 years, they still show they're economic, but there's only a couple hundred million cubic feet of gas to be recovered in an interval of 20 years to 40 years, we cut it off for ease of calculation at 20 years. We do not know whether it's right or not. We have submitted this to Ryder Scott. They do think it's appropriate technology, and as good as can be done at the current time.

The Mesaverde sands, which are the orange curve over here, are a little bit different, they come on at a higher rate, they fall off much more rapidly, we show this coming on at 600 MCF a day declining to 180 MCF at the end of one year. At that point in time, we have projected, for reserve purposes, that we will recomplete the wells in the next hole up here. We'll have the pressure down here so that we can work on the wells. We will go in there and set the plug, perforate the productive intervals, oh, from there to there, as a maximum, frac it the same way, put it back on production long enough to get the production. We can work it hot, not use a snapping (sic) unit at extreme expense, go back with our tubing, into our coal, put both of these on, that will raise our production back to the 600-MCF-a-day level, from which time the combined two zones up here would fall off as indicated by the orange line and, coincidentally, not because we did it that way on purpose, you, again, get nine-tenths of a BCF in 20 years and roughly because the curves are very close to each other at the end of 20 years, about 200 MCF indicates to be commerical in the next 20 years.

Q (By Mr. Knowlton) Mr. Reed, are their exhibits colored? I don't know that they are.

A Yes. Now, again, in the final point on the Cameo, I want to impress that we are not certain what those reserves are, we are not certain what either zone is. We're pretty comfortable with what we think we got of Mesaverde. There's less certainty out of Cameo. We are comfortable with it, to be spending large amounts of money.

What are the drainage implications of these reserves? Okay. We have pointed out many times that this Langstaff here is expected to get 10 percent, 1.4 BCF of the 12.8 BCF in place. Those are numbers that go with page 5, which is the 15248 exhibit. So that's 10 percent recovery factor on 320 acre spacing. What would the Barrett reserves as shown by this curve -- set of curves do for us? The Mesaverde recovering nine-tenths of a BCF in 20 years, that has a 11.4 BCF in place, we have calculated that on 160 acres, that is 8 percent recovery, which is less recovery than what's given to the Langstaff in the highly fractured area and the percentages of 160 -- we're planning to drill two wells -- that means we get 16 percent of gas in place on the 320. So the increment of recovery that we expect from this is six percent by drilling two wells.

CHAIRMAN WELBORN: It's 16 percent.

THE WITNESS: The increment they are going to get, 10 -- we're going to get 16 by putting two wells in the ground to the Mesaverde sand reserves. To the Cameo, we are expecting nine-tenths of a BCF in 20 years, based on the gas contents of the coals, which we have numerous measurements. The content is 480 to 700 MCF per ton of coal. We have calculated numbers based on the 480, the lower of the numbers which we think are more appropriate, and 160-acre spacing unit, having 60 feet of coal, that we have 60 to 100 feet of coal averaged through. That's what we normally look at through -- our area has 7 1/2 BCF in place. So the recovery that we're seeking of nine-tenths of a BCF would be 12 percent recovery from the gas in place on that 160. That's still not sparkling recoveries, but they are improved over what's being seen over here and that's because in the Mesaverde sands, we think we're doing a better job of stimulation than in the Cameo coals. Out of ignorance, because we don't know what they will do, we just think this curve is applicable.

Let me go from there to Barrett economics as we see this play. That last page of your Exhibit 2, page 33. This covers the reserves that I have discussed with you, reviews those, shows the 26 wells that are commingled in sands only have 1.4639 BCF ultimate recovery, as we book them, as we had them audited by Ryder Scott as they appeared in our SEC documents. I believe through the current drainage program, we anticipate by virtue of those curves, with the caveats I gave you about recoveries, 1.8 BCF per well on 160-acre spacing, we follow that with the assumptions that a dual producer will cost $550,000 in our 25-year well program.

The wells that we have the invoices in on have averaged 547,000, so we're able to meet that projection. We anticipate that the recompletion at the end of one year will cost $90,000 and we have included that in this analysis. Many of the wells will have more than one recompletion interval. We have only programmed one recompletion interval into these economics. The additional recompletion interval will give us an -- additional reserves. The coals have 1,020 average BTU. The sands 1,080.

There's a 35-cent dealer charge, which we have charged against these wells in calculating the economics: Lease operating expense and dollars per well per month is 1300. And we're assuming a price of $1.50 per MCF BTU based on year-round sales. We averaged around 1.76 last year. We think we will have to go in the spot market more to keep this gas moving around in the current marketplace.

The numbers, you see both for costs and for product price have been escalating at a rate of approximately 5 percent per year. This gets us to about $2 per million BTU in 1994. It's a very conservative estimate. The price and cost escalate in the same manner. We have kept the gas prices at $4. When they reach that level, we don't go any further. We reduce the escalators on the operating expenses and other expenses, attempt -- we stop those escalations.

What economics does this give us? Pay out profit to investment ratio rate of return are universal. Indicators of economics with coal bed methane gas tax credit, that tax credit, I think you probably know, is one you must spot a well by December 31st of this year. If you then are able to qualify your completion in the coals with this commission and the FERC, you get ten years of an escalating tax credit, if you can use it against other income in the year that you get the production. So the tax credits are good through 2000. That tax credit this year is 91 cents per MCF. It does escalate. It has a dramatic effect on the economics. 2 1/2-year payout, 3.1 to 1 profit to investment ratio, and rate of return of 45 percent.

Without the coal bed methane tax

credit, which project is still viable, is four-year pay out. 2.3 to 1 profit to investment ratio at a rate of return of 26 percent. These are a certainty. There is no risk applied to them. If they look a little high in the coal bed methane tax credit side, that's what we're using to give us the contracts to move as rapidly as we are into these new areas. We do use that as improvement to our rates of return. In the time it's available to us, it would not be prudent for us, we just wouldn't be operating in a rational manner, if we didn't attempt to do that. We have drilled 26 wells prior to the coal bed methane tax credit being available and used by us and we project to drill wells after it's over. We think there are 4 to 500 locations out here on 160-acre spacing. Those are our economics. The coal bed methane tax credit does offset our reserves uncertainty to an extent. And if it's not reserves uncertainty, as we get more data, it certainly improves our rates of return.

Few other points about that. We have spent $40 million out here developing these properties to this date. 40 Wasatch wells, 50 coal -- 50 Mesaverde wells. The gathering systems have cost that much. We wouldn't have done that if we didn't think we were in an area where we could get economic recovery. We're forecasting a minimum of 30 wells per year after the tax credit is no longer available. Well cost with recompletion, $640,000. We certainly don't want to drill any unnecessary wells. We have drilled the eleven 160s over in the unspaced area. We have seen nothing to make us concerned with having wells located in that situation. There's also a number of papers out that tell you what the potential in the Piceance Basin of the coal bed methane. We're the only ones actively pursuing that in this area out here. In '77, the CFS quoted by the Colorado Geologic Society, Department of Natural Resources maps series No. 19, if it is ever to be recovered, somebody has got to get out here and determine what's really going to be recovered out of the coals.

What kind of losses might we experience if the 320s are upheld? Black dots on this map represent the wells in the area that's under appeal that we would like to have in our next 25-well program. There are 11 of those.

CHAIRMAN WELBORN: That's Exhibit 1 you are referring to?

THE WITNESS: Exhibit 1. There are

also two wells that, in effect, the DOE hold veto power as a result of this spacing. I will explain that further. I have simply taken 12 locations that one of two things might happen to. If we're delayed past the end of the year, and we don't get to qualify for the coal bed methane tax credit, what's the loss to the working interest owner/partners? That's $6.4 million. The royalty interest owners under these tracts are also able to use that tax credit or allowed to, if they can, that's $1.4 million. Other part could be that, without the coal bed methane tax credit, these wells might not get drilled. They might not get drilled because we got partners who are concerned about having to prove up locations that they may not participate in in the future. Major partner is in that position. If they didn't get drilled, the numbers increase to working interest owners, losses of $24 million. Royalty loss of $9 million. And the severance tax ad valorem tax from these wells, which ends up being mainly ad valorem, the way the system works, is 3.3 million.

COMMISSIONER McCORD: Are you using your percentage of ultimate recovery that you talked about earlier?

THE WITNESS: That I talk about that

same type well number, yes, sir, it is. Let me talk just briefly about DOE as partner, which is what we have with some spacing on 320 here. One 160, as we would have developed it when it was unspaced, we had 100 percent controlled 160 there. A 100 percent -- there would have been a 50/50 with the DOE location to be determined in the future. The DOE would have been forced to look at where they have -- thought they were being drained, and should they drill that well where we are with this.

The day the order came out, in fact, the day we verbally heard the form of the order, we AFE'd DOE on both of these wells. Two weeks later, we got back from them saying they cannot make a decision on those wells until they get a communization agreement on this unit, signed by all parties, and an operating agreement signed by all parties. We knew that. We went out -- the day we went out with AFE, what we're trying to do was give them warning. We about got those ready to go back to them, should go back this week, take going back to all of the partners, signing up. We should be able to do that at this point. The DOE will have what they need to make their decision.

If they decide they don't want to join

in drilling those wells, then the position we're in is, we can either drill them and carry the DOE with no penalty or we can forget drilling them. Because they are -- they do not recognize the state's abilities to force pool, which would be our recourse with industry's partners. We have seen this happen before. We thought in drilling these Wasatch wells in the Parchute Field, they would be subject to force pooling. That was a spaced area. We drill the well, then start force pooling in here. In front of this body, it was held they were not subject to the force pooling.

And the result was that they were allowed to look at these wells and production for two years, then copay their part, get their proportionate share of the reserves, having suffered no risk, no penalty from waiting. That delay, I am not saying it's right or wrong, I am saying it's awful tough to run a program. That's what we're faced with. There's no way we can drill $550,000 wells with uncertainty of reserves. It's quite different than drilling $140,000 Wasatch wells. The uncertainty that accompanied that opportunity. Not really your problem, but it sure is my problem at this point.

Finally, the coal bed methane program

is coming to a critical point. The 25 wells shown by the stars have four rigs operating. We have already dropped one because we don't have a well in the next 25-well program that's approved for drilling at this point. The locations are ready but partners are withholding approval until we find out what happens at this hearing. We have rigs drilling here, we have three drilling right here. 1, 2 and 3, that will complete the 25-well program. Two of those rigs will finish up this weekend. Then Monday or Tuesday, we're either going to be moving them to a new location, stack to see what happens, or with a 160-spacing here or with whatever it takes to get our partners off dead center, we can proceed to drill some more of these wells.

At this point, I don't know what they will do, as I mentioned here. One of the partners only earns -- it's a very substantial partner, but he only earns when he participates in the drilling of a well. His problem is, why should I drill that one, and that one, and that one, and defying these four that I cannot participate in. I am not sure where this is going to end up. Other partners are faced with, there is some additional risks to stepping out further, although I think it's acceptable, I don't govern what they think. We'll be at their mercy as to whether this program will continue or not. It requires greater and greater extension of pipeline than would be required if we could drill on 160-acre spacing, if that is the appropriate spacing.

To quickly review what we have had in our technical presentation to you today. That is that the 15248 paper that DOE quoted recognized the highly fractured area here, and the conclusion, even in recognition of that, in the model that was used, says that 160-acre spacing or more dense is more appropriate there. The stratigraphic column over here in Parachute/Grand Valley is much less fractured than it is here.

We got the concept that the DOE was trying to say it's all in communication from top to bottom. It is certainly not there; that our treatments of this interval, then -- come up to treat this interval, we have never seen anything there. If you had a natural system that connected those, you would certainly see it when you start putting hydraulic fracs on. The reservoirs are very long, narrow and discontinuous. You have got to have more withdrawal points to even find the sands, and then you have got to have closer spaced ones to drain these sands that are tight gas reservoirs by definition. That highly fractured area is there -- we have defined through, I count seven different methods that Mr. Reinecke went through during the day. I believe it very definitely is different. But even though it's there, it's not as effective as it needs to be when the best wells that you drill over here are only going to recover 10 percent of what's in place and leave 90.

There is waste too in their economics to drill additional wells. Fina is about to find that out. We think we know it. We want to proceed with it. There's east/west orientation to the fractures, however they exist. 8-4 confirms that we have got it.

We're accused of never cooperating with DOE. We spent $30,000 in conjunction with them working here. I have -- I am on their task force, helped with the horizontal hole that's being drilled. I just don't understand why we're accused of not cooperating. We do cooperate. We have given much more than we received. The highly fractured area leaves 90 percent of the gas in place, after developing on that spacing. The DOE Cozzette reserves, which they portrayed to you as representing what we can expect to recover from this total stratigraphic interval, are totally without merit. And that economic analysis that they gave you that pointed to 320-acre spacing, just doesn't apply. Just must throw that out.

Barrett reserves and economics, we have talked about our concerns and uncertainty in the economics area, but we have done the job that anybody can do out here at this point in time. We don't think mathematic models are going to get us any further along. We're willing to drill the production, find out what it is. We spent $40 million. We're ready to spend 15 million on the next well, if we can get a way where we can do that; the DOE is not a viable partner. They have proven that in the Wasatch. If we had 160, those two wells would drill and would be on, then, very quickly. It would then be a question of what do they want to do about one other 50-50. The shoe would be on the other foot at that point in time.

The delays are costly to all parties. If we don't get coal bed methane tax credits, we're certainly losing an economic advantage this year. We're -- working interest owners are losing, the royalty interest owners are losing, the state is losing because money we spend over here creates jobs in an economically depressed area. We certainly have the ad valorem tax that would be lost, if we are not allowed to drill these wells at all. Finally the program continuation is dependent on what happens at this hearing as well as other concerns, that we're working on with our partners, and we hope we presented enough to get you to reconsider the decision that was made in February.

CHAIRMAN WELBORN: All right.

Q (By Mr. Knowlton) For the record, I assume you have an opinion as to what is most efficient and economical spacing of the Mesaverde in the Parachute and Grand Valley Fields?

A I do.

Q What is that opinion?

A I believe 160-acre spacing is the proper spacing at this time.

Q I would ask that the exhibits which Mr. Reed has testified from, were they prepared either by you or under your direction and control?

A They were, with the exceptions of the papers; that we have made that exception, noted on in previous comments.

MR. KNOWLTON: I would ask, then, that

those exhibits be introduced into evidence at this time.

CHAIRMAN WELBORN: Those are Exhibits 5, 6, and pages 31 to 33 of Exhibit 2. Is there anything else?

MR. KNOWLTON: I think not.

CHAIRMAN WELBORN: Any objection to the admission of those exhibits, Ms. Egger?

MS. EGGER: No.

CHAIRMAN WELBORN: Those exhibits were admitted. Anything further?

MR. KNOWLTON: No, nothing further.

CHAIRMAN WELBORN: All right. Please cross-examine.

EXAMINATION

BY MS. EGGER:

Q Mr. Reed, just a couple of questions. With respect to your reserves estimates in the -- I had thought you had said that it was, for your single completed well, was 1.469?

A For the sand wells, those are completed in sands only and all sands are commingled, the 1.469-BCF-per-well average.

Q That explains, when you say on your paper which is page 33, it says Mesaverde sands BCF and Cameo sands commingled. Cameo sands are Mesaverde sands as well?

A That's correct.

Q How were those reserves calculated?

A They were calculated by decline curve analysis using up to four years of production history.

Q It was based on four years of production history?

A Up to -- all of the wells don't have four years of production history. The oldest well has four years of production history or oldest wells. There are more than one that have that amount of production history.

Q I see. Would you view more than four years as a better method or --

A You will know at 50 years what the results are going to be. If you want to be absolutely sure, wait for 50 years.

Q The more years you have the better?

A Absolutely.

Q I had thought you testified with respect to that calculation, but maybe I am incorrect, that you used some of the data from the Rulison?

A Shape of the curves in the Mesaverde sands did consider the production histories of various wells within Rulison. That's been part of the data background. As to a direct numerical length to the curves, no, just the production history, the types of completions, the fact that they are producing from Mesaverde sands, only not from the Cameo section, with one or two exceptions they got slightly, in the Cameo, one or two wells that have a a little bit of Cameo well. No one well has the entire section.

Q Would that have been from the area within or without of the red lines?

A It was both. All wells' production history have been reviewed.

Q Were some wells within the red lines that you considered in calculating those reserves?

A Absolutely.

Q With respect to the reserves estimates in the coals, did you say that you performed core analyses to determine gas contents?

A We got some gas contents from core analysis, we do it very periodically from the drill cuttings. It's an imprecise method -- technology, available to, somehow to account for the losses, done that way, but -- we have done it numerous ways.

Q Maybe you can just explain further how you calculate the reserves in the coals, came up with those calculations.

A I can only repeat what I said before.

Q Maybe I just didn't understand.

A What we did was, we recompleted two wells of the old wells so that they produced only from the coals. We did it in the same manner as we're completing these wells that are in the first 25-well program. And we have 18 months of production history from those wells. They defined a curve which is flatter than the curves that we see in the Mesaverde sands, and that's why these curves that were placed into evidence here show that the Cameo comes on at a little less rate, then runs out for 20 years and the curves do come together, after you get two sand zones open out there. That's the data that we have used. We have used those two wells with 18 months' production history with -- consulted with Ryder Scott, who got their coal experts from the San Juan and the Black Warrior Basin involved in this, is this the right methodology. And we know that the producing mechanism is quite different. We don't have the water you have got there. But we do have the desorption process; that there it says if you are getting any desorption, you should have flatter curves. What we're seeing out of linear and hydraulically fractured Mesaverde sands, that technology has been placed into making these reserve estimate.

Q That was based on about 18 months of production history?

A 18 months is all we have. Grows every day. Other piece of information that is valuable is that the 25 wells, the new program, we do have a number of zones that have now been on anything from 30 to 90 days. And we're seeing that same flat curve. It's not falling off rapidly as is, is -- in the sands in the same way. So we do have some confidence being generated by the new wells.

Q Excuse the ignorance of this question. I am not a petroleum engineer. Is -- why is it you would have an estimate of 1.469 BCF per well with the sands commingled and 1.8 when they are dual completions? What's the discrepancy in there?

A That's a good question. The difference is -- difference is in the single completion, what we did was complete only in the yellow. Only in the yellow, in the Cameo interval.

None of the blacks were perforated. None. We did the same thing up here in the Mesaverde that we would do in the new wells. But what the difference in the reserves estimates is what will these blacks zones produce versus what will these yellow zones in the same stratigraphic interval produce. It's two different types of reservoirs.

Q I see. With respect to your spacing economics, did you do any economics on other spacing scenarios than 160s?

A I have not used economics to determine, other than that our economics are viable and we have seen no indications -- no indication of drainage across 160-acre spacing. The 11 wells we have got certainly are too early to expect any pressure work to be effective, other than the one we attempted. We will still look to find more information about that issue. I base my spacing mainly on the recoveries. I don't believe you can leave up to 99 percent of the gas in place on 320-acre spacing and think you are getting effective drainage.

Q So even with coming up with 160-acre spacing, you did not apply economics to reach that result?

A I don't know what I would recover on 80 acres. I might recover the same as I do on 160. That will be the subject five years from now.

CHAIRMAN WELBORN: You don't know what you recover on?

THE WITNESS: She asked me, did I look at 80s or 640 or 320. No, I did not. I may get the same economics out of 80-acre recoveries, out of 80-acre spacing out here that I got out of 160. It will be some time before I can bring that before the commission. I believe that will be true one day.

Q (By Ms. Egger) Let me just, again, understand. I think my last question was, when coming up with 160 as a spacing recommendation, you did not apply economics to come to that?

A Very much so. I gave you the economics of the wells I believe are applicable to the wells I am drilling out here. My problem, I can't define the reserve difference in drilling a 160 and an 80 today. I don't think you can define the difference in a 320 and 160 by anything I have seen so far.

Q You didn't run alternatives, but just looked at the 160?

A I didn't do mathematical scoping. I

think it's inappropriate, waste of time.

Q The answer to that is no?

A Yes, ma'am, the answer is no.

Q Just in looking at -- trying to quickly, still pay attention to your other testimony, the Exhibit No. 7 in the February 20 hearing, and as compared with your page 33, reserves and economics. I don't know if every one has that. It appears, though, there are different assumptions that are being used, or at least slightly different assumptions being used in that economic analysis and this economic analysis.

A If you would show that to me I will attempt to identify the difference, if possible.

Q I hate to give you my only copy.

CHAIRMAN WELBORN: I have a copy.

MS. EGGER: Exhibit 7.

Q (By Ms. Egger) Again, I haven't had any time to look closely at this.

A I recognize these. Mr. Heinle presented these, at that time, as his independent analysis. They do speak to much different things. This is the Rulison area. Almost, essentially, the one place that's the same is the Grand Valley at 550,000. We think that applies to Grand Valley and to Parachute. The other had numbers in there, all have to do with Rulison wells, which are deeper, it's higher pressured.

Q So where it says typical 88,700 feet Mesaverde/Cameo dual completion at $730,000. That really isn't a typical dually completed well?

A In Rulison where the depth is 8700 feet, it would be. I believe that this exhibit was -- is still talking about spacing in Rulison when this came in as exhibit. Our exhibit now speaks to Parachute and Grand Valley and costs we think were appropriate in there.

Q It was my impression Mr. Heinle was talking about a mixture of both Rulison and Grand Valley and --

A He was.

Q And Parachute at the time.

A He was.

Q Is there another Heinle? Is there a reason, also, for example, that the gas prices have now gone from hundred -- from $1.50 for MCF BTU to $1.55?

A I think we have used anything from $1.50 to $1.60 out here in various types of estimates. Our last year's average was 1.74 to 76 so we're anticipating a lower average as we have to sell greater volumes in the spot market to sell year round.

Q Is there a difference?

A It's an estimate.

Q There's a difference between these?

A It's a small estimate. I hope it's that accurate. Be overjoyed if it was.

Q With respect --

A I will make one more comment. Allen Heinle is a consultant that we hired to do an independent study. We endorsed his figures as representing what we want it to represent. We think they were in the ball park of economics out here. You can get two engineers to do it in the same company, you are going to come up with a difference of this magnitude. They are estimates of futures. Nobody knows that answer.

Q With respect to gas prices being -- the ceiling prices seem to have dropped from $4.50 per MCF.

A Allan used that in his runs. We said, gee, we don't know whether it's going to be 4 or 4.50. We like the $4. It's a little more conservative. We use $4 in our internal checks. We did not make him change it and rerun it at that time.

Q That's the only point I would like to ask you about. There are differences in the economics previously submitted by Barrett at the February and the economics now being submitted?

A The absolute numbers are slightly different. The results are no different. They are both viable economically and, in our opinion, both at February with Mr. Heinle numbers and our numbers at the present.

Q Just one last point on the Fina location that you referenced.

A Yes.

Q The -- with the exception to 320-acre spacing, to your knowledge, was that discussed in advance with DOE and the approval by the commissioner was based on topography and not 160-acre spacing?

A To my knowledge, was it, no.

Q I know when it came up at the hearing that we sat through before our discussions began, that that comment was made that the DOE was in agreement with its being moved for topographical reasons.

I still make my point, certainly if they had been concerned about reserve drainage at that 160-acre offset, that's a viable location for 15 to $20,000. Doesn't take much gas to pay for that.

Q The answer to my question, then, is yes?

A Yes.

MS. EGGER: Okay. That's all of the questions I have.

CHAIRMAN WELBORN: All right. Any further questions on direct, Mr. Knowlton?

MR. KNOWLTON: No further questions.

CHAIRMAN WELBORN: All right. I didn't give commissioners an opportunity to question either of the witnesses, so let me do so at this time, if you have questions.

COMMISSIONER McCORD: I have got one question on 16.

CHAIRMAN WELBORN: To whom, Mr. Reinecke or Mr. Reed?

COMMISSIONER McCORD: Mr. Reinecke.

COMMISSIONER McCORD: On exhibit page 16 which is the channel encounter exhibit.

MR. REINECKE: Okay.

COMMISSIONER McCORD: The clear circles are -- represent those wells which would be drilled in a 160-acre spacing scenario.

MR. REINECKE: Yes, those would be the legal locations of the 160s.

COMMISSIONER McCORD: Would it make any difference as far as ultimate recovery as to whether those clear circles wells would be drilled, say, now, or a year or two from now? Would it make any difference?

MR. REINECKE: It would not make any difference if they would ultimately be drilled under our concept of the drainage.

COMMISSIONER McCORD: As far as the economics, though, you are saying it would be -- make a difference due to the CBM tax credits?

MR. REINECKE: It will double the rates of return, offset the risks of proceeding during reserve uncertainty.

CHAIRMAN WELBORN: Other questions? Yes.

COMMISSIONER JOHNSON: John moved me a long way from that map. The black rigs are your next set of wells that you will drill.

MR. REINECKE: Yes, sir. Those were recommended in the absence of having the black circles available today. We just went to the ones that we would try to drill under what we think is readily available under current spacing rules and our land position.

COMMISSIONER JOHNSON: They are predicated on 320-acre spacing.

MR. REINECKE: Yes.

COMMISSIONER JOHNSON: And circles would be predicated on 160.

MR. REINECKE: They would be. There are two exceptions to that. There is two black rigs in the application for change of spacing tomorrow, and we have taken the liberty to put those in there on at least two 320-acre spacing hoping we would be allowed to drill that way in the 640 area.

COMMISSIONER JOHNSON: All of those contemplated, if you had your wishes, during this year?

MR. REINECKE: No, sir, they are really not in the next 25-well program. We would probably not drill the three wells out on the far east end.

MR. KNOWLTON: Why don't you show them.

MR. REINECKE: If we concentrate a limited number of 25 wells back in this way, what we would do is kick out a couple of these, we would not get those, we would probably just concentrate our efforts in here. That solves another problem we're working on with Battlement Mesa people about land use in here. It would be in an area probably of -- that you would take a couple of wells off like that. Just have to, in this fast of a program, with that many rigs, you have to have a lot of locations, a lot of alternative locations to get all of the land spacing access problems satisfactorily handled. I think we heard that previous situation here, that if we go running helter skelter doing this without talking to people, you get into all kinds of problems. We are just not doing that so far. We're considered a good citizen over here.

COMMISSIONER JOHNSON: What is the drilling time typically.

MR. REINECKE: In the Grand Valley Field, it's taking about 20 days to get a well down and set pipe on it. As you come east, it is deeper, getting gradually deeper. We're up to about 23, 24 days there on the east side of Parachute now. The wells over in Rulison, we have not drilled one in this latest program, but the two we drilled last in there were considerably longer. They are overpressured. They got the fracing problems. It will take 25 to 30 days to get those things worked out. We're typically going deeper down through the Cozzette and testing it again, depending on how deep we go, it could be a 30-day well.

COMMISSIONER KREY: You show $550,000 for well cost to you. Are you allocating any pipeline gathering system, compression, dehydration costs?

MR. REINECKE: They are not in that cost, but we do have attendant costs to add to the infrastructure out there by expanding it to connect these wells. Those costs in terms of pipe are going to run 50 to $100,000. The difference being per well, the difference being in getting across that river to the river -- I-70 Frontage Road and railroad, to get south of those obstacles. We just done that. We just put that crossing in.

COMMISSIONER KREY: What does the density of wells have to do with your costs on pipeline? On your gathering system.

MR. REINECKE: The timing of the extension is, we keep them closer clustered into our current infrastructure. That's less pipe we got to lay to get out to connect them.

COMMISSIONER KREY: Plus you get twice

the deliverability, we'll say, out of the --

MR. REINECKE: You will get some help out of that. You won't have fraction loss in your pipe.

COMMISSIONER KREY: There's a limit to how far you can lay a line?

MR. REINECKE: That's correct.

CHAIRMAN WELBORN: Other questions? I have a couple. In your discussions with the DOE and vice versa have you considered alternative scenarios still, other than 320 versus 160s versus 180S on a more traditional basis? Have you considered the possibility of say three wells per section and a wide -- areawide range of -- within which each well might be drilled east/west as opposed to north/south, some kind of slot within which the well could be located in an effort to hit these sands that you are trying to hit and yet not drill more wells than necessary.

MR. REED: Along that line, yes. Following our February meeting, excuse me, our March meeting, I got Mrs. Egger at the map. We discussed what -- would they have any interest in a compromise that would allow us to drill the wells that were essentially a mile away from the border. And their answer, which I am sure she will elaborate on, given that opportunity, to me was, no, we can't do anything prior to this hearing, but we will consider something that would be a joint put-together program if Barrett would quit not allowing us to have the data that's in there repeatedly, and let them assist in designing it.

Well, one, it doesn't help to -- for her. We can try to go forward after we find out what this is. 32, $37 million spent in drilling and collecting the information on those three wells right there, we can't afford to get into this kind of program. We're a little outfit. We live on economics, economics alone. We can't gather data like they can. We are glad to be their partner and fund part of it in our operation as we did in the 8-4. We can't do a program like they would want to do at our expense. We'll still love to talk to them at the same time. We're talking to them now, we're doing a project with them right now. It's part of that expense, spending another $5 million to encourage development out here, not the part that's trying to stop us from doing that development.

CHAIRMAN WELBORN: I guess my concern is that the only alternatives that are presented to us are A or B, black or white. And we're going to have to pick one. And I assume that after we hear the DOE testimony and get to the end, it's still going to be difficult to pick one. And trouble with picking one is that we give one or the other of you what you want. And thereby we eliminate all incentive for coming up with what may be a much more appropriate method of developing this area and still protecting correlative rights.

I just want the parties to know that in the past and at least one occasion in the recent past, we have been willing to get creative for parties who are willing to get creative. And I don't know what, of the five or six points that you have raised, the DOE disagrees with and the extent to which they disagree with those individual ones. But if there were some agreement, for instance, on the elliptical nature of the drainage pattern of a given well in this area, seems to me that it's possible to work out a scenario where something more than two, with something less than four wells which looks an awful lot like three to me. Drill this, a given section -- in a given section we allow a much different way of locating those wells than we have in the past.

I don't want you to feel constrained by tradition. This is an incredibly liberal group. Just look at Rogers down there. We're perfectly willing to consider creativity.

MR. KNOWLTON: Mr. Welborn, that was the purpose of my suggestion, we're doing what they want. They want us to stay a mile away. Give us the right to drill these wells that are at least a mile away or approximately a mile away; that no way can you believe that those are even draining, if you believe what you are telling the commission. But what I got from that letter, and I'll let Mrs. Egger expound on that, is that look, fellow, we got what we want already. There's no reason for us to compromise. That's my interpretation of the letter.

MS. EGGER: I do have another interpretation, if you care to listen.

CHAIRMAN WELBORN: I assume you do. Oh, in any event, perhaps there will be some time this evening. All right. Those are the only questions I have, I guess. What time is it? You have to -- any further evidence?

MR. KNOWLTON: No further testimony.

CHAIRMAN WELBORN: All right. Let's proceed then, if we can.

(Discussion off the record.)

CHAIRMAN WELBORN: You still at your -- looking at what, say, two to three hours?

MS. EGGER: I would say suggest, frankly, we wouldn't get very far if we have to conclude at 5:15; that we would --

CHAIRMAN WELBORN: Let me just -- Dennis, did you have any questions of the witnesses?

MR. BICKNELL: No, thank you.

CHAIRMAN WELBORN: The applicant.

CHAIRMAN WELBORN: All right. The agenda tomorrow doesn't look as ominous as it might first appear. Dennis, what do you think about --

(Discussion off the record.)

CHAIRMAN WELBORN: Let's go back on the record to the extent we weren't already. I can't tell from what Harriet is doing. We will continue this hearing until tomorrow morning at 8:30, at which time we convene at Greeley and start with the DOE case. And I do want to ask the parties to continue to think about creative solutions and to consider conferring on technical solutions. If you want to look at the solution in the case to which I allude, Dennis can get you that yet tonight. He can show you how we -- I think we referred to this term of slotted spacing or something like that, slots, in areas within which wells may be drilled. And it was a meaningful compromise and there are lots of characteristics here that are ringing bells for me from that case. And, in any event, start at 8:30 in the morning.

MS. EGGER: I will request and would like to collect the DOE exhibits. We distributed all of those copies. I can take out the Exhibit 4, which is -- has been introduced as an exhibit, which has been introduced, and -- for this evening.

CHAIRMAN WELBORN: We have one question from the commission of one of the Barrett witnesses. I would like to do that now so we complete that.

(Discussion off the record.)

CHAIRMAN WELBORN: Commissioner Johnson has a question, another question of Barrett before we leave.

COMMISSIONER JOHNSON: May be of Mr. Reed. What advantage is the downspacing now from 320 to 160 to Barrett during 1990?

MR. REED: Think one thing, it will get the next 25-well program off the ground as far as it has been withheld by the partners not approving, depending on the outcome of the spacing. The other thing would be to get those 11 wells into the drilling program, get them drilled, those would be certainly drilled under this scenario. If they are left, that we have got to go elsewhere. If people will go, they will have to decide, do they keep going with five rigs, do they want to cut back to two, do they not want to do any. We would lose wells that would not otherwise be drilled, if we don't get them turned loose.

COMMISSIONER JOHNSON: That's just additional expense incurred to the investors.

MR. REED: We're seeing this every day. We're more comfortable with what's happening here than the people we got to convince to come along with us, put up your money; we feel very comfortable in stepping up to maximum rigs. We're quoting four or 500 locations. The other partners don't see it that way. They want to move in a more cautious manner, offset today, drill closer to existing production, get the coal bed methane tax credit. That's what keeps them wanting to do the five rigs.

COMMISSIONER JOHNSON: I do hear you say the, practicality, that on the northwest corner of your area wouldn't be your highest, early priorities?

MR. REED: That is correct. They wouldn't be included in the second 25-well program. We want to drill 75 more wells, if we can keep everybody in this, on this deal. This would be the third 25-well program.

COMMISSIONER JOHNSON: To be correct, would probably be wells that would drain the Department of Energy more than any others.

MR. REED: Those are on the northwest, they were slightly on their base. They don't -- anyway, they are still completely encased in Barrett acreage.

COMMISSIONER JOHNSON: Limit on the other end?

MR. REED: West here.

COMMISSIONER JOHNSON: East/west fracturing.

MR. REED: East/west fracture, if that's any factor, do you get anything draining the 320 acres?

COMMISSIONER JOHNSON: I meant the one or two north of here would be the most potentially risky to the Department of Energy.

MR. REED: Probably would be that one

on the east/west concept.

COMMISSIONER JOHNSON: Those were relatively low priority on your drilling program?

MR. REED: We would drill that one today if we had that, where the rig would go next. That's a good cross producer with a month's production.

CHAIRMAN WELBORN: If you could put your hands on it.

COMMISSIONER McCORD: I thought you were going to abandon those.

MR. REED: What I was talking about with the black dots, the black dots and the black rigs out here, in the 25 -- next 25-well program that's at issue, over this weekend, I could do without those and those. But in the 25-well program that will immediately follow that, then I am going to be out here trying to pick those out. What I do is contract this to independents, with the same 25 wells, so by picking out black dots, I can pick out equal number of wells or black dots out here on the end.

MR. KNOWLTON: Please remember his testimony in your question, how is Barrett affected by a delay. Please understand that the significant factor he's testifed to is that fact that, with the coal bed methane tax credit, if we don't get this ability to develop on 160s, we're going to lose the benefit of the best economical shots at this. We're going to lose that. If we have to, if this is gone to 320 in 1991, then we may come back and say we won't even drill those on 160s later on. We may not, because we will have lost that tax credit. On the desirable location, obviously, when you are drilling on 160s, you have got existing production, it's very nice to cuddle up to that 160. You are not taking near as much risk. That's what we have liked and wanted to do. We're going to lose that, if the spacing is changed. We are on 320, that's where we are.

COMMISSIONER JOHNSON: Would it be an advantage for your gathering system?

MR. KNOWLTON: Well, sure.

CHAIRMAN WELBORN: That raises a point that I didn't raise earlier by question, but I just, I think it hasn't been -- I should tell you has not been fully resolved in my mind. That is whether the coal bed methane tax credit is a factor, a parameter that's used in determining the maximum area that can be efficiently and economically drained, which is the standard that we have under our statute. And I don't want argument on it now, but I just warn you that in my mind, I say, whether that means -- I don't know which way I fall off the fence on that. I notice that your page 33 does calculations -- has calculations in it that both include and don't include the coal bed methane tax credit. Because, as I understand it, the coal bed methane tax credit isn't a number that's tied to that well. It's a number that is the result of your business and the way your business works. It's a credit on profits in your business that include production from that well and other wells and other properties. Or am I wrong?

MR. REED: That is correct, but it is a tradeable. It doesn't mean that Barrett, per se, has to utilize that. It can be used in various creative ideas as to how to get that to somebody that can use you and get a benefit to Barrett and its partners for doing that. That is what we have done.

CHAIRMAN WELBORN: We traditionally look at rates of return from production from a given well based on the current and projected base of sale and current and projected cost of producing. We don't traditionally crank into that whether the company that owns that well is going to make a profit in a given year in its business or would have retained earnings or whatever the name is for the funds that are used as the basis for the calculation of the coal bed methane tax credit.

MR. REED: I understand.

CHAIRMAN WELBORN: And yet I don't know that that doesn't mean that it's -- I don't know that it means it's inappropriate to consider that in this. We have just not dealt with that issue. It's always been kind of hovering around, but we haven't dealt with it; we didn't deal I with it down in the San Juan Basin.

MR. REED: I understand your concern. And the only point that I would make today; that is, that production from that interval generates that item, the -- that -- it may be equitable for a ton of sulfer being produced rather than a coal bed methane tax credit, because it really doesn't matter whether I can use it or not. People have devised methodology for that, to add to their effective price. It's like having a gasoline plant, take out liquid and improve your price, if you want to equate an analogy of that nature.

CHAIRMAN WELBORN: It's in -- it's

assets.

THE WITNESS: It's assets we create in drilling the well, getting that production out of that zone.

CHAIRMAN WELBORN: I understand what you are saying.

MR. REED: I understand your concern.

COMMISSIONER KREY: Mr. Chairman, I have one question. I was going to ask the DOE but I can ask it now of the three of them. What was the purpose of the Rulison atomic energy shot that went on years ago? Second, what was the purpose of the multiwell DOE project and what's the intent of the act giving tax credit for nonconventional energies? We are getting down to basic facts, I feel.

COMMISSIONER McCORD: Could you repeat the first one?

COMMISSIONER KREY: What was the purpose of the Rulison atomic energy shot that went on? Can you point that out, where the --

MR. REED: It's this well there where they set the atomic bomb off.

CHAIRMAN WELBORN: Well, to the extent that those are questions that need to be answered through a witness, we probably ought to let the DOE answer those tomorrow.

COMMISSIONER McCORD: Is that a unique fracturing technique?

MR. REED: Yes, sir, exactly.

COMMISSIONER KREY: Exactly what it was.

MS. EGGER: I can tell you, though, that we do not have any planned witnesses that can speak to the effect of policy matters for the Department of Energy much less the United States government on -- for a tax credit.

CHAIRMAN WELBORN: I do want to say. I guess that was the point of my point about this coal bed methane tax credit. I think that, as a group, Tim can agree or disagree, we have to tie all of this stuff back to our standards, which is what the maximum area that one well will efficiently and economically drain. That's what we have to do. Now, in my question, is -- does that standard include a factor for the coal bed methane tax credit as applies to this particular company drilling these wells at this particular point in time? And that's the question that's in my mind. It may or may not matter what the purpose of coal bed methane tax credit is for our purposes, because we still have to figure out what the maximum area is that one well will efficiently and economically drain.

COMMISSIONER KREY: We're only going to know that 50 years from now.

CHAIRMAN WELBORN: That's true in every spacing case. We sit here and take a shot at it. That's why there are changes. That's accurate. That's why the given moment it looks right to space the Wasatch on 160s.

COMMISSIONER KREY: I think your idea of getting an arbitration is exactly on-line because maybe we need more R&D like the multiwell project, maybe some of those sections should be more dense spacing. Maybe some of those sections shouldn't. Maybe the whole error was when we encompass such a large area to be spaced the same.

CHAIRMAN WELBORN: Those are things we have to consider. Remember, it's not our job to solve these people's problems. We have certain tools available to us. Spacing is one of them. We have spacing standards. On the other hand, I want to -- everybody to know there is precedence for us considering type spacing which are not traditional. I would just like to throw that out, raise it up the flagpole, then see if anybody other than the lieutenant salutes it.

MS. EGGER: If I could just say in response to the Barrett suggestion of compromise, the DOE responded that there were -- appeared to be a large number of Barrett wells on 160-acre spacing already. And that we propose that we would join with them and study the appropriate drainage areas based on the information gained from those wells. I think we heard today there were, in fact, 11 wells that Barrett has now drilled in the Grand Valley Field based on 160 acres. We're suggesting, I dare say, not with the arrogance that was implied, that the area that endangers us need not be penetrated. We have other areas to look at.

CHAIRMAN WELBORN: Well, maybe those are the beginnings of some fruitful discussions.

MR. KNOWLTON: That's the same answer we got ourselves. Do what you will. I don't see any room to to do anything, but I am sure going to stay here as long as she will, see what we can do about it.

CHAIRMAN WELBORN: Any further questions of the witnesses? Max, I am not going to put your questions off, to the extent they can also -- they will do so tomorrow.

COMMISSIONER KREY: I didn't expect an answer.

CHAIRMAN WELBORN: Okay. Any further questions of witnesses?

(Discussion off the record.)

(Thereupon these proceedings were concluded at 5:10 p.m.)

# CERTIFICATE

STATE OF COLORADO ) ss

CITY AND COUNTY OF DENVER )

I, Harriet S. Weisenthal, Certified Shorthand Reporter and Notary Public for the City and County of Denver, State of Colorado, do hereby certify that the foregoing proceedings were taken in shorthand by me at 1580 Logan Street, Denver, Colorado on the 19th day of April, 1990, and was reduced to typewritten form under my supervision;

That the foregoing is a true transcript of the proceedings had; That I am neither attorney nor counsel, nor in any way connected with any attorney or counsel for any of the parties to said action or otherwise interested in the event;

IN WITNESS WHEREOF, I have hereonto set my hand and affixed my notarial seal this 9th day of June, 1990.

My Commission expires October 15, 1993.

H. Weisenthal

Harriet S. Weisenthal

NOTARY PUBLIC
HARRIET S.
WEISENTHAL
STATE OF COLORADO