STATE OF NEW MEXICO
ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT
OIL CONSERVATION COMMISSION
STATE LAND OFFICE BUILDING
SANTA FE, NEW MEXICO

17 June 1988

COMMISSION HEARING

VOLUME V OF V VOLUMES

IN THE MATTER OF;

A hearing in the matters involved in Cases Nos. 7980, 8946, 8950, 9111 and 9412.

CASES 7980, 8946, 8950, 9111, 9412.

BEFORE: William J. Lemay, Chairman
Erling Brostuen, Commissioner
William M. Humphries, Commissioner

TRANSCRIPT OF HEARING

A P P E A R A N C E S

For the Commission:

Robert G. Stovall
Attorney at Law
Legal Counsel to the Commission
State Land Office Bldg.
Santa Fe, New Mexico

A P P E A R A N C E S

For BMG Drilling Co.:	William F. Carr Attorney at Law CAMPBELL AND BLACK P.A. P. O. Box 2208 Santa Fe. Mew Mexico 87504-2208
For Sun Exploration and Dugan Production:	W. Thomas Kellahin Attorney at Law KELLAHIN, KELLAHIN and AUBREY P. O. Box 2265 Santa Fe, New Mexico 87504-2265
For Mallon Oil Company:	Frank Douglass Attorney at Law SCOTT, DOUGLASS and LUTON Twelfth Floor First City Bank Bldg. Austin, Texas 78701
For Mallon Oil Company and Mobil Producing Co.:	W. Perry Pearce Attorney at Law MONTGOMERY and ANDREWS Post Office Box 2307 Santa Fe, New Mexico 87504-2307
For Amoco Production:	Kent J. Lund Attorney at Law Amoco Production Company P. O. Box 800 Denver, Colorado 80201-0800
For Koch Exploration:	Robert D. Buettner General Counsel and Secretary Koch Exploration Company P. O. Box 2256 Wichita, Kansas 67201-2256
For Mesa Grande Ltd. and Mesa Grande Resources:	Owen P. Lopez Attorney at Law HINKLE LAW FIRM P. O. Box 2068 Santa Fe, New Mexico 87504-2068

INDEX Cont'd

I N D E X Cont'd

E X H I B I T S Cont'd

E X H I B I T S Cont'd

(Thereafter at the hour of 8:45 o'clock a. m. on the 17th day of June, 1988, the hearing was again convened and the following proceedings were had, to-wit:

MR. LEMAY: The meeting will come to order.

At this time I think we'll take a break that's been agreed to by -- not a break, a break in Mr. Greer's testimony, and with permission of the lawyers present, we will have a witness, Amoco's witness very briefly, one exhibit, I understand, and a closing statement by Mr. Lund, for a clarification of the Bear Canyon unit.

MR. LUND: Thank you Mr. Lemay.

Would you please swear the witness? She hasn't been sworn.

(Witness sworn.)

MR. LUND: Thank you, Mr. Chairman, and I thank the participants for letting us go out of order.

BETSY LOUGH,

being called as a witness and being duly sworn upon her oath, testified as follows, to-wit:

DIRECT EXAMINATION

BY MR. LUND:

Q Would you please state your name?

A Yes. My name is Betsy Lough.

Q And you're employed by Amoco Production Company as a reservoir engineer?

A Yes, I am.

Q Briefly state your educational background from college on.

A Okay. I graduated from Stanford University in 1980 with a Bachelor of Science degree in petroleum engineering.

Q And briefly what was your work experience since graduation?

A I worked in one of Amoco's District Offices in Colorado for two years, 1980 to 1982. My primary responsibilities were with well completions and evaluating wells for workovers.

Q All right, and your next period was '82 to '84?

A Yes, that's correct. I worked in the

Denver Region Office. My responsibility there was evaluating secondary recovery projects, projects that were both operated by Amoco and projects in which Amoco had a working interest. These included waterflood, secondary gas injection projects, and CO_2 floods.

Q All right, and then '84 and '85?

A I performed a reservoir simulation study on a dry gas reservoir, the Red Oak Field in southeastern Oklahoma, which lead to an infill drilling program by Amoco.

Q And then '85 to '86?

A '85 to '86 I was in Tulsa at Amoco's research facility performing a petrophysical study on the Niobrara formation in the DJ Basin which is a naturally fractured formation similar to the Niobrara here in the San Juan Basin.

Q All right, and then '86 to '87?

A '86 to '87 I performed another reservoir simulation study on a dry gas field in southeastern Oklahoma.

Q And then when did you start work in this area?

A I've been working this area since May of 1987, performing a reservoir simulation in the Northeast Ojito Area, as well as reviewing the general operations in the Gavilan Mancos Pool.

Q All right. And you've studied this area for purposes of this hearing and you've also prepared an exhibit?

A Yes, I have.

Q All right, before we look generally at the exhibit, in general how did you prepare the exhibit we've marked as Amoco Exhibit Number One?

A Just in the course of testimony this week the Bear Canyon Unit has -- has been mentioned several times and we thought this would be a good opportunity to present some data that we've collected on the Bear Canyon Unit.

Q All right, let's turn to Exhibit Number One and just go through it as quickly as we can.

Would you please turn to --

MR. LEMAY: Are you going to qualify the witness?

MR. LUND: Oh, I'm sorry.

MR. LEMAY: That's fine.

MR. LUND: Offer Ms. Lough as an expert.

MR. LEMAY: Her qualifications are accepted.

MR. LUND: Thank you.

Q Would you please go through Exhibit Number One and first talk about its format?

A Kent, I don't have a copy of that.

Q Oh, I'm sorry.

A Thank you.

Q I'm sorry.

A Okay, the purpose of this exhibit is to set forth some properties and some characteristics of some different reservoirs here in this area; the Bear Canyon Unit, the Gavilan Mancos Area, and the Canada Ojitos Unit Pressure Maintenance Area.

Q All right, what's included in the Gavilan Mancos Area?

A Okay, the Gavilan Mancos Area, I've included here the Gavilan Mancos Pool and also the wells in the proposed expansion area.

Q And when you reference pressure what is your datum point?

A The datum is +370 feet sea level, which is consistent with the previous exhibits that have been presented in this hearing.

Q The first point on your exhibit is the initial reservoir pressure at the datum point. Would you identify what that means, please?

A Yes. The Bear Canyon Unit, we measured the initial reservoir pressure there in November of 1987 in the C Zone using a pressure bomb corrected to the -- to the datum of 370 feet is 952 psi.

Q That was in the Bear Canyon No. 1 Well?

A Yes, that's correct.

Q Then go on to the Gavilan Mancos.

A Gavilan Mancos Area initial pressure, March of '82, 1800 psi, and that's taken from Hueni's Exhibit Number Twenty.

Q Okay.

A The Canada Ojitos Unit pressure maintenance initial pressure, 1890 psi in September of '62 and again that's taken from Hueni's Exhibit Twenty.

Q Next is the bubble point pressure.

A Yes, we collected a downhole fluid sample from the C Zone in the Bear Canyon Unit No. 1 and had that sample analyzed, and the bubble point pressure found from that sample was 925 psi. At that time we took a static pressure from the C Zone prior to getting the fluid sample, was 1040 psi at mid-perforations, which is where the fluid sample was taken.

Q And the fluid sample was taken in December of '87?

A Yes, that's correct.

Q Next the Gavilan pressure.

A The Gavilan bubble point pressure, 1482 psi. That's from the Loddy No. 1 Well that has been referred to in previous testimony.

Q Was that from Mr. Bush's testimony?

A Yes. Yes, that's correct.

Q And did you hear Mr. Roe testify that the Loddy pressure was about 1594?

A Yes, I did, and I'm not sure why the discrepancy there.

Q How about the bubble point pressure for Canada Ojitos?

A That pressure, 1534 psi, I found from Mr. Lee's exhibit from the -- from the previous hearing this -- earlier this year.

Q All right, let's turn to the latest pressure then.

A Okay, we measured a pressure again in the Bear Canyon Unit No. 1, C Zone, using a downhole pressure bomb, May of '88, measured the pressure to be 907 psi.

Q The Gavilan?

A The Gavilan, the February '88 static pressure in that reservoir, 825 psi, again taken from Hueni's Exhibit Number Twenty.

For the Canada Ojitos Pressure Maintenance area the pressure as of February, '88, 1400 psi, again from Mr. Hueni's Exhibit Twenty.

Q Then we go to the current field producing GOR.

A Yes, the current field producing GOR for the Bear Canyon Unit, approximately 120 standard cubic feet per barrel. This is based on the average production from the Bear Canyon Unit Wells No. 1, No. 2, and No. 3.

Q Is that from the May of '88 production?

A Yes, that's correct.

Q Gavilan Mancos?

A The current producing field GOR, 4000 standard cubic feet per barrel. That would be in March of '88 and that's taken from the -- some production data that was put together in the course of Mr. Hueni's study of the area, of which Amoco was a participant.

Q And finally Canada Ojitos Unit.

A Canada Ojitos, 1,200 standard cubic feet per barrel in March of '88. This was significantly higher than the GOR's during 1987 and also, well, the GOR was in -- seemed to have been increasing starting in January of '88. February '88 was even higher, and then this 10,200 in March of '88.

Q And you took this from the Bergerson study and the production (not clearly understood)?

A Yes, that's correct.

Q All right. Let's go next to the current average per well oil rate.

A Okay. The Bear Canyon Unit, 350 barrels of oil per day. Again this is based on May production figures.

Q And that's a 3-well average also?

A Yes, that's right.

Q All right.

A Gavilan Mancos Area, 48 barrels of oil per day per well, that's per producing well, again taken from the data compiled in the course of Mr. Hueni's study.

And then 40 barrels of oil per day in the Canada Ojitos Pressure Maintenance Area.

Q And then finally we've got the primary producing zone, and what is that?

A The majority of the production in the Bear Canyon Unit is coming from the C Zone. The Bear Canyon Unit Wells No. 1 and No. 2 are completed in the C Zone, as well as the A and the B Zones. We just recently completed those wells in the A and B Zones and we're -- and we're still evaluating the data from those completions.

The Gavilan -- oh, excuse me, the No. 3, Bear Canyon No. 3 Well was only completed in the C Zone at this time.

The Gavilan Mancos Area, those wells are primarily being produced from the A and B Zones, and the Canada Ojitos Pressure Maintenance Area wells primarily produce from the C Zone.

Q And that, the latter two producing information is primarily based on the prior testimony in this case?

A Yes, that's correct.

Q Just real briefly summarize what this exhibit tells you as an engineer.

A Based on the data that I've put together here on this exhibit and that I'm familiar with, it appears that there are some significant differences between the characteristics of the Bear Canyon Unit compared to the Gavilan Mancos Area and also the Canada Ojitos Pressure Maintenance Area.

Q Now, were you present when Mr. Roe testified that in his opinion there was communication between Bear Canyon Unit and the Gavilan Mancos Area?

A Yes, I was.

Q Do you have an opinion about that?

A Yes, I do. At first glance, if you just look at the initial pressure in the Bear Canyon Unit, which is much lower than we expected, I can see why -- why you would think that there has been some pressure depletion in the Bear Canyon Unit, but I also believe that there is --

that there is other data that's shown here on our exhibit that indicates that there are some significant differences in the Bear Canyon Unit compared to the Gavilan Mancos Area.

Q And those are the things we discussed earlier in discussing the exhibit?

A Yes.

Q What about well producing information?

A Okay. There are some wells to the south of the Bear Canyon Unit that have performance that I don't think we can ignore in evaluating the Bear Canyon Unit.

The Amoco operated Siefert Well --

Q I'm referring you to Exhibit Number Five of the Proponents, which is a base map.

A The Siefert Well is located in Section 22 of 2 West, 26 North.

Q So the Siefert Well is -- the Bear Canyon Unit is north up in here, is that correct?

A Yes.

Q The Siefert Well is -- the main Gallup production is down in here, so the Siefert Well is between Bear Canyon and Gavilan.

A Yes, that's right.

Q All right, and what do you know about that Siefert Well?

A The Siefert Well is completed in the A, B and the C Zones and we've recently connected it to a pipeline. For the first three months in 1988 the well averaged 27 barrels of oil per day, which is significantly lower productivity than the Bear Canyon exhibits.

Q What about some of these other wells also to the south of the Bear Canyon Unit?

A Okay. The Wildfire Well that's located in Section 26 of 2 West, 26 North, that well in -- in May of 1987 that well averaged 18 barrels of oil per day and as far as I can tell from the producing data, it had been shut in for the majority of the time since then and it was shut in in March of '88, also.

Q And finally the Tapacitos Well.

A Yes. The Tapacitos No. 2 Well has a cumulative production of about 31,000 barrels of oil. In 1987 it averaged about 11 barrels of oil per day and for the first three months of 1988 it's averaged about 4 barrels of oil per day.

These wells have -- are significantly lower productivity wells than the wells that we see in the Bear Canyon Unit.

Q So it's fair to say that the three wells you just referenced are essentially between the Bear Canyon Unit to the north and Gavilan to the south.

A Yes, that's right.

Q Director Lemay asked Mr Roe yesterday in his testimony whether in Mr. Roe's opinion if wide open gas production would drain the Bear Canyon.

Were you present for that testimony?

A Yes, I was.

Q Do you have an opinion on that question?

A Yes. Using again the apparently the low -- the area of low productivity between the Bear Canyon Unit and the more prolific producers in the Gavilan Mancos Area, I think it's unlikely that by increasing the allowables we would be suffering adverse affects in Bear Canyon.

Q Do you see any evidence on the information you've studied to date that the Bear Canyon Unit and the Canada Ojitos Unit are in communication?

A No, I don't believe they are.

Q What's the basis of that opinion?

A The basis for that, first of all, is the difference in current pressure in the Bear Canyon Unit compared to the Canada Ojitos Unit. That's a difference of about 500 psi.

Q And other factors set forth on Exhibit One, does that also contribute to your opinion?

A Well, excuse me, I don't understand.

Q Okay. That -- is your primary conclusion that there's no communication between Bear Canyon and Canada Ojitos the pressure difference?

A Yes, that's -- that's one of the main points. Also in Mr. -- Mr. Greer's tan exhibit book, Tab N, there is map that shows that to the -- the area to the east of the Bear Canyon Unit in the West Puerto Chiquito Area, that's cross hatched with the white and brown, is an area of non -- non-productivity C Zone, or a very tight C Zone. So I don't feel like there could be communication from the C Zone in the pressure maintenance area to the C Zone in the Bear Canyon Unit.

Q Have you examined any cores in the Bear Canyon Area?

A Yes, I have. Bear Canyon Unit No. 1 Well was cored.

Q What did you learn from your examination of that core?

A I examined the core at a CORE Lab facility near Denver. When the core was originally unleaded, it had not been wiped -- wiped off; there was still mud on the core.

We took the core out of the -- out of the tubes and put the core in the black light and the core did fluoresce, which indicated the presence of hydrocarbon. We saw the hydrocarbon -- we saw the fluorescence both on the fracture faces as well as on the matrix itself.

Q Did you examine thin sections also?

A Yes, we've had some thin sections prepared from the Bear Canyon Unit core in which you can also see the fluorescing hydrocarbons in the matrix.

Q And what did you conclude by examining the core with respect to the nature of the fractures?

A The Bear Canyon Unit core was very intensely fractured. Often these fractures were -- were less than an inch apart and they covered sort of really the entire cored interval.

Q And, finally, the last question is were you present when Mr. Bush testified that -- I believe he said that there was substantially less C Zone production south of the Bear Canyon Unit. Were you present to hear that?

A Yes, I was.

Q Do you agree with that?

A Yes, I do.

MR. LUND: Nothing further and I offer the witness for cross examination.

MR. LEMAY: Thank you, Mr. Lund.

MR. LUND: Oh, I'm sorry, I'd better offer the exhibit into evidence.

MR. LEMAY: Exhibit accepted. Exhibit of Amoco is accepted.

Were you going to be a Proponent and ask questions on this, Mr. Douglass?

MR. DOUGLASS: No questions.

MR. LEMAY: Anyone else in the Proponents side?

Mr. Carr, do you have some questions?

MR. CARR: Mr. Kellahin is going to go first and then I'll have questions.

MR. LEMAY: Mr. Kellahin, please proceed.

CROSS EXAMINATION

BY MR. KELLAHIN:

Q Your last name is Lough?

A Yes, that's correct.

Q Ms. Lough, if Bear Canyon were in good pressure communication with Gavilan or West Puerto Chiquito Mancos, would you expect the discovery pressure to be near but slightly above that in Gavilan?

A Not necessarily. As I stated, the initial pressure we saw in the Bear Canyon Unit was lower than we expected but the only reason we had expected a higher pressure was because of the pressures we had seen recorded from the -- from the areas around the Bear Canyon Unit.

Q If the Bear Canyon pressures had their pressure draw down, wouldn't you expect the bubble point pressure to be quite near the pressure at the time of discovery?

A Yes, yes, that's true; however, as I stated earlier, there was approximately 125 pound pressure difference between the bubble point pressure determined and the initial -- initial pressure at (unclear) in the Number One Well.

Q Let me take your Exhibit Number One for a moment. When we look at the second column over and the third entry down, the A-25 number?

A Yes.

Q What's your date of first production out of the Bear Canyon Unit?

A Bear Canyon Unit, I believe, to the best of my knowledge, that was in July of '87?

Q When you have captioned this Gavilan Mancos Area, you've included within the Gavilan Mancos Pool the expansion area out of West Puerto Chiquito Mancos?

A Yes.

Q And when we look at the last column to the right, the Canada Ojitos Unit, that pressure number, the 1400, that does not include the pressures taken out of the expansion area?

A Yes, sir, that is correct.

Q And it does include the pressures out of the main project area up in there in the gas cap?

A It -- as I understand it from Mr. Hueni's exhibit, that includes the -- only the pressures that are == that's the average reservoir pressures that's to the -- to the east of the barrier.

Q Have you made a calculation of the pressure to put in the last entry under Canada Ojitos Unit as a substitution for the 1400 pounds if you put the expansion area pressures into the pressure maintenance project?

A No, I haven't. I just simply took those pressures from Mr. Hueni's exhibit.

Q And have you conversely taken the Gavilan Mancos Area pressure, the 825 pounds and calculated what that pressure is when you take the expansion pressures out of that number?

A No, I haven't.

MR. KELLAHIN: Thank you.

MR. LEMAY: Mr. Carr.

CROSS EXAMINATION

BY MR. CARR:

Q Ms. Lough, if we look at your Exhibit Number One, is it your testimony that the initial reservoir pressure of 950 pounds is in fact the original reservoir pressure?

A We did have some fluid production from the unit from the time they completed a well to the time that the pressure measurement was taken.

A And so what does that do to that figure?

A It would be -- the initial pressure would have been higher than the pressure that's shown as our initial pressure.

Q And could you estimate how much higher?

A No, I couldn't.

Q When you took this bottom hole fluid sample to determine the reservoir bubble point, could you tell me how the well was conditioned prior to taking that sample?

A Yes. The well was shut in for, I believe it was about two months. We were waiting on the well to be connected to the pipeline before producing any fluids.

We lowered a pressure bomb in the well, recorded the static bottom hole pressure. Since the fluid that was in the well had been sitting there for quite awhile. We purged the tubulars of that fluid to allow fresh fluid to enter the wellbore. We did shut in the well to allow these pressures to stabilize and then we took our fluid sample.

Q What did the fluid sample show you about or for gas in solution at the bubble point pressure?

A I don't recall that number.

Q Would it be possible for that analysis to be made available to us?

A Yes, it would.

Q You did a core analysis that you talked about?

A Yes.

Q Now what well was that?

A That was on the Bear Canyon Unit No. 1 Well.

Q And would you be willing to make the results of that core analysis also available to us?

A I don't -- I don't know if I have the authority to do that. I would have to check with our manager on that.

MR. LUND: We'd be happy to do that.

MR. CARR: Thank you, very

much.

MR. LUND: I think Mr. Roe testified he already examined it but we'd be glad to look into that.

Q Do you have a written description of how that core sample was analyzed? I'm sorry, of how the core was analyzed?

A Yes, we have a complete core report that was prepared by CORE Lab.

Q Do you have photographs of the core?

A Photographs of the core or of the thin sections? We do have photographs of the thin sections. I don't know if we photographed the entire core or not.

Q Would you see if those photographs might also be made available to us for review?

A All photographs or the thin sections or --

Q Yes, all of the thin sections?

A Yes, I will.

Q Do you have a written analysis or summary of how that well was actually conditioned prior to taking the sample?

A Prior to the fluid sample?

Q Yes.

A I would -- I would think that there

would a -- there's a daily operation summary that would -- that would have that information.

Q And, if possible, we'd also like to have that made available to us.

A Okay.

MR. CARR: That's all I have.

MR. LEMAY: Additional questions of the witness?

Mr. Chavez.

QUESTIONS BY MR. CHAVEZ:

Q Ms. Lough, what bottom hole pressure did you expect to discover in the Bear Canyon?

A Higher than what we saw.

Q If you were to take the difference between the bottom hole pressures measured in November of '87 and May of '88, could you draw a graph similar to Mr. Roe's exhibits about how much pressure drop you have per psi of -- I'm sorry, per barrel of oil withdrawn from the reservoir?

A Yes, I have done that.

Q If this reservoir had been partially drained, would you expect it to be drained more of gas or oil that would contribute to the lower producing GOR?

Never mind that question. Let me ask

another instead.

You said you're still evaluating the A and B Zones in this Bear Canyon Unit Area?

A Yes.

Q So you don't know for sure whether the primary producing zone will be the C or the A and B in the future?

A The data that I am familiar with to date shows a minor contribution from the A and B -- from the A and B Zone. We completed both of those zones together. I don't have the exact production figures for that but we did see a small incremental change in oil production and only a very small incremental gas production.

Q Was the C Zone the major contributor to the production in the Bear Canyon Unit No. 1?

A The C Zone?

Q Yes.

A Yes, absolutely.

Q Did you review the production data that Mr. Bush presented as to the production from the A, B and C Zones in the Bear Canyon Unit Area and for the Siefert Well?

A I did not review -- I was here for the testimony. I don't recall what those numbers were.

Q Thank you.

MR. LEMAY: Additional questions of the witness?

MR. BROSTUEN: I only have one for clarification.

MR. LEMAY: Mr. Brostuen.

QUESTIONS BY MR. BROSTUEN:

Q Ms. Lough, you mentioned that you had completed the No. 1 and No. 2 Well in the AB and are now completing in the C or --

A We completed in the C Zone first and we recently moved up hole.

Q Okay, I just wanted to get that clear in my mind. Thank you very much.

QUESTIONS BY MR LEMAY:

A Ms. Lough, the extremely low GOR that is present in the C Zone, could you speculate a little with me, assuming that some of these fractures from some of the superstars, I mean some of those Mallon wells down in the Gavilan Area did have some C Zone communication up there to the Bear Canyon Unit, with the low GOR in the C Zone, do you think it would be possible that by increasing allow-ables in Gavilan that it would draw some C Zone production and therefor keep the GORs lower than normally would be expected?

A First of all about the low GORs, we are -- we have been producing below bubble point and so we would expect our GORs to be low in the Bear Canyon Unit. We've just recently got to the point where we are near -- we are below or near bubble point pressure, so we're expecting to see the GORs increase at this time.

We have to --

Q Well, we're looking for some reasons that don't make sense down in the Gavilan Area. We're witnessing lower gas/oil ratios with higher allowables and at the same time we're witnessing an increase in oil recovery from a pressure drop with lower allowables.

With that situation it's been speculated that these wells -- not speculated but proven, some of the wells can reach out and drain an area quite a ways away from the initial wellbore. The fracture system extended those areas, and I was just wondering, although you consider this pool separate because of three marginal wells, it would seem easy to extend some fractures between those wells and maybe communicate with some of the good wells, like the Bear Canyon No. 1. If that's too long a distance, and it may be, I don't know, but we're just looking for possible reasons for some of the things we're witnessing in Gavilan.

A It's, well, I think everyone is aware

that it's a very complex reservoir. I just -- I find it is somewhat perplexing that we could have such prolific wells, some of Mallon's wells being very, very good wells, and the Bear Canyon Unit's wells being very prolific, we've had those three marginal wells in between, it's difficult to see how you could have a major fracture system extending between the two areas and yet passing through an area where we see such low productivity wells.

Q Agreed. Your well density, with one or two wells per section, isn't -- doesn't seem to be -- you only have a 7-7/8ths inch hole there --

A Yes.

Q -- and a lot of it's projection from that hole, and I guess with the heterogeneous reservoir, would you say that the conditions are expected to vary throughout that area?

A Yes, I think so, but also with the major fractures, or major faulting that may be contributing some to the natural fracturing here, I would expect to see a fairly wide zone of natural fractures and to say that that's passing between two wells that are a little bit less than a mile apart, I find that a little bit hard to believe.

Q Okay. So it would be your conclusions that you would not expect zones to the south to communicate through the these -- because they'd have to have a wide zone of fractures -- through three marginal wells to draw on areas that are beyond that, those three marginal wells.

A Yes.

Q Thank you.

MR. LEMAY: Additional questions? If not, you may be excused. Thank you very much.

MR. CARR: Mr. Chairman, I'd just like to ask Mr. Lund if when they're checking to see what can be made available to us, if we might not also see the (not clearly understood.)

MR. LUND: We'd be happy to check that.

MR. LEMAY: Appreciate that.

MR. LUND: Be happy to.

MR. DOUGLASS; Mr. Chairman, you requested at one time the over-injection figures, I think, --

MR. LEMAY: Yes.

MR. DOUGLASS; -- from BMG?

MR. LEMAY: Yes.

MR. DOUGLASS: Have those been furnished yet?

MR. LEMAY: Not yet, as far as my knowledge.

MR. LEMAY: There was a request by Mr. Lund that he summarize for ten minutes, approximately, that his -- his concluding arguments. Is that agreeable with the lawyers present here for both sides?

MR. CARR; I have no objection.

MR. LEMAY: Carry on, Mr. Lund.

MR. LUND: Thank you very much. I appreciate the courtesy and I'll try to be real brief.

Way back when we heard opening statements in this case I wrote down some of the comments made by Mr. Kellahin and Mr. Carr. Some of the things that were noteworthy was that Mr. Kellahin stated that there would be no rhetoric in their cases, just the facts. He's concerned about the Gavilan owners it think he said "blowing and going" from the reservoir, and stated over and over again that less is better for Gavilan and that unitization is the only way, and again brought out how this emergency and dire situation existed before and how everybody got scared.

Mr. Carr was a little less strident and said that his intention is not to violate anybody's correlative rights and his intention is to show that

Mr. Greer's pressure maintenance project needs to be protected and he's going to show how the pressure maintenance project is working and why, and, of course, their evidence would be that there's no barrier here.

Well, we've already talked about the incompetence of lawyers and, frankly. I've sat in on years of these hearings and it's overwhelming sometimes just the technical data that we're receiving and, you know, for a simplistic lawyer's mind I ask, how can we sort it out, you know, what's important, and I'm kind of like Dr. Lee, he talked about the good professor, he said he'd lay out a bunch of data and say what does that mean. Well, so I sat down with my expert last week and the other engineers and said what does all this mean, you know, what's important? What's the bottom line and what should the Commission consider in rendering a decision in these cases, and I think Dr. Lee summed it up pretty well. He said that really there's just two major issues.

One is, is there matrix contribution or is this a dual porosity system over in Gavilan, and the second major issue is, is there an effective barrier here as the proponents have drawn?

And I think that's a good way to look at it and I think we have to focus on the evidence of those two big areas and I'm sure that the others will talk more about the evidence and there's going to be rebuttal and there's going to be some very interesting squabbling and I hate to miss it, but the first -- it seems to me if we look at the first issue, is there dual porosity and matrix contribution, what is the major evidence, and I sat down with my engineer and tried to figure out what's important for you to consider as a Commission.

Number one is the inverse rate sensitivity, and there's a lot of excellent data from Mr. Hueni, from Mr. Weiss, and even from Mr. Roe himself about that. The gas rate is constant even though the oil rate is varied.

Number two is the porosity and Mr. Elkins testified that the porosity is too high in Gavilan to be in the fractures alone and there's going to be a dispute over that 1965 test and I think that's going to be very interesting to hear Mr. Greer and Mr. Elkins talk about this. But the fractures can't be that big, is basically what Mr. Elkins said.

Next is the core data and this is some of the hard data that Mr. Kellahin invited us to review, and the core data from the Mallon Davis Federal 315 took fluid into the matrix which their geologist on this panel, my geologist told me that that's significant and that's something that you should consider and in addition, prior testimony, Mr. Faulhaber testified about the televiewer information that showed intense fracturing from that data.

Next is the pressure build-up tests and my engineers pointed me to two of them in particular, the Rucker Lake No. 2 and the Mobil Lindrith B-37, which indicated dual porosity.

Next the evidence of Mr. Hueni is that Mr. Greer's pressure maintenance project has the lowest and slowest production per acre of any fractured matrix field, and it's the only one that is engaged in secondary recovery operations for any extensive period of time.

Next is the fracture spacing, a significant difference here. Our experts say that it's one inch or less with respect to the fracture spacing, and that's based on, again, hard evidence in the core data, but Dr. Lee testified that this fracture spacing is much broader, 270 feet I believe is what he said, and he also indicated, Dr. Lee did, that the fractures fizzled out, I think he said, around the wellbores.

And again, our evidence is quite to the contrary.

The next piece of evidence that's significant is the Bergerson model study, which when they're matching actual observed field performance they had to have a dual porosity system, which is also persuasive.

The barrels of oil recovery per acre in Gavilan is better than in West -- in Canada Ojitos and that shows something for us, too.

Now, in the 1987 hearings one of Amoco's petrologists, a man named John Thomas, wrote a letter dated March 30, 1987, that was included in the Bergerson exhibits and that indicated, I thought, quite succinctly, what's going on here and I'd like to read just a little bit of it.

He said that, "In issue is the role of matrix porosity in the total pore volume of oil and gas contained in the Niobrara, which is also know as Gallup and Mancos, in the reservoirs in Gavilan and West Puerto Chiquito."

And what he said is based on his continuing studies of Gallup cores, bit sections, core analyses, and xray distraction data, he believes that there are three components contributing to the pore network in the subject pools, and they are, number one, pore space within and around sand grains; number two, abundant tiny hairlike fractures that cut across and parallel layering in the Gallup zones; and three, large scale fractures that cut across multiple beds of rock. And he said that the discontinuous nature of types one and two cores are interconnected with the larger fractures.

And he goes on and talks about the tiny, delicate microfractures and and he says that the microfractures have been well documented in Gallup and Mancos intervals by means of this fluorescent examination and have been recorded by Terra Tech, and additional microfracturing evidence is gained -- has been gained by studying continuous cores, both wet and dry.

And so when we talk about this chicken wire thing, and that's what he references in this letter, he says that because of the fineness of the fracture spacing and the "chicken wire" interpenetration of the fractures, this type of porosity is significant as a matrix component in the zones.

And then he concludes his letter by saying that his observations are based on a number of pieces of data.

Number one, the Amoco Jicarilla Apache 118 No. 14 cores and cores analyses, and that's near the Ojito Gallup Pool; the Mallon Davis Federal 315 Well, which is in the Gallup, excuse me, the Gavilan; and the Mobil Lindrith B-38 Well, which is also in the Gallup, and he also said that he used to be a consultant for geology and engineering and he saw similar evidence of this system in other San Juan Basin wells.

So, he concludes, he says, "I do not believe the Gallup Mancos reservoir in the Gavilan and West Puerto Chiquito Pools is a simple mega-fracture drainage network. The microfracture intergranuslar pore spaces must be interconnected with the mega-fractures."

That's part of the evidence, and of course we like to think of it as our evidence, and we believe it is persuasive.

The second major issue is the effective communication barrier that's drawn on Exhibit Five. Does it exist? And again it appears to us that the evidence is overwhelming that it does.

First you've got to look at these wells drilled into the barrier that are very poor. I think Mr. Brostuen asked about that and he asked about the No. 22 Well, and Mr. Roe testified that there wasn't any data on that because it's completed in the Dakota, which is lower than the A, B and C Zones.

So we don't know why the A, B and C hasn't been tested, you know, and if the sand is continuous throughout there, that's interesting that it wouldn't be there.

The interference testing across the barrier, I realize there's going to be more evidence on that, but we though that Dr. Kohlhaas' testimony was excellent. There were no, as we would say, points made on cross examination.

Dr. Lee disagreed with it but he didn't say why, and Mr. Greer has disagreed with it, so apparently his reasons will be obvious later.

Next is the pressure build-up data that we thought also was persuasive.

Next is the Greer rainbow map where they show those gradients. We realize that Dr. Lee said that it's a pressure gradient, not a barrier, but we think if you look at all the evidence, particularly Mr. Hueni's testimony, that's persuasive.

Mr. Powell's isobar map was also persuasive in this regard and perhaps most interesting was his 25-year interference test that has been shown and talked about over and over again. It's Exhibit Twenty that Mr. Hueni talked about and it's Exhibit Number Nine (not clearly understood), but it's very interesting to see how the Gavilan production and the restricted -- or the lower pressure has not affected Canada Ojitos, and that's hard to escape.

Mr. Hueni testified that there is lost oil forever because they didn't produce in the Gavilan fast enough, and that's very significant.

And finally I think there's no dispute over geology here and in previous geological testimony they indicated that this area just by virtue of the -- of the geological formations, you'd expect a quiet area here and there's no dispute about that, for example, Mesa Grande, but anyway, just to try to sum up real quickly, there are some -- it's kind of hard to reconcile as a layman some of these things, you know, like Dr. Lee passed out exhibits on Monday and talked about some production figures for -- expected for the Gavilan area, and the numbers really changed Monday to Tuesday, you know, and his first number, he estimated ultimate recovery in thousands of stock tank barrels without pressure maintenance as 5,439, that's thousands, and then the next day it jumped up to -- I'm sorry, it's the other way around.

Monday he said 7,106-thousand stock tank barrels and the next day it dropped down to 5,439 barrels, and the same thing happened with pressure maintenance. Initially it was 7,494-thousand stock tank barrels, which is only different, an incremental difference of 388,000 stock tank barrels. And then the next day it goes to 10,215, and you know, he testified it as used as an exhibit, and this has been a hotly disputed case for years and, you know, we can understand some differences in modeling and -- but that just doesn't make sense.

The second kind of conspicuous by its absence factor is the lack of core data in the Canada Ojitos Unit. Obviously that's an important part of the facts that Mr. Kellahin says we should look at.

We already talked about these poorer wells before and there's some data on it.

The next is how can gravity drainage contribute substantially to production here with dip being so small? Maybe I don't understand it but, you know, Boulder Mancos is 20 degree dip, West Puerto Chiquito is about 5 degrees and Gavilan is less than one degree maximum.

Next thing, what happened to Spraberry? Remember, that was a big -- a big issue and the Proponents brought in the two experts on the Spraberry, Mr. Elkins and Mr. Powell, but it's gone now. It's not an issue any more.

It's still analogous because it shows that secondary recovery by gas injection won't work. It's kind of hard, Dr. Lee testified about the over-injection but he assumed that it only went straight to the west, but he didn't assume that it went any place else. That's hard to buy, and perhaps even most telling is Chairman Lemay asked Dr. Lee, well can you give us an example of another fractured reservoir where secondary recovery has been effective? And what Dr. Lee's response was, I think, was, (not clearly understood.)

I'm just about done. We caught a lot of heat from the Proponents I can remember a couple of years ago. We wrote a letter and it said, gee, we've heard both sides of the case and both sides are technically competent and if you on the Commission are going to err, you've got err on the side of preventing waste, and we got in trouble with the Proponents. We thought that there was some more study needed and we think you did the right thing by ordering the study and we think now that the data is in and the hard facts are in, that the Proponents are correct, and what that leads us to believe is that, you know, Mr. Humphries talked about correlative rights, what does that mean? It's the opportunity, the fair opportunity to produce your fair share. It's not an equalization, you know, just because you have a poor well doesn't mean you get a piece of the good well just because of correlative rights. That's not the way it works. It's an opportunity and the only difference we have at Amoco is that we'd recommend that the statewide allowables, Rule 505 and Rule 506, and we've been chided that apparently 505 doesn't apply to spacing over 160. Well, if that's true, I assume the Commission won't worry about statewide allowables for more than 160-acre spacing, but we think that particularly the gas/oil ratios should be 2000, just for general reasons more than anything else. We think that you shouldn't allow the original energy to escape that much. That's the only difference.

But the bottom line here is that this area is so variable and what we find hard to believe is you look at all these variations, look at the variations of Bear Canyon as opposed to all these areas, and it appears like the Opponents are saying, this area is one and we've got to treat everything the same. Well, it's just not true. There are these quiet zones and barriers and difference in production based on differences in fractures and variables in area, and each pool needs to be examined specifically.

So in conclusion, Amoco respectfully requests that the Commission do what you said you would do and that is make a decision and not split the baby, and we submit that the evidence is overwhelming that the production restrictions ought to be eliminated in the Gavilan and the Gavilan ought to be expanded two tiers to the east, and I thank you very much for allowing me to go out of turn.

MR. LEMAY: Thank you, Mr. Lund.

We can resume now with the

testimony of Mr. Greer. Thank you, gentlemen, for accommodating Mr. Lund.

A. R. GREER

being recalled to the witness stand and remaining under oath, testified as follows, to-wit:

DIRECT EXAMINATION CONTINUED

BY MR. CARR:

Q Mr. Greer, would it be fair to say that the last few days you've been preparing exhibits at a hectic pace?

A That's a fair statement.

Q Have you found an error in Exhibit Seven-B?

A Yes, sir, I have.

Q Does it change actually the conclusions that you reached from that exhibit?

A It does.

Q Would you go through that exhibit and explain and identify that error, please?

A Yes. Seven-B is a sheet of handwritten notes, and has some figures on it.

On the top line it says Migration Across Area of Low Permeability.

Q Go ahead.

A The -- on the bottom set of figures I have a column labeled L over W, which is length over width. L is the direction of flow and W is the width across the flow and I have there for the ratio of 1, .5 darcy feet and then I wanted to show the more the transmissibility in length, the width was five times longer than the length, and I just wrote down 5 and I should have written down 1 over 5 so I show 1 to 5 instead of 5.

The figures then would still be the same Kh .5 to 1 and .1 for W.

Then I made one other mistake. That's under item number 3 of the third line there, you have Q equals something and Kh equals something plus or minus and I had 150 x .6. That 150 is (not clearly understood) so that should be 100 instead of 150. That then reduces all the figures by about a third, so .5 would be calculated .35. Kh down at the bottom should be .35 on the top line and .07 on the bottom line.

Q And your conclusion from this exhibit that this is evidence of migration not dual porosity is unchanged.

A Right.

Q Would you -- before we go to Exhibit Eleven, I believe it would be fair to say that in the course of the hearing we've seen the different results that have been obtained when build-up tests are used as opposed to the information obtained through interference testing. Do you understand why this is?

A Yes.

Q Would you review that?

A Yes, sir. Mr. Chairman, ordinarily we engineers feel like a build-up test gives information for the reservoir over -- over large areas and gives information over larger areas, for instance, that we could expect from all the coring and we've come to accept that as a way to get the information over a pool and we take a number of build-up tests, get those characteristics, and then add them and say that that's the characteristics of the pool.

That just doesn't work for West Puerto Chiquito and the reason we just touched on briefly yesterday is that the reservoir comprises a system of fractured blocks and the blocks on the order of 10 to maybe 80 acres, perhaps some of them larger than that, and taking a build-up test, all that the test would show is the characteristics of that one small block, so if it's 10 acres that's all it shows. If it's 2 or 3 acres that's all the characteristics you get, and along with that, being so small it tends to, characteristics tend to be well covered up such that you can't really tell what they are. You can postulate them, and I discovered this first by observing the pressure build-up test and drawdown test and there's just no question that this concept is how the reservoir is made up. It cannot be any other way. When a well builds up over a short period of time and levels off, no longer continues to build, I'm speaking now of hours, then it just has to be representative of the boundary condition and that boundary can be either a closed reservoir, or a small re- reservoir, or it's a reservoir with constant pressure at the boundary. Now you can tell which that is simply by running a drawdown test, pressure drop down and level off and if the well continues to produce and produce and pro- duce, and the working pressure doesn't draw down, then there's a positive pressure at the boundary and it's being supplied from somewhere else. In this instance being supplied by the high capacity fracture system surrounding these little tight blocks, and twenty years after we dis- covered this and had a survey made, a geologic survey, and confirmed, sure enough they found evidence on the surface of these fractured blocks, and in addition we ran an electromagnetic survey and it showed the same thing, ex- cept more fractured blocks, and we ran another one in the area of B-6 and sure enough, it showed a lot of fractured blocks and there we got a good well. We ran one in the area of the P31 and didn't find any fractured blocks and we have a very poor well there. So we believe there is some consistency in our earlier -- in support of our earlier conclusions in a geologic sense as well as an engineering sense.

You can kind of look at -- might take a quick look at one of our exhibits we had in March --

Q And that's what's marked as Benson-Montin-Greer Exhibit Number Eleven It was entered in Case 9111 and it is a tan plat of fractures.

A The E-6 Well is in Section 6, 25 North, 1 West, on the lefthand side of the plat up to the top and these fractures can be seen on this plat and we think that the reflection on the surface of these fracture remnants is probably -- represents only a small part of what's there. There's probably even more than these, but to understand this reservoir now and how it works, when I say "this reservoir" I'm speaking particularly of Canada Ojitos, we found, well, we could only determine the real average reservoir characteristics through interference tests, no way we could do it through individual build-up tests because they got too small an area, and the tests of the small tight blocks would show low, low transmissibility and yet the interference tests of a large area shows high transmissibility and in my view the interference tests covered several thousands of acres, to quote Mr. Douglass, and so get a sampling of the reservoir over a very large area and that's how we first determined that had adequate transmissibility and gravity drainage and when we put that into the classic equation we find that yes, indeed, we do have gravity drainage on the order of the figure we discussed yesterday, and I'd like to review briefly, as briefly as we can, how we analyze and know that we've got these tight blocks, or at least short dimensions from the well -- from a well to the fracture system.

Q And is that information summarized in what has been marked Benson-Montin-Greer Exhibit Number One?

A Yes, sir.

MR. CARR: That's the green book, Mr. Chairman, that was distributed on Monday.

Q Mr. Greer, would you identify the information contained behind Tabs A and B of this exhibit?

A Yes, sir. Under Tab A is just an introduction that explains generally what we've just discussed. I might say how I describe or how I initially analyzed these before a type curve became available. It's clear we were dealing with a small -- a small reservoir with constant pressure at the boundary but perhaps the best way to describe those, if I had some sort of an idea of the effective wellbore radius, and can use those classic equations.

Well, that gets a little bit involved but I found that I could use an effective wellbore volume and I could approximate that from the results of a frac treatment and from that, when I'd use the classic equation, why I could arrive at an approximation of the size of the block.

Another, a second way that I arrived at it was just through the diffusivity process and the two checked fairly well. The simple diffusivity constant allows one to determine over a period of time how far the pressure pulse will go and the time that it takes to reach what would ordinarily be called steady state conditions and From that we can determine a number of things.

If it just takes a short time we know that the information reflected doesn't cover more than a short, small area.

Under B we begin to describe some of the background regarding our analyses and then if we might turn to Tab C.

Q What is the first plat behind Tab C? What does that show?

A Tab C just shows a type curve of a pressure build-up in a well in which the pressure is shown on coordinate scales vertically against log time horizontally, and the thing I'd like to point out on this first plat is a hodgepodge of phases and effects in early time of what had occurred; very difficult to analyze just what's going on here in the early, so-called early time.

Q Now if you'd go to the second plat, which is the first item behind Tab D with a different portion of it shaded and explain what that shows.

A Here we see the shape, just the general shape, again, of a pressure build-up curve if a reservoir has matrix porosity laced with fractures, and the build-up curve is flat at first and then it slopes up and just from that general slope that gives us an idea and, of course, this is just a generalization of how these curves can appear.

Q Behind that are a couple of curves on pink sheets of paper.

A Yes, sir, on the pink sheets of paper a couple of sample dual porosity systems, porosity laced with fractures, and the coefficients and the character of the particular reservoir is described by the different factors that affect it.

Both of these curves, one with wellbore storage and one without, we see the increased slope which is characteristic of dual porosity. If the slope picks up, steepens, sometimes it can come back and parallel the first slope, but without that first (unclear) of the line that steepens towards the curve, it does not reflect dual porosity. We've found another fact. None of the wells we tested showed this kind of a general shape.

Q All right, Mr. Greer, if you'd go to the copy of this graph behind Tab E and focus on the upper righthand portion of it, would you explain that and relate this to information on the Canada Ojitos Unit?

A Yes, sir. This is the type of a curve that we found on the Unit wells where the pressure would build-up and then level off, level off rapidly, which meant one of two things, a boundary effect that is either a closed reservoir or whether it is a constant pressure at the boundary.

Q Would you go back to the blue sheets that follow that and explain how you read those curves?

A Here, Mr. Chairman, we seem to find a way in which you can determine the difference. Here is a pressure build-up and levels off, either a closed reservoir or is a form of constant pressure at the boundary. So we found that we're able to take not just the pressure in the well but the difference in pressure from the time it's producing and shut-in and the pressure builds up and we take that difference in pressure and plot that against time and produce a type curve as shown in the upper blue graph.

If the plotted points fall above the

plotted points fall above the line for infinite conditions, then we have a closed reservoir.

And looking down at the lower graph if all the points fall below the line for infinite conditions, then we're dealing with a constant pressure at the boundary.

So here, although the curve on a semilog plot will have the same shape, we find now that we can plot differences in pressures and we find that one reservoir will behalf one way and one another, so now we can distinguish between them.

Q Would you now go to the graph on the E-6, which is behind Tab F and explain that?

A The E-6 is an example of a well drilled in a tight block. The steeply rising shaded area is -- is the area that's represented or has characteristics only of the little tight block in which the well is completed.

To determine the transmissibility of the area around a well for any distance at all, one must rely then only on the so-called late time region, the brown shaded area, and analyze that, and, of course, when you analyze that we have to be careful about boundary conditions beyond that point.

Even so, with the sensitive pressure bombs we have now it's possible to analyze this area, whereas earlier engineers were hesitant to do it.

This is the area that Dr. Lee and I analyzed in our report to the Commission a year ago in March and we showed, as I recall, 12 or 15 darcy feet. Our observation said that you had to analyze the slope along the shaded area and we got substantially lower transmissibility.

Q And, Mr. Greer, when you say slope along the shaded area, do you mean green shaded area?

A Yes, sir, well, the green shaded -- well, the green colored area and it's shaded in black on the exhibit.

Q And this is a typical build-up curve?

A For West Puerto Chiquito, that's right.

Q And the part that you believe should be analyzed is the part under the area shaded brown.

A In order to tell something about the area away from the well, yes, sir.

Q Would you now go to Tab G and the first yellow sheets behind those and review those?

A Yes, sir. Plat I is a copy of the same plot that we just looked at before, same pressure build-up.

And then if we go to the Plate II, the upper righthand plate, this is the same well with build-up pressure taken at a later time when the relative permeability is dropping off and you get a steeper slope now. or the B slope is steeper.

And then in Plate III on the lower righthand side shows the build-up taken last November and the B slope becomes more evident, in fact really is the slope that should be used, that should have been used all along, and I note that Mr. Weiss, when he made his analysis of this build-up he used the B slope, which is the proper slope.

Q All right, Mr. Greer, let's go to the material behind Tab H and ask if you would briefly show how a radius of investigation would be determined.

A Well, this is just a simple way to take the value you get from a build-up test, Kh/u and put it into a formula to estimate the radius of investigation.

Now ordinarily that's done with the classic formula used, so the porosity, if you don't know what it is, or the permeability, you don't know what that is, we can use Kh/u and so I just put that in, we may want to refer to it for confirmation perhaps later on with some other information.

Q Okay, let's go to Tab I and ask you if you could give us a general example of how we measure the dimensions of tight blocks working within the section.

A Yes, sir. This is one of the problems, in knowing that we really are properly analyzing this reservoir, is indeed the problem of wellbore storage and afterflow, particularly the oil wells. To try to reduce that error, we selected a gas injection well, where we were injecting gas under a packer through tubing and we have, therefor, a small reservoir storage and it's gas and it doesn't have the problems of phase segregation during the build-up, and in this instance pressure fall-off occurred, so this gives us more accurate information.

The first time we tested this was back in 1969 when we were using K-13 as an injection well, and at that time we, to get the information as accurately as we could, but particularly the differential information, we used surface pressures measuring with a dead weight tester, and of course we had to leave the pressures a short time interval, for only a few minutes, as part of the test to try to find the exact shape of the curve.

Even so I think we got very good inform- ation.

Now, the first approximation that we would make would be from the formula shown on this graph and from the semi-log plot. Now, to prove the information, we used, rather than differences in pressure, which you can use, but more accurately it's best to use a difference in squares of pressures, and better still is to use difference in squares of the pseudo steady state pressure to take into account some of the other possible errors, which we did that, and in 1980 we reported what we found in the 1969 test to the Department of Interior hearing at that time.

Since we now have sensitive pressure gauges, we decided to take another test about a year ago from the same well, and that test is shown on the yellow pages.

We have here roughly the same thing, the first approximation formula is .013 darcy feet, and now we analyze that by measuring the constant pressure at the boundary, which is shown on the pink sheet. And I should pause here, Mr. Chairman, and point out that the reservoir closed systems for concentration at the boundary are most unusual. We don't find many oil reservoirs that have constant pressure at the boundary, and the constant pressure that's listed here is not absolutely constant, but it's so close as compared to pressure within the type log that for all practical purposes it is a constant pressure at the boundary.

Now the type curves that came out in 1978 in the technical literature was the connection on how to use type curves for concentration value. We can find these type curves themselves, but by taking the report of the calculated interval and calculation made on type curves and we included them here in this book in case anybody else might want to deal with constant pressure at the boundary; save them the exercise of going through the calculations.

Now, what we do here, Mr. Chairman, is to plot on a transparent sheet of paper the pressures against time that we made in the test and you can plot them first on one of these graphs that doesn't have the curves on it, and what you do, you draw the curves while you do your plotting, and after the plot is made, you shift that transparent layer around until it fits the curve, and when it fits, why then at that time you pick a match point and that's on the formula when it calculates the characteristics.

Now, what I've done, which incidentally, here's another little mistake, on the calculations in the center of the sheet it says m equals some numbers equals some more numbers times 1.25 and there should be a times 10^6 after that and then it should be 1.07 times 10^6. That's the trouble in using these formulas.

I like to see a plot of this on the semi-log scale also, but first I would point out that the pressure points, the circles on the bottom lefthand side, pretty well fit the fairly straight line on the early part of the graph coming up to the point that says "end of period of linear flow". Now that's the period during the time of the test that we believe that oil or gas is flowing into the fracture and that's the induced fracture that we induced with the fracture treatment, and that's a linear flow; that's not a radial flow as we ordinarily consider otherwise around the wells.

After that point is reached, then the conditions, the full system becomes more radial and this is something that we look for if we have the kind of information that can let us look for it, to see if really that's what's happening, and here it appears to me that that is what's happening. Now it doesn't quite fit the bottom ones because of wellbore storage. That would be my guess.

Then we take this information, I don't make the calculation here, I just take this information and from that derive the dimensionless pressure whereby I can make the semi-log plot, and we do that with the calculations shown next. In terms of the green sheets, I'll just take a minute to talk about why we use these pseudo pressures.

In the flow of gas to a well from -- from the outer reaches of the drainage area to the well, pressure will change and when the pressure changes the gas viscosity changes and the gas deviation factor change, and ordinarily, to simplify it, we just take an average and say, well, this is approximately it, and go with that.

Here we have to take into account how that changes the viscosity and the deviation factor all the way from the edge of the reservoir into the wellbore and that's the reason we use pseudo pressures. Now some -- some engineers use pseudo pressure to be a pressure divided by viscosity divided by deviation and they deal with a number like 40,000, 50,000, something like that. I like to take the ratio of the viscosities and bring the numbers back to something it can relate to, like, for instance, on the upper righthand side of the upper graph, 2000 pounds of pressure equates to about 250 pounds of pseudo pressure.

Then the interbedded characteristics are shown on the bottom plate and, incidentally, in the reproduction process we missed changing the 10^6 again. Here it should be times 10^6 at the bottom of that.

Q All right, let's go to Section J and I'd ask you first to tell you what -- or tell us what you intend to show with this section in the exhibit.

A This is simply the same thing we looked at before except it's on a semi-log plot and I picked out a slightly different place that the 1.6 or so, it looks like we have about 1.7. On the upper righthand side where it levels off, the ratio of the size of the outside boundary is square to the length of the fracture.

That's probably not a very good fit. I'm sure we could change it perhaps on the lower a little bit. Those points on the lower lefthand side probably should fit closer to the curve, but it's not significant. The important thing is approximately what's the ratio of the outer boundary to the fractures, and of course this applies again more specifically if you had a square and had a well in the center, but what is supplied is the distance, the distance, the nearest distance, the closest distance to the high capacity fracture system, and we have determined that fairly well, it will change a lot with its shape of the area, but the significant thing is that there's a high capacity system right toward the top.

The calculations are shown on the yellow sheet following.

Q These calculations are calculating the length of the fracture, is that right?

A Yes, sir, and at the bottom righthand part of this sheet the length of the fracture. It varies from about 160 feet to nearly 400 feet depending upon the pore volume of the fractured rock and the equivalent acres wouldn't perhaps by chance be square with the acreage shown there as 40 acres, whatever it is, it's a fairly small area and less than we want to (unclear) with this kind of test.

Q All right, will you go to the Section K and review that plot on the E-6?

A We do the same thing with the E-6. We note here on the first yellow sheet, and this is the same sort of test we looked at earlier and as you see, it levels off in three to ten hours and suggesting, of course, another small block with a constant pressure at the boundary. We analyzed that with the same kind of type curve over on the pink sheet following, and then at the bottom of the pink sheet in the figures, why, we find I made another mistake. So just above the wavy line where it says xe/xf (from graph) 1.5, in this instance it's 1. We can see that that 1.0 is where the plotted points fall out on the graph above xe/xf = 1.

I believe I properly prepared the calculations otherwise, then at the bottom on the lower lefthand side where it says x^2 = .37 x 9760 = 360/porosity feet, that should be 3600.

And then you have corrections for the length of the fracture and behaviors. I'll read them straight down.

There are four fracture lengths.

Instead of 40 it should be 134.

Instead of 60 it should be 190.

Instead of 85 it should be 27o.

Instead of 200 it should be 600.

And under acres instead of .2 it should be 1.6.

Instead of .3 it should be 3.3.

Instead of 7 it should be 6.7.

Instead of 4 it should be 33.

Now one of the problems you have, of course, is what is the pore volume of that tight block, permeability to thickness. We really just don't have a way to put a handle on that other than through some comparisons I made years ago when I was testing there for this well (not clearly understood). It probably falls somewhere around that 500, and when you're talking about, oh, 7 to 10 acres for the fracture length, that's something like 300 feet and my analysis of this is that that fracture from the well has extended from the well towards the fracture system; it's gotten clear out of the tight block and I think that's what this means.

I should point out also another characteristic. It seems to me like -- like I get a better match when I used the type curve for -- for uniform flux factor rather than one for infinite conductivity. There are two types of curves. One is for the assumption that the fractures were produced as an infinite conductivity, no pressure drop throughout, and the other is if the flow was feeding into the fracture uniformly along its length and there is a pressure drop. I'm not sure just what the situation would be if we had a log with just absolutely no-where we can go, all we have is the fracture to the -- to the high capacity system. We don't have a fracture drop -- a pressure drop in that fracture, too, and whether that might be reflecting here or not, I don't know, but I think it is of interest to know that it appears that uniform flux gets measured, and my concept of these tight blocks is that their reasonable approximate size trends to 30, maybe 80 acres, or bigger.

The tight blocks themselves have, in the wells that we looked at, the wells we cored, and we cored two, only analyzed one of them, there were very many hair-line fractures and my feeling is that those tight blocks, the contribution they made was from those hairline frac-tures.

The, what they call matrix porosity was apparent in the (unclear) part of the cores, a very low volume, practically left, and then when we brought the core to the surface and had it analyzed, this pore space was still filled with something, either water, mostly water. or oil, and the oil just didn't come out. Whether it was dead oil or something about it that the pore system was -- those tight pores have only dead oil, I don't know, but in our wells when we cored we didn't find anything occurring with that -- that so-called matrix porosity.

My feeling and my analysis of the capacities of the wells, is that the fractures are really tiny fractures. It just doesn't take a big fracture to carry a large volume of oil. Hairline fractures (unclear) high capacity system.

Q Now, Mr. Greer, the information contained in Exhibit Number One confirms your interpretation of the reservoir, is that correct?

A Yes, sir.

Q And the remainder of the information that we haven't gone over in any detail is supporting material for the conclusions you've stated?

A Yes, sir, it just has some of the type curves and the equations that we used.

Q Now, Mr. Greer, I'd like you to refer to what has been marked as Benson-Montin-Greer Exhibit Number Twelve, we passed out yesterday, a booklet that contains certain material on the Fisher Federal 2 No. 1 Well, dated February 20, 1988.

A This is a --

Q Just a minute.

A Oh, excuse me.

Q All right, would you review Exhibit Number Twelve, please.

A Yes, sir. This has information on Mallon Oil Company's Fisher Federal 2-1. Now this well is a mile or so inside the Gavilan down to the west of the boundary line and it appears to me that it has characteristics very much like what we found in the Canada Ojitos wells.

I have here at the first white pages are the properties of the core which Mallon filed with the Commission on the pressure survey.

Now this -- this report was prepared by a service company and it appears that they just used their standard formula for calculating the characteristics, and I've examined this -- this build-up in the light of -- of constant pressure at the boundary (not clearly understood) and made a comparison of this information determined both ways.

I'd like to refer first to the second white sheet which says Test Summary and note the remarks, Number 3, it says "No period of linear flow was observed. Wellbore storage dominated the first 1/2 hour of the test."

And then if you'll go past the next two white sheets and the blue sheet to the yellow sheet, we can see how the points plot up on this graph and I apologize for the small size of the graph, but I believe you can tell something about it.

We can see the Horner plot building up rather steeply with the first part of the curve and the point where those plotted points make the curved line is about a half hour and that's the part of the curve that the service company says is dominated by reservoir storage, and we can see why the service company did not observe the slope which would imply to them linear flow up into fracture, the reason being that they didn't cover enough time. Just vertically above the point at which the plotted points meet the curved line, the remark there says "End of period of linear flow", and so that's why they didn't see any measure of flow, and the odds are that there's a fracture and that there's linear flow into it that we just can't determine from the test.

The way I compare the curves, I come up with a ratio of 1.5 for the distance, the distance of the side of the drainage area compared to the fracture length.

Plotted again on the next graph is the same information on the semi-log plot. You can see the (not clearly understood) is closer here. Now, one thing is perfectly clear, the plotted points do not fall to the left of the upper part of the line of (not clearly understood).

We see another thing where it says "Begin semilog straight line" we can see that the points come up and level off before that line is reached and that means that we cannot accurately use any of the information from this test to estimate under the ordinary (unclear) the permeability even though this line appears to be a straight line on the semilog plot. The closest characteristics are such that it's just not balanced.

The next sheet is where we have the calculations again and then the last sheet, the last green sheet, we have a comparison, and for instance, on total mobility Kh/u, the report says 1.9 darcy feet. I get 1.2, and of course that's not a significant difference. The Koh is .43 compared to .28, again really no significant difference.

What is significant is the fracture length. The service company (unclear) with the zero feet I think is unrealistic for a well that's been treated with 135,000 gallons of frac fluid and 180,000 pounds of sand.

What I get is 98 feet for probably the highest pore volume which could be expected, and to 540 feet fracture length, and so I imagine the fracture length runs somewhere, I would guess, between 200 and 400 feet.

And the area of investigation is probably not in excess of 15 or 20 acres; it could be as small as 3 acres that the report shows, but I would think that it's probably, oh, more like 10 to 20.

Q Now, Mr. Greer, this exhibit confirms

the approach you've used in analyzing these fractures, that being by a closed system concentrated at the boundary.

A Well, this is using concentration at the boundary when we make a comparison. The way I would analyze it and the way the service company analyzed it, and as close as the plotted points fit on the type curve, I'm convinced that there's no question as to this tight block, high capacity fracture system exists here in this area just as it does across the line.

Q All right, would you now refer to Benson-Montin-Greer Drilling Corporation Exhibit Number Two, the tan volume that was distributed on Monday?

First I'd ask you simply to identify the material behind Tabs A and B in this book.

A Tab A is an orientation map and Tab B is our interpretation of the structure in the area.

Q Now, Mr. Greer, have you reviewed the pressure interference data obtained during the recent Oil Conservation Commission order testing?

A Yes, sir. As we determined first twenty years ago, I just have no confidence in anything that's been developed so far with respect to determining oil in place and that was my approach analysis for the reservoir from that prospective.

The logs don't tell us anything and I

personally have no confidence whatsoever in cores. What I place my reliance on is the gas and the oil, the volumes we take out of the reservoir and how they affect the pressures, and in this reservoir with such a widespread communication, it's very difficult to determine, even if you project a pressure decline curve with the total -- total oil to be recovered from the reservoir, the question is where in the world is it coming from? How many acres would contribute to it?

And in order to try to get a -- some kind of a handle on pore volumes and barrels per acre, my feeling is the best thing is interference testing and it's difficult to get an interference test when wells are producing and going on and off production and trying to find a good point to start from. So I was most pleased when the Commission ordered the shut-in period and the pressure surveys because that gave us an opportunity to make an interference test that otherwise would have been most difficult to do, and of course there's a complication with it in that when the wells have been producing and we shut them in, then none of those wells can affect the observation well, and one of the problems is -- is how much affect could each well have and what then, when we put it all together what does it mean, and to do that, why we've developed a program that calculates the interference effect for each of the wells and then sums it up to -- for the total.

Q Okay, you're now going to go to Exhibit Number C?

A Yes, sir. I'd like to go to Tab C, the area of this interference test, the D-17 Well is one we used for an observation well, and we provided the Commission in March a copy of the -- of the reaction of this observation well when the other wells were shut in. We did not at that time show an analysis. We didn't think it was of substance at that time, but we have it here now and we've shown in the dashed circled area, oblong area, wells that might affect the D-17.

The D-17 is shown as a square and then each of the circled wells, the ones that were producing at rates that might have been high enough, the volumes high enough to affect the D-17's response from when the well was shut in.

Q Will you now go to the yellow sheets?

A The yellow sheets, the graph shows the match that we came up with. It shows a porosity times feet value of .14, displaced right at 1000 stock tank barrels an acre. It has the value of Kh/u of 55 and that would translate into Koh is the difference, the balance depending upon the gas/oil ratio.

We show the -- at the bottom of the page of statistics, the bottom line is gas/oil ratio and just above it we show percent. Now what that percent means is the percent of total effect on the observation well caused by the individual wells, and so we can see that there's a number of wells that have only 1 and 2, 4 percent. One of them even has 0 percent, so those wells would not have much effect on it.

The biggest effect would come from wells that have like 16, 10, one of them has as much as, let's see, 26 percent for the F-19 and I see the Howard 1-11 would have 15 percent. That covers a very big area. We can't say that the characteristics that we got is representative of the entire area, but it's probably a pretty good -- pretty good figure for a high capacity fracture system. It might represent a little more than that and contrasted to a 30-day test, like we ran before in 1965, these -- these short tests may reflect only your particular (unclear), the volume of the high capacity fracture system. Now, it's important to recognize that in terms of total volume of reservoir space, this is a large figure. If -- the best I can see for this area is something like 15 to maybe 1800 barrels an acre in place total, and if 1000 barrels of it is in the high capacity fracture system, that's a big part of it, and that's important to know because that's the part of the reservoir that can respond to gravity drainage and pressure maintenance.

Q Mr. Greer, if I understand this graph, what is says is, for say the E-10 Well, which is this well, it is 5 percent of the influence on the D-17. Is that the way you read that?

A Yes, sir, that would give you most of the (unclear) that have effect and then if you're in the half that says there's a barrier there, why, then you can say we're going to change that 5 to 0 but that still won't change the general calculation of the area.

Q Will you go to the green sheets that follow, please?

A Here we show on the green sheets -- well, first I should say that it takes two of these print-outs to determine the effect of any one of the wells, and way we do this, is -- make this calculation is to assume that the wells continue producing and get the lowest pressures reached in individual wells.

Then another run is made assuming the well was shut in, and then by taking the difference of those two, why, then we find the effect of any one well on the whole, so it takes both of those to do that, and that's the other one on the green sheet, and then the graph is simply the one that shows the relation or the ratio of the Koh to Kh/u as determined from the total transmissibility, the permeability of oil.

Now, obviously, there is many different wells, three zones of ultimate production, different gas/oil ratios, there's no way we can expect an absolutely accurate calculation, but (unclear) goes in this area.

Q All right, the remainder of the information in this section is supporting material, isn't that correct?

A Yes.

Q Would you now go to the material behind Tab D and review the information on this other interference test?

A Okay. This interference test is what we made when the first shut-in period that the Commission set last July, or really shut-in in June and the production started in July, and again we used the same system of identifying wells. The Lady Luck Well in the lower left-hand side, that we don't have a circle around it, that well didn't start producing until about the end of the test.

The observation well is Native Son 3, which well was kept shut in following the pressure build-up survey and was used as part of the pressure decline in the area after the other wells are on production.

Q And on the yellow sheets behind that we again have the curve.

A Well, here we show the match of (unclear) pressures against calculated pressures. In this instance we have a pore volume of porosity feet of .18 so real quick about 1100 stock tank barrels per acre, not significantly different than what we found on the other side, and this is something that I notice throughout the area, even in areas of the high capacity wells, I'm confident that there's more oil in place there as I notice that they are smaller, but probably not an awful lot. It's just these happen to fit that high capacity system in a good way and are hooked up with it and that's the difference.

Again it's still the same system as before for the percent effect that each of the wells had; in this instance Homestead Ranch has 37 percent of the effect, so we can believe that is actually the bigger share of influence on the test, and here again is a high capacity well like the other wells in the pool, and yet it does not reflect a lot of oil in place compared to anything else.

The next two green sheets are the same information to compare the total mobility and determine the transmissibility of the oil, and in this instance both wells at that time the gas/oil ratio was pretty high, it went to 14,000, I believe, so even with the Kh/u of 110 darcy feet, they only had a permeability of oil, Koh, transmissibility of the oil of 2 darcy feet; however, with that much, that gas/oil ratio, I'm convinced had the test been run at a time the gas/oil ratio was lower, the transmissibility would have been much higher, probably in the range of 5 to 10 darcy feet as we'd earlier estimated. High enough that they could have developed some gravity drainage had they been able to affect measures to do it.

Q Now is the remaining material in this section just support material (unclear)?

A Yes, sir.

Q Would you now go to Tab E and review the interference test information in that -- behind that tab and compare it to the (not understood)?

A Yes, sir, this test is one that we ran when the Engineering Committee was in existence but it didn't work out quite the way we had planned. There we'd made arrangements with Mr. Mallon to try an interference test at a time it was convenient with everyone and also needed to track a well nearby, the J-6, and something happened, Mr. Mallon's gasoline price went down and trying to change the schedule over there but we were still able to, I think, get pretty -- pretty good information, and we can see on the blue sheets as to what -- what took place about that time.

Starting on the lefthand side, the wells had been shut-in, Mallon's wells had been shut-in long enough that the pressure appears to have been leveled off. That's at the 1632 pound level on the lefthand scale and just before we commenced the pumping, the J-6 was fraced. You can see the response to the J-6 frac, and then about the 9th or 10th of May, why, the pressure started falling off after that frac treatment.

On the 12th of May we pulled the bomb and ran it back in. There's a little (not clearly understood) that you can see there, about .3 of a pound between the two bomb runs. Picked up a slope, then, of 4600 pounds a day and the interference effect that to analyze this -- this test is indicated by the difference between the 4600 pound per day slope and the actual measured pressures.

On the yellow we show the match of the gauges pressures and the calculated. It's not a perfect match and yet there's 1.3 of a pound at the top on one side and 1.3 on the righthand side. I have an idea that this is fairly representative of the characteristics of the area.

One of the things that we didn't go back to correct, that change, the Mallon wells seem to have a real wide variation of production from day to day and we felt like it was probably responding as a consequence of reading at different times, and so we tried to normalize that some and in that process we normalized from 53 barrels a day the first day to 113, and so that -- that probably was a -- did about half that very first day, that probably 53 barrels was about right. So that gives us a higher drawdown from the reservoir than we had starting out.

So I think it's probably a pretty good match. Now here we show 1700 stock tank barrels an acre, and this would be a little higher than we what we had estimated before.

This was at a time when the pressures were higher. There's considerable controversy about the compressibility of the formation. If I use the compressibility which Bergerson suggests, why, the pore volume would be about a third less than I've shown here. Nobody knows for sure. If I had my feelings, I think this is probably closer to right. I'm sure they feel the other way.

Q All right, what does the green sheet show?

A Again we show here the ratio of Kh/u to transmissibility and for the gas/oil ratio of the dominant well, the Howard 1-11, which is about the same as the Howard 1-8, it shows 10 darcy feet for transmissibility, or Koh, again a fairly considerable difference of opinion. We felt like transmissibility had been that high all the way through, we measured with the frac pulse tests, measured with interference tests, we find the tight blocks, so what we're measuring is the characteristic of a small tight block which means that there has to be a substantially higher transmissibility in the high capacity system and this high transmissibility, I would have to agree with the chairman, it makes one wonder about the Bear Canyon Area. There's certainly a possibility that drainage is occurring, it seems to me.

Q Are you ready now to go to the material behind Tab F?

A Yes, sir. Under F we take a look at how we analyze the pressure test period of last year. We tell that by looking at the sketch on the bottom where we show the cutoff of the bomb at the bottom of the hole; it might be higher up or whatever, the pressure is measured at that particular depth.

Then with the density of the fluids in the wellbore that pressure is corrected at the intersection of the wellbore with the producing formation, which in this instance I used the top of the B Zone. I believe that's what Bill Weiss used. And then from that point to the datum depth, the density used is the density of the fluids in the formation, and that's where we have a problem, is what is that density?

And so we review that briefly on the green sheets. Here is one of the reasons why different engineers will get a different set of pressures starting off with the same basic information. We just don't know what the density of the reservoir fluids are.

The common method of adjusting pressure to datum is simply to use the density of the continuous (unclear) phase in the reservoir. Well, here we don't know what that is, so that makes some cures which I think are on the high side, some on the low side, and I just made them as what might be appropriate to use.

On the high side the curve that I have used there is what the density of the reservoir fluids would be if the reservoir itself were just expanded until that pressure, that particular pressure is reached, and that then would be -- would define density of the gas and oil. Now, that's, of course, not what's happening. The reservoir would take out some oil in some places and gas n some and there's no way to say that that represents what's going to be the effective rate of pressure up and down the structure of the reservoir.

On the other side, the little dotted line on the bottom, that represents the density of the mobile fluids. The sum of the density is added to gas and oil that's moving through the formation and that's one way to analyze it. In fact, that's the way Bill Weiss analyzed his.

Then we have a density that's considerably less. I feel like in time that there's no question in a solution gas drive reservoir that that dotted line extended on out is what it's going to be. The question is when does it drop down from the upper level down to the dotted line?

I used, I think, maybe an average of one of these lines, an average of the two of them, for the different tests. That's all part of the (unclear) I ran for the November survey and then I show the difference. Then from November to February I used the same because of (not clearly understood.)

Q All right, and on the yellow sheets following, you review the ranges shown on the --

A Yes, I show on the yellow sheet, on this first yellow sheet, how I handled this. Highlighted on the bottom lefthand side of the -- of the page, we show that for everything else being the same except the reservoir density, I find a difference in pressure in this particular well, the Meridian Hill Federal No. 1, running from 944 pounds to 965 pounds. Nobody knows what that pressure is. Chances are it's in between there somewhere, but no one knows.

This is one of the reasons why you cannot use reservoir pressures taken in the ordinary method of bottom hole pressures to try to estimate pressure gradients across a reservoir. This is one of the unknown quantities.

Now it's not the only thing that makes bottom hole pressures not reliable for determining bottom hole pressure gradients across the reservoir, but it's one.

Then we might turn to the last sheet in this section, the gold colored sheet, and you can see here why in making my analyses I chose to deal with pressure differences from one survey to the next, rather than absolute pressures within the surveys.

Take for instance the Mesa Grande Bearcat, which is highlighted. In June its pressures would range from 1041 pounds to 1061 pounds and in November I would estimate from 768 to 787, but when you take the difference for the different surveys, we find that for one reservoir density we get a difference of 273 pounds, for another one, 275, another 274, so here when we deal with only differences, assuming the wells build up approximately the same, of course is another question, but we've eliminated the problem, I think, pretty much, and the problem of reservoir densities, it's unlikely to me that the reservoir density would change substantially in any one well during this pressure survey. I can see it would be different for any one well as compared to another across the reservoir but it probably would not change (not clearly understood.)

So that's one of the differences in my analysis of the survey.

Q All right, let's go to Tab G and I'd ask you to review the pressure differences as exhibited in that section of this exhibit.

A Okay, here we show, like I said the three -- three different areas, the Gavilan Central, and what I call the Gavilan outer, and the boundary area, and show -- show the differences, and for the overall period of June to February I show the Gavilan Central has a decline of 309 pounds and the Outer, 248 pounds, and for the boundary area of 232 pounds.

Q What is shown on the tan sheets, Mr. Greer?

A Then on the tan sheets we've taken a look at recovery in terms of barrels per thousand of reservoir pressure decline.

During the high allowable period we show on the righthand side what I call the recovery coefficient of 1800 barrels a pound, and during the lower level period I show about 5000 barrels a pound.

Here I've used the -- because we had such a small pressure difference from the survey in the past there is no way that we could accurately determine what that difference is.

I used the difference for the highest capacity well in the group, which probably would have the least problem of reaching fill up through a statewide pressure.

Q Now the figures shown on these tan sheets are for the expansion area, is that correct?

A Yes, sir, that's just for the production in the expansion area clearing insofar as the Unit is concerned and this expansion area we believe is the correct term for our pressure maintenance project and insofar as our operations are concerned, we see a higher recovery in barrels per pound at the lower -- at the lower allowable.

Q Are you ready to go on to Exhibit H at this time, Section H?

A Yes, sir.

Q Mr. Greer, the first page behind Exhibit -- or Section H in Exhibit Number Two has a plat on it and on the plat is a green area, or an area highlighted in green.

Could you identify what is depicted by that highlighted area?

A Yes, sir, that's the area that I selected to -- to make an estimate of pore volume for the Gavilan Area.

Q About how many acres are in this area?

A I estimate approximately 27,500.

Q Is this the study area that you referenced yesterday?

A Yes.

Q And in this area there are a number of different numbers in small boxes. Would you explain what this is designed to show?

A Yes, sir. These -- these numbers show the pressure declines that we looked at a little earlier and this is for the period of July through November 30 and during the high rate period.

I took those pressure declines and the production for wells within the green outlined area and fro the pressure decline I made an estimate of pore volume. I did this with only the information from the test period and I did this because I think it's really about the best information we have to date to make an estimate of pore volume.

If we tried to go to the classic method of using material balance, go back to the beginning of production, we run into problems as to what was the original bubble point and is this that is significant. The problem of an average of pressures and particularly we run into a problem of migration away from the area and migration to the area, and those are pretty difficult to take into account.

Here is seemed to me that there probably was a minimum of migration from the east, from the unit area tests, although I'm not certain of that, I'm concerned about it; as compared to earlier times I think it was probably small.

There may have been some migration from the north in view of what Amoco's told us, however, I'm afraid I would have to disagree with Amoco that there has probably been substantial migration from the north.

Q What was the average range of pore volumes that you've taken?

A Those are shown on the green sheets following and here -- here I just used a very simple calculation just to get compressibility itself. For compressibility I've used the Loddy sample, although there's not a lot of difference between it and the other ones. And I made the calculation for a number of assumptions.

Now, if, of course, one makes an initial run like this, it's possible to go back and take the calculated recovery and calculate the oil in place and then make a (unclear) calculation of the free gas, and I've not done this here. It seemed to me like there's probably some free gas to begin with and I don't know just how useful it would be, and the volume of free gas isn't going to make that much difference. You can see how it varies.

I made three sets of calculations. One was with 5 percent free gas, another with 10, and another with 15, and for each calculation I've use the minimum of compressibility for the formation that might apply and also what I think might be relaxed.

And we see, if you look at the pore volume on the righthand side, column 9, that even though there are variations, we only have a variation of .2 to .25 for pore volume.

Q Are you ready to move to Exhibit I?

A Yes, sir.

Q Exhibit I contains your recommended method of setting allowables but before we get to that would you review the data contained on the first tan sheet for that section?

A Yes, sir. I just listed here a number of the pore volumes that we calculated at different tests, both interference tests and frac pulse tests and the production with pressure decline that we just now looked at, and it appears to me that the average is pretty clearly in the range of .2 or .25. I have used in order to be a little bit on the high side, I've used .2 for the next -- next set of calculations.

Q Now, Mr. Greer, if we go to the yellow sheets, I'd ask you first to explain to the Commission how you believe the allowables -- allowables question should be approached.

A Well, here I believe we should approach the allowable from the standpoint of the gas allowable rather than oil allowable and I say that for a number of reasons. One is it's easier to calculate the amount of gas that might be produced. When you're talking about oil there's a question of recovery factor and with respect to gas it doesn't make any difference what the recovery efficiency of the oil is, all the gas is going to be produced out of the ground, I'm afraid.

So if we deal with gas volumes I think it's a lot more appropriate way to have handle the allowables. Right now it's being handled that way by the gas/oil limitations and I would recommend that it still be handled that way, but the principal governing factor is -- is the gas volume and here we want to look at what's a reasonable gas volume to permit the reservoir to be depleted in a reasonable length of time and not allow some means for the wells that just happen to be much better connected in the fracture system to recover a disproportionately high share of the -- of the reservoir gas and oil.

The first six lines are simply analysis

of how much gas might be in place, the recoverable down to 150 pounds. I've used the two different samples that have been provided by the operators. It comes out very close on line 6), 680 and 640 MCF an acre and I suggest we use the average, 660.

Then from that to determine the amount of gas in place on a spacing unit, Line 7), that would be 640 acres and 320 acres, and then we show on Line 8) the average rate of gas production if the reserve is produced in 2-1/2 years, MCF per day, and I've used that because that's the current allowable and we can see there that if the fields are all drilled at one time, wells all go on production at one time, the depletion, the rate of depletion at the current allowable would be 2-1/2 years.

The reason, of course, that the pool has lasted as long as it has, longer than this, is because the wells are draining a wide area.

If we look down at the bottom four lines we have a per well allowable of, for instance, at 320 acres a day that's 1400, which is approximately 700 barrels a day at 2000 cubic feet a barrel, which I understand some people have suggested, and I guess others have suggested no number at all.

And the number of reservoir depletion in terms of acres per day, on 320 acres it would be a little over two acres a day; 640 would be four acres a day, and then the time to deplete the tract's reserves would be 150 days and what that means is an average well with average reserves under it if produced at that rate, it would take it 150 days to produce all the gas and oil that was under its tract. Anything more that it would produce would have to have come from outside its tract. I'm sure the wells during the high rate period last year produced practically all the gas and oil under their tracts during that 5-1/2 months of high rate of production.

So this, this points out the problems with having too high an allowable. The wells that don't have that big a reserve, just have a better connection with the system. So we think that's one of the things that needs to be taken care of.

Q Now, Mr. Greer, before you go on, Line 7) on the yellow pages says "Recoverable gas at 600 MCF per acre". Line 7).

A Oh, well, I hope that's not another mistake. I'll call on one of our assistants to ask if I used 660 or 600.

(There followed comments off the record.)

A We need to correct that on Line 7) where it says "Recoverable gas at 600 MCF" to be 660.

Q Now if you'd go to the gray sheet that follows and explain what you're trying to show with the two blocks on it.

A Here we show the problem of unequal drainage for mixed spacing units. The Commission a year ago moved from 320-acre to 640-acre spacing, or possible spacing, and one of the problems here with mixed spacing is having that well on 640 acres produce as much as two wells on 640 acres. If it can, then there's no problem in protecting its correlative rights, but the higher the allowable, the closer the wells will come to the producing capacity and when that happens, then the one well on a tract will not produce as much as two, and so what that means is the correlative rights, then, it's going to be a real problem to protect correlative rights if the allowable is so high that all the wells are -- or most of the wells are producing to capacity.

MR. CARR: May it please the Commission, we probably have 20 minutes additional direct.

MR. LEMAY: Let's take a -- if this is a good point, let's take a break to five minutes after 11:00.

(Thereupon a recess was taken.)

MR. LEMAY: We shall continue.

Mr. Carr.

Q Mr. Greer, will you refer to the plat behind Tab J in Exhibit Number Two and we've got a blow-up of it here, and would you review the current status of development along the boundary between the Canada Ojitos Unit and the Gavilan Pool?

A Yes, sir. One of the issues, of course, is protection of correlative rights across the boundary, which I'd like to discuss briefly, and also point out that we see no useful purpose in moving the boundary.

A year ago we asked the boundary be removed just to simplify the rule that all wells would be operated under the same rules, but of course that can be done giving both pools the same rules and under the circumstances it seems to us like the boundary should stay where it is.

There's been a great deal of effort, of hearings to this Commission, and wells drilled in accordance with orders of the Commission, to recognize the change in spacing from Gavilan into West Puerto Chiquito, and I would like to point out that there's really only one way that the spacing can be changed in a pool and do it with assurance that correlative rights be protected and that's to make the spacing change at a unit boundary and when the unit boundary coincides with a pool boundary, why, that is what we've taken into account and what would have been done to protect correlative rights across this boundary.

I'd like to point out just what has been done.

We might start at the upper two pink squares and note that there's one well on one side of the boundary on a section and there's one on the other side.

There the drainage is balanced, at least the opportunity to protect from drainage is balanced.

Down below that are two blue squares with two wells on a blue cross section and one on a pink cross section.

Sections 1 and 6 there are two wells on each section there and they're balanced.

And down below that, Section 7 offsetting Section 12, there's one well on each section.

Down in the next row, Section 18 versus Section 13, one well on each section.

Then we see three rows of sections in which there are two wells in each section on the Gavilan side and one well in a section on the Unit side. Now there we have no problem with protection of correlative rights for the reason that of these units we can look at all three sections here, 19, 30 and 31, and if we take the combined production in those three sections, we find that the value of that production, even though we're injecting gas, just the value of the oil that we sell is substantially in excess of the value of the gas and the oil from the other -- other tracts, and so although reservoir voidagewise we're taking no more reservoir space, we have protected our correlative rights.

So right now, the way the situation exists across the boundary, there is a pretty good situation if we look at protection of correlative rights assuming there is pressure maintenance credit, that's a pretty simple way to view it.

Q Now, Mr. Greer, let's go to the map that is behind Section K of Exhibit Two.

A Here we show again the pressures differences which we developed in surveys and we show the yellow colored area some information we presented in March, 50 to 100 pounds the pressure decline during the period from July to February. That's the yellow colored area. which, incidentally, I have pointed out before, I'll just point it out again, it's pretty difficult to get a weighted average pressure in the gas cap with the extreme variations in pressures; there's no way to put a real close figure to it, but generally it's something in that range.

And then the expansion area, the brown

shaded area, the pressures drop to around a little over 200 pounds.

Then in the green shaded area, 300 pounds. The boundary wells in the west and the boundary well to the north, the Wildfire, 217 pounds, not produced, also had little pressure declines.

Q Now what can you -- what conclusions can you draw from these three areas?

A Well, it seems to me that we again have the general pattern of -- of higher withdrawals and the effect of that in Gavilan, the pressures are dropping more rapidly and probably pressure support from the unit from east to west, the general flow that we found that everything else was (not clearly understood)

Q And if you hadn't had this pressure support from the unit, what would you anticipate would have happened in the brown area?

A Well, it's pressure would have dropped down.

Q More than is shown on this exhibit?

A Yes.

Q All right, Mr. Greer, let's go to the first exhibit behind Section L in Exhibit Number Two, and I'd ask you to review the information on the first gray sheet.

A Yes, sir. This shows why when we presented the rainbow map in March and it's presented again now, that this shows a minimum pressure gradient from east to west and the pressures on the rainbow map were surface pressures and we had at that time gas in the wellbores from the surface to the producing formation. And so we know that the pressure gradient, then, from east to west, would have to be higher than that, maintaining would be determined by comparing one pressure to another because as we see here on this sketch, the reservoir density of the fluids would be higher than the density of the free gas in the wellbore and so, as we indicated before, the rainbow, and all it's designed to show is the direction of flow and it has the minimum pressure gradient and compares one pressure against another.

Q And then behind that is the rainbow map

A Yes, sir.

Q On this map could you tell me how far apart approximately the C-5 and the B-18 Wells are?

A It would be about two miles.

Q And this gives you an accurate depiction of where the wells are actually located as contrasted to the map presented by Mr. Hueni?

A I didn't realize he had a difference there.

Q I mean if you -- when you've looked at them in this fashion you can actually see the actual distance the wells are apart.

A Yes, sir.

Q And again would you explain the purpose of presenting this map. What does it show?

A Yes, sir, the purpose is to show that the direction of fluid movement through this area is from east to west, and also we pointed out the equalization of pressures north and south applies all the way across the reservoir, beginning with the injection wells, there tends to be an equalization north and south, and then with the injection wells, the next area, rather a large pressure drop. The largest pressure drop in the field is right there between the B-18 and the K-13, that are only a mile apart, and there's 500 pounds of (unclear) pressure gradient.

The green area, again the pressures north/south are very well equalized.

The brown area and the yellow area, even though we're talking now about a small pressure difference, still north and south there's an amazing degree of equalization.

The only -- the only difference, and that's only a 2 pound difference in Section 6 from the E-6 to the J-6, and here we find that the structure is the other direction and so that's probably the reason for that.

Q All right, Mr. Greer, would you now go to Section M and review the evidence of pressure support from the pressure maintenance project into the expansion area?

A Yes, sir. I show here on a plat wells that were produced in the expansion area during March, I think it was about mid-March, I think -- March 15th to 23rd, and the two observation wells, the D-17, which is a small well, small capacity, and the B-29, which is our highest capacity well, and the producing wells are the F-18, B-32, F-30 and G-5, and we show on the tabulation just above the plat the production rate for those wells during that test period, which, incidentally, was their flowing rate all through the month, and the gas/oil ratios, and we point out the extremely low gas/oil ratios from these wells, whose production is coming primarily from the C Zone, and we've inferred from that that we had effective gravity drainage and pressure maintenance.

Q Now if we go to the plats that follow that, could you explain what this -- what this first plat is designed to show? That's the plat on the D-17 Well.

A Yes, sir, this shows the pressure in that well during this test period.

Q Is that depicted by the little line I'm indicating now, that goes across the graph?

A Yes, that's right.

Q What does that tell you?

A That tells me that those wells are using pressure support from the pressure maintenance project. There's just no way that we can produce 1500 barrels a day without a pressure decline unless there is pressure support coming from some place. The C Zone is a good zone and it's good but it's not good enough to produce the pressure motion indefinitely without a pressure drop. It has to have a pressure drop.

During the high rate test period the pressure decline in the area was around a pound and a quarter to a pound and a half a day. I've run that as a comparative slope to see the difference.

Q And that's shown on the lower part of this graph?

A Yes, sir.

Q All right, let's go to the next graph. This is a similar graph on the B-29.

A Yes, sir.

Q Does it show basically the same thing?

A Yes, sir, it shows the pressures are practically leveled off at this rate of production and the

D-17, of course, it's being in a tighter part of the reservoir, it takes it awhile longer to replace, but that pressure change is in the reservoir, the B-29 reflects it very quickly and here it's very clear that this pressure was just level during this period of time in March, and you can see in order for the pressures to be level and not drop, and still take oil out, and with the pressures in Gavilan, production over there and pressure dropping, we had pressure support not only for the 1500 barrels a day but enough more to keep going on over to Gavilan, otherwise the pressure would have dropped here.

So how much additional pressure support we have, of course, we don't know, but we had to have a minimum pressure support of 1500 barrels a day, and we only produce on an average of, I think, oh, in that range, 1500 to 2000 barrels a day.

Q Mr. Greer, these are actually observed facts which show that pressure maintenance is in fact working in this area.

A Yes, sir.

Q All right, let's go to the next plat, which is a plat of the area with a blue rectangle and dashed lines on it, and I'd ask you to explain what this shows.

A Yes, sir, this just shows that the production that we get from the wells during this time, the transmissibility required to provide that production is consistent with what we think the reservoir properties are and I've shown for a 2-1/2 mile distance the pressure difference of 400 pounds; the amount of production from that approximately 4-1/2 mile long area, and what it shows is that it will take about 1.3 darcy for a value of Koh to provide that support. Now this is all oil. If, through this high streak we have some gas mixing up with it, why, it wouldn't require that much, and, of course, I think that's what's happened.

Now this is in the area of the B-32 and C-34 interference test which showed an average Koh of about 10 darcy feet and I tried to point out in March when I talked about it, but I guess I was unsuccessful in getting my point across that normally these interference tests or frac pulse tests didn't show the average characteristics for a large area, several thousand acres. If there's a tight streak in the middle of it, it's not going to pick that up and if there's directional permeability, that's not going to be reflected. You can't tell that with just one test across the area. So the effective permeability in the east/west direction can be significantly less than that shown for that average for the area, and we think that on average there's got to be transmissibility and gravity drainage for pressure maintenance; even though there's a tight streak here and there, it's not going to deny its ability to recover oil efficiently.

Q Mr. Greer, this is a copy of the map which is the first exhibit behind Tab N in Exhibit Two and I'd ask you first to identify what you depict by the gray area on this map.

A Well, the gray area is interpreted to be the initial gas cap area with extremely low pore volume.

Q Okay, and then what is depicted by the solid brown area on the exhibit?

A The solid brown area shows the area which we think still contains a high percent of oil in the C Zone.

Q And in the yellow area?

A The yellow area shows gas invasion of that part of the C Zone.

Q And the northwestern portion of this plat has brown lines on it. What do you intend to depict with that?

A Well, so far in the northern part we have found no production in the C Zone and we interpret it as possibly the whole area will be noncommercial in the C Zone, although we're not certain, we won't know until we drill more wells up there. We do anticipate initial production in the A and B Zones up there.

Q Now using this exhibit, could you explain to the Commission how you believe this area needs to be produced?

A What we want to do, Mr. Chairman, our, or my belief as to the prospects that we have to produce a significant additional amount of oil from the C Zone by gravity drainage and pressure maintenance, can be seen from this -- this plat, and we don't know just exactly where that stocked area is but we feel that -- that over 20 years through gas moving through that area, as we injected moving up dip and displacing oil down dip, and apparently there's been quite a bit of oil moving down through the yellow colored area and the stocked area doesn't -- hasn't appeared to move as fast and as far west as one might have expected.

We believe that -- that continued pressure maintenance will bring -- keep the project effective by gravity drainage work just as the tight -- the oil moved down to the tight zone and we would cross it with gas drive or effective gas drive above the gravity drainage, goes across the tight streak, we'll have gravity drainage again. Even in the flat reception area that we have now we consider the expansion area primarily the collector for our pressure maintenance project. In time we'll finally get some gravity drainage down there even though it's (unclear) there is enough high capacity formation there that we'll pick up a little bit, but right now what we're getting is low gas/oil ratio oil, not concentrated in the gas drive where we have high, high gas/oil ratios. That oil is collecting, moving down principally by gravity with the force of the pressure maintenance gas cap behind it to go to some high areas, and we anticipate a very large additional amount of oil to be produced. As we indicated yesterday, the efficiency so far has been outstanding as compared to other solution gas drive areas, for instance, Gavilan, and all we want is the opportunity to continue our pressure maintenance project into the expansion area. We're not interested in trying to pick up oil off of Gavilan and drain oil in that direction. That just is not our intention at all, and we don't want any of it.

But we would like to be able to carry out our program the way we think it should be done. I understand the opposition has said that gravity drainage won't work, pressure maintenance project can't work, hasn't worked, won't work, but the people in the unit, who own the unit, think otherwise, and we would like the opportunity to continue our pressure maintenance project.

Q Now, Mr. Greer, to develop these reserves do you have to balance this pressure maintenance with the migration?

A If we attempt to move too fast, the gas will tend to bypass the oil and we will not get as efficient recoveries as we'd like to have.

Q If you're to continue to operate this area with your pressure maintenance project, of what importance is the gas injection credit?

A Well, the -- we'd have to have gas injection credit or we can't afford to carry on the project. If we don't have credit, why, the gas and oil will move across the line and we've done all that is reasonable, we think, we can do to prevent migration. But at the low rates of production now, as can be seen by how we can produce the C Zone wells with no pressure drop, we can produce a long time very efficiently.

When we move to the high rate of production all we can do is try to protect our boundary and increase production from our wells and try to keep up with the offsets and our efficiency will be diminished.

Q Now would you go to the material behind Tab O in Exhibit Two and review for the Commission how you believe the boundary migration can be minimized?

A Yes, sir. As I indicated before, we would like to carry on with the pressure maintenance project; we have no objection to any kind of a reasonable long term (unclear) of whatever that will assure that there is a balance of withdrawals across the boundary. A suggestion was made at the March hearing that one way to do that might be to measure pressures on each side of the boundary and we're certainly willing to do that, and we think that there are certain things that need to be done to be assured that we can measure comparably what the pressures are, and we made those suggestions as to what pressure gauge should be used, use the same wireline to lower the bombs into the wells and utilize wells that are in good communication with the main producing reservoir, and try to select that wells that have a minimum difference in structural position so that we would not be plagued by the problem of the unknown density of the reservoir fluids.

And finally we would suggest that as a practical matter, that the Aztec Division or office of the Conservation Division be charged with the responsibility and authority to establish the procedure, witness the tests, and then, in the event the Aztec Office determines that migration is occurring from Gavilan to the Unit, I won't say anything about the other way, if they find drainage occurring, migration occurring from Gavilan to the Unit, then to reduce the Unit's percentage of gas injection credit for the expansion area wells, and that adjustment to the gas injection credit percentage be carried until another survey.

Q Mr. Greer, were you present and heard Mr. Roe's recommendation concerning letting wells in the area produce at high rates for short periods of time to achieve more efficient oil production?

A Yes, sir.

Q And would you care to comment on Mr. Roe's recommendation?

A Well, in general, the phenomenon that -- that apparently occurs in Gavilan of the high rates and the low gas/oil ratios I just did not find in our wells, the significant ones. We found where it apparently occurred but it was a consequence of offset drainage. But we have absolutely no objection to that if they feel they can more efficiently produce the reservoir by producing at high rates, and then in order to protect correlative rights shut in until the time their allowables are balanced. We certainly have no objection to that.

Because of a little (unclear) in what we just discussed in balancing pressures across the boundary with (not clearly understood) I think that reasonable people can resolve and no, we have absolutely no objection to that.

Q Mr. Lemay raised yesterday a question of whether or not there were examples of injection projects working in fractured reservoirs and do you have examples of those?

A I can remember, I think I can remember, of a large reservoir with no matrix porosity, only fracture porosity, a gas injection project, but I can't recall which one it was, and if it is possible that we could research the literature and submit that at a later date, why, that's what we'd like to do.

Q Do you have an opinion, Mr. Greer, on what the impact will be upon this reservoir if higher production rates are in fact authorized by the Division, or the Commission?

A I feel that the ultimate recovery from the Canada Ojitos Unit will be -- be reduced if the allowables are permitted to go much higher than they are right now.

Q In your opinion will that result in waste of oil?

A Yes, sir.

Q In your opinion is pressure maintenance working in this unit?

A Oh, yes, sir, absolutely.

Q And in your opinion could there be a barrier across the unit as depicted by Mr. Hueni?

A No, there's no barrier. There is a

permeability restriction but it's not adequate to completely stop the pressure maintenance project from being effective.

Q Now, Mr. Greer, were Exhibits One through Six, Seven A and B, Eight and Eight A, and Ten, Eleven and Twelve, compiled by you or prepared under your direction and supervision?

A Yes, sir.

MR. CARR: May it please the Commission, at this time we would offer those exhibits into evidence.

MR. LEMAY: Without objection those exhibits are admitted into evidence.

MR. CARR: That concludes my direct examination of Mr. Greer.

MR. LEMAY: Thank you, Mr. Carr.

Mr. Kellahin.

MR. KELLAHIN: Thank you, Mr. Chairman.

CROSS EXAMINATION

BY MR. KELLAHIN:

Q A point of clarification, Mr. Greer, in response to Mr. Roe's recommendation yesterday with regards to allowing wells in either pool the flexibility to overproduce their allowable, my recollection was that Mr. Roe recommended that the flexibility be the option to produce any well, overproduce up to a maximum limit equal to four months of allowable during any one continuous production period. Is that your understanding?

A That sounds reasonable to me, yes, sir.

Q Do you have a recommendation as to whether or not it should exceed more than four months during any on those periods of production?

A Well, as fast as Gavilan is being depleted, gosh, I believe we ought to take a minute or two and take a look at John Roe's Exhibit Four, that -- that -- at the time that the Commission called attention to the operators that they might want to do something, was just about the righthand side of that dashed line, and we did manage to take some pressures in our E-6 Well and the Loddy Well, and it was clear that Gavilan at that time, Mr. Chairman, was draining probably two townships, and --

Q You're speaking about that portion of Exhibit Four in here where it says the E-6 and the Loddy Wells?

A Yes, sir.

Q Way up in here?

A Yes, sir, and then as the wells were

drilled and migration to Gavilan cut off, wells in the expansion area were drilled, we're not sure about Northeast Ojito. There's an igneous dike that runs up along the township line between Northeast Ojito and Gavilan that I would think probably would reduce migration generally in that direction.

It might -- might have come down around the south part of the dike and then into Gavilan, but certainly there was a significant amount of migration into Gavilan that began to be cut off, both -- well, I say both -- all from the south, the west is beginning to be cut off, from the east it's been reduced substantially from the unit, and it would appear now that in view of my interpretation of what Amoco gave us this morning, that Gavilan is going to see another -- another sharp decline when the north part of Gavilan comes on production and cuts off that migration.

And so in answer to your question, I think it's going to be best not to allow longer than four months overproduction.

Q Within that four month limitation or restriction, what then is the advantage of allowing those superstars the opportunity to produce in short, continuous, high rate bursts for that period of time?

A Well, it seems to me that if that solves a problem that they feel the need to produce at a maximum capacity, and that being the case, I would see no reason to limit it, if that's really what they (unclear), produce just as fast as they can and it would seem to me that that solves two problems: We assume that they proceed at high efficiency and at the same time protects correlative rights by not being able to produce indefinitely and draining other properties.

Q Is there any advantage or necessity to have the provision, a flexible rule, one restricted to one of continuous production during that high rate period?

A I --

Q I didn't make myself clear.

A I'm sorry, say it again.

Q Yes, sir. With the high capacity wells, the proposition Mr. Roe gas us was that once you put that well on production at the high rate, that that high rate ought to continue, that the production from the well ought to continue continuously until that well was no more than four times overproduced.

Now what happens if that production is interrupted? Would the well have to be balanced again before you could then produce it in a high rate burst?

A Well, in principle, I think it should be but I presume the Aztec Office should be given some flexibility there for such problems as mechanical breakdowns and such as that. I guess we haven't given that too much thought.

In general, it seems to me like it should overproduce, then be balanced, then overproduce (unclear).

Q Once the overproduction, then, is made from the well, it should be required to balance by going back to a zero state within terms of its allowable?

A I believe so. I don't believe that would be too -- too much of a burden or a hardship, say, the well produced two months allowable instead of four, produced in two weeks, and then shut down. Then it could be balanced at the end of the two month period; start over again and go for four months.

Q Thank you, Mr. Greer.

MR. LEMAY: Thank you, Mr. Kellahin.

Is there any other on the direct, the opponent forces want to ask questions?

Why don't we take a break before we start cross examination for lunch, if that would be all right, returning at 1:00 o'clock.

(Thereupon the noon recess was taken.)

MR. LEMAY: We shall resume with the cross examination of the witness.

Yes, Mr. Douglass.

CROSS EXAMINATION

BY MR. DOUGLASS:

Q Mr. Greer, approximately what is your gas cap volume now in MMCF or MCF, do you know?

A Well, we worked out some numbers last time, I haven't quite kept track of it, but we can go through that exercise again, if you want to, (unclear) --

Q Well, I just -- is it something you've got to calculate, you just -- you don't know approximately how much your gas cap volume is with the gray area here?

A Oh, from time to time. The gray area I think is just not substantial.

Q What about the gas that's down in the yellow?

A Down there, we can approximate that. Well, we produced about 9-million barrels, and about 7, roughly 7 cubic feet a barrel, that's about 63-million barrels -- 63-million cubic feet, and then at roughly 100 atmospheres, that would be about 6.3-million.

Then the drainage pressure has dropped,

oh, maybe down as low as 14, 1450 pounds, there's been some shrinkage particularly from the up-dip area; that would give us a little more participating gas, maybe -- maybe 200 BCF.

In round numbers it's probably in the range of 8 to 10-billion cubic feet.

Q 8 to 10 BCF?

A Yes, sir, that's my estimate right now.

Q On the wells that you've (not clearly understood) in the unit out here, do you measure -- first of all, are all your oil wells in the expansion area on gas lift?

A All except one that we're still fooling around with.

Q All right, producing wells that are on gas lift in the expansion area?

A Yes, sir. I think -- I believe the G-32 is the only one we don't have on gas lift.

Q You said there were about nine producing wells in the expansion or are there more than that now, actually on production?

A Well, we'd have to count them but --

Q You're going to have to add up the wells in the expansion area? That's all right, if you have to add them up, I don't -- I don't want to take the time.

A The producing wells, yes. About fourteen.

Q Fourteen. You counted the D-17, it's not a producing well, is it?

A Okay, take that off. We've been using that for -- we've been using the D-17 as an observation well for about a year, so that would get us down to thirteen.

Q You're actually producing thirteen wells during the month, now.

A Well, most months. You know, occasionally we get overproduced. We've been trying to stay fairly well within the current allowable.

Q Do you measure the gas that goes into your gas lift at each well?

A Oh, yes, sir.

Q How do you measure it at each well?

A Measured by keeping track of the -- the pressures that cross the choke and calculate (unclear).

Q Pressures that cross the choke. Do you have a chart on it, a meter?

A It's a calibrated choke.

Q It's a calibrated choke, so the pumper will go out once a day and check that or how often would you check it?

A Yes, he checked it once a day.

Q It's an eyeball measurement that he made across the choke?

A Yes, sir,

Q And then how do you measure the gas? Do you measure the gas immediately when it comes out by meter?

A Yes, sir.

Q All right, out of the well you measure it by meter.

A We use a standard, conventional flow meter to measure the total volume of gas.

Q At the well?

A At the well.

Q You have a meter at the well that measures the gas. Is it separated at the well?

A Yes, the gas and oil are separated at the well.

Q And then you measure the gas at the well.

A Yes, sir. And we have a separate measurement for each well for the gas volume and the oil volume.

Q Each day.

A Each day.

Q Charts.

A Yes, sir.

Q You've got the chart, the gas chart.

A Right. We use 7-day charts for the gas.

Q Is that -- are those the charts? Do you add up those charts to get what the gas -- the well produced for the month?

A Once in awhile. Usually, we've found that for the most stable wells, the most accurate way to determine the volume is to get the gas/oil ratio for a period that's representative and use that gas/oil ratio for the full month.

Q In other words, you --

A Well, no, I'll say until there's a change and we can, of course, tell by looking at the charts if there is a significant change in the gas volume, and that's only on the boundary wells. All the others are fairly stable. (Not clearly understood) end of the month these are checked within, oh, 4 or 5 percent.

Q So you make measurements and then you allocate for the gas produced for the well.

A That's correct.

Q And that's how -- you use those measurements to calculate your gas/oil ratio.

A Yes, sir.

Q And that's the wells along the -- for

instance, the E-6 would be one of those wells.

A Yes, sir.

Q Now --

A Oh, excuse me, I believe the E-6 right now, I think, with the high gas/oil ratio, I believe we cut the gas lift, the input gas off, so all we've got is just the (inaudible)

Q Is it flowing, then?

A Oh, yeah.

Q The E-6 is flowing.

A Yeah, they all flow by the gas lift system and some of them will flow all the time without the gas lift but I'm using the gas lift to get more stable rates and I just prefer to do it that way.

Q Mr. Greer, you've submitted some injection figures here, is that correct?

A Well, that schedule that you have, as I understand was given to Dr. Lee's people from our office but I have not looked at it.

Q Let's see if I understand what is happening.

You started injection according to this about in looks like 1968, is that correct?

A Yes, sir.

Q And you took the gas that was being

produced, all the wells that you were producing were east of where we've designated the barrier, is that correct?

A Until -- until we brought the wells on west of the barrier.

Q Right, and that wasn't until what, 1982 or '83?

A I believe it was closer to '85.

Q '85, I think you're right. I believe the first well went on in January, '85, and so from '68 to '85 you had gas production the brown area injected in the brown area.

A Yes, sir.

Q All right, sir, and then is the way you over-injected -- strike that.

When you first started injecting, prior to that time had you been -- what had you been doing with the gas?

A Before we started injecting?

Q Yes.

A We'd had a period of time when gas at that time was worth, I think, the high was around, oh, 12 or 13 cents a thousand. We tried to get pipeline companies to lay to us so we could market the gas but we were unable --

Q I'm sorry, Mr. Greer, were you flaring the gas?

A Yes, sir, so until 19 -- about 1967 or '68, we made arrangements whereby we could deliver gas to the towns of Dulce and Chama, made a swap out arrangement with the -- to the pipeline companies so that we could market gas. We sold gas for I think 6 or 8 months and at that time I had concluded by studies and decided instead of selling gas we should inject it. So we turned around and instead of selling gas we started buying make-up gas.

Q And the gas was pretty cheap in those days.

A Yes, sir, we had like a 25 year contract (not clearly understood), something like that.

Q So one of the advantages in addition to what you say is additional oil recovery, is that you in fact got to store the gas where if gas prices ever did move up, you'd have it available.

A Yes, sir, but unfortunately we didn't have the foresight to realize that would be an advantage, but it turned out by happenstance that it was.

Q And then you over-injected, I believe that you got up as high as 1.4, is that 1.4 BCF? Is that what those figures over here?

A Well, I haven't seen this schedule. I don't believe we injected roughly 12 billion total.

Q Well, I don't know. I was just looking at the -- I assume the minuses, according to the column, is a net over-injection. It says MMSCF, is that --

A Well, I'd have to ask the people who prepared this schedule. It doesn't look like I can interpret it myself here.

I think I'd better ask Dr. Lee's opinion.

Q Is it (not clearly understood) over-injected?

(Thereupon a discussion was had off the record.)

Q Mr. (unclear) has conformed that according to these figures, that's BCF figures if I put the decimal in, and I'm going to say it's about 1.4, roughly you got about 1.4 BCF over-injection, is that correct?

A I assume that that's right. I don't know. What -- what year is this?

Q Well, you look at it and tell me what year.

A (Not understood.)

Q Well, there's a whole lot of 1.4's along with the year, it looks to me like 1983.

A Well, I presume that's right. I know

that we bought make-up gas. We used (unclear) and my recollection is that -- just offhand I would not have thought that we had that much over-injection.

Q I see. In 1980 does it show -- can you give me November of 1980 off of this -- this graph?

A Yes, sir, if I recall, in 1980 we made a review of our injection; in fact, we filed it with the Commission at a hearing, and as I recall we had -- we were gaining about 10 pounds a month, which I felt was just about enough to balance the drainage down dip of the oil in the oil section.

Q Mr. Greer, in 1980 you over-injected 1.4 BCF, haven't you, approximately 1.3 BCF according to these figures you submitted to the Commission in 1980, late 1980?

A Mr. Douglass, as I said, I have not checked these figures and I don't mean to hedge, but let me tell you what the situation is.

When -- when I made my review for the Commission in 1980, I recall that in using total figures of production and injection, I had to take into account fuel usage, and I'm not sure that they're on here. I didn't do this. We might save some time here if --

Q That would be all right with me, Mr. Greer.

A I have a feeling that there may be a --

I don't whether I have a misunderstanding or what, but there was -- if these are Dr. Lee's pressures, it's my understanding that he was running a study for Sun, a directional study. Sun is very much concerned about migration and Sun feels very strongly that we have an oil bank effect and they wanted some information from him, I think, on preliminary -- (unclear) preliminary basis, and I made my own calculations for migration and I know we had the same corrections. They're substantially different from Dr. Lee's.

Q What you're really telling me is that during the time of over-injection the pressure was still going down in the unit area, this brown area, isn't that correct?

A Well, now, up until 1980 I think we over-injected enough to just about balance the pressure and at that time I think my pressures were around, oh, 1450 pounds, and today in talking about these things, I (not clearly understood) talking about, oh, 1600 to 1650 (unclear).

Q Well, Mr. Greer, didn't you testify that even though you'd been over-injecting that you could not maintain pressure in your unit?

A Well, yes, sir, the situation is there but again, as I explained in my 1980 hearing, is that in addition to replacing the gas with the volume of oil that's produced, as the oil moves down dip you have to increase the pressure of the gas cap just to maintain the pressure in the oil flow, so even though we over-inject, why, we don't see a substantial increase in the pressure.

Q Are you saying that the pressure decline that's shown on Exhibit Twenty from the time you started injection till the -- you actually measured some pressures in the oil column is incorrect?

A Oh, I wouldn't say it was substantially incorrect. I think we have about 1600 pounds in 1980. What does your graph show?

A It shows in 1980 that the pressure was about 1570, 60, 70.

Q Okay, then I didn't miss it more than 50 to 100 pounds.

A But it's not at the level that Dr. Lee shows in his work, is it?

A Oh, no, it's not.

Q Now, let me see if I can understand the situation.

If the barrier exists here, and it is effective separation, then that's not going to adversely affect your injection project. Is that correct?

A Well, if it was an absolute barrier, which, of course, you know I disagree with that, --

Q Sure, I think I had feeling, too.
A Okay.
Q I sensed that, Mr. Greer.
A You're very perceptive.
Q One country boy to another country boy, I sense that.
A If this area is a barrier, okay, what about that?
Q It's not going to affect your gas injection project you've got carrying on.
A Well, if it's an absolute barrier, it would affect it to the extent that we'd have to do something different. We'd have to find just where the blamed thing is and drill some more wells down there right next to it.
Q Now, when you say absolute barrier, have you put on any absolutes in this case so far, Mr. Greer?
A Oh, in this business I think there hardly are any absolutes.
Q In other words, even if there's not effective communication across that barrier, it's not going to affect your injection project, is it?
A Well, only to the extent that there's additional stuff. We feel there is lots of oil down dip from the existing producing wells and if we're going to

have to move that oil across your (not understood) to the down dip wells, then we've got to drill additional wells to pick it up.

Q Let me ask you, if -- what are these wells up here to the north, directly north of your injection wells?

A That's the East Puerto Chiquito Mancos Unit.

Q The East Puerto Chiquito Mancos Unit, and pressure maintenance?

A Well. we've got a pressure installed in some of our lines; we've not got it in operation yet. We've done the other things that go with that kind of operation to shut in the high gas/oil ratio wells.

Q Answer no?

A We have not started the injection yet.

Q And so it's not a pressure maintenance project over there.

A Not yet.

Q Is it separated, effective separation, from the -- from --

A Oh, yes, we've mapped faults. In fact we actually (not understood) a fault in one of the wells and it had a throw of something like a little less than 300 feet. So it's separated by a fault from the area to the west.

Q Now, Mr. Greer, we all know that you can have a fault but it doesn't necessarily mean separation, does it?

A Well --

Q You've got a 600 foot formation here, don't you?

A Yes, sir, but we have an initial -- I might take just a minute and point out that initially we thought that it was in communication with the rest of the area.

Q Might have been a source from where that gas was going where you couldn't build up the pressure, it kept going down when you were over-injecting.

A Well, as we said before we started injection, after we drilled enough wells, found the fault, we also found water on down this side and so that pretty well confirmed it's isolated.

Q Is there a pressure differential up there between your West Puerto Chiquito Area here and that area?

A Yes, sir.

Q How much?

A Well, if you're speaking of the injection wells, of course, apparently you have a different view of them and

Q Well, how about --

A -- injection well but they're --

Q How far --

A They're up about 1600 pounds and the pressure there will be a couple of hundred pounds, so there what --

Q And if you'd use the pressure in the area you've got 1400 versus 200 pounds.

A It was 1200.

Q You're producing that area up there at depletion now?

A Well, we're producing it, like I say, like I say, rather gently while we're trying to get our -- all the things together we need to do to our enhanced recovery method.

Q When you produce it gently, though, it gets down to the same pressure.

A Well, we shut in the high gas/oil ratio wells so that we can produce oil to take the pressure gradient.

Q Now if the (unclear) exists, as I understand what's taking place, is that you've over-injected in the unit area and I notice here that after a period of time, according to these figures, you quit the over-injection, according to the figures that you've submitted to the --

A My recollection is that when the price of gas went up, it seems to me that it was around '78, it may have been within a year or two later, then we reduced the amount of gas that we were -- make-up gas, that we were buying.

Q I guess one of the problems I have, I can't tell that on this list because it goes from 1975 to 1980 and so I can't tell what happens in there, but you think it's about 1978 or '79?

A Somewhere in there, and I apologize, if I'd known you wanted this information, why, I'd have prepared it and tried to help you.

Q Well, I understand and I'm sorry. You know that this is information that the Chairman requested and I'm just trying to see what it is.

A Okay.

Q Yeah.

A I just don't know enough about it, anyway.

Q Well, I'm trying to see what took place in the Unit during this period.

A I think I can pretty well tell you that.

Q So then I notice even after that,

though, in '81, '82, you've still got the over-injection's building up. How does that happen if you start selling gas in '78?

A Oh, well, the over-injection, as I understand that they were working on is on the assumption that it would be only in the project area.

Q Well, I think until '80 -- this is based only on the pressure maintenance area here?

A I assume that that's what they're talking about when they show over-injection. That's what I -- I meant by over-injection in the hearing in March, you know, we had an exhibit or two that showed how much we had over-injected in the project area and converted that to reservoir barrels a day, which I felt had been moving across the tight strip, but I'd have to go to that exhibit, but that's not -- that was my -- the way I figured over-injection.

Now this is Dr. Lee's work and I don't know what they were doing.

Q Well, what is the project area? Do you consider the project area to go over to the boundary of the -- between --

A Well --

Q -- the pools now?

A No, sir, it's identified as stopping

right along the (not understood).

Q Right along the barrier there, maybe, huh? Is that a pretty good place where you said you'd -- is that where you said you -- is that there you stopped it?

A No, it was along the permeability restriction.

Q In fact you're shown a restriction in that area for many, many years, haven't you?

A Oh, yeah.

Q Well, I still don't understand how if you started selling gas in '78 that you continued overinjecting until '82 or '83.

A Well, if indeed we're talking about the project area only when we use the term "over-injection" --

Q Uh-huh.

A -- which is all we can do right now, that's all we have is the project area, so gas that was produced in the expansion area was what constituted over-injection.

Q Well, but I didn't think you started producing the expansion area till '85.

A That's right, so I don't know what -- again, I didn't prepare these figures and I can't --

Q You can't help me understand them, then, can you?

A I'm sorry, I can't understand them, either.

Q Well, this --

A From my own knowledge, my own understanding, I know that we did not buy enough make-up gas to -- well, it would be over-injection (not understood).

Q Well, let me ask you, if you continue on during the period of time we're talking about here, when you started development of the expansion area, you took the gas produced from those wells and injected it in the pressure maintenance area, is that correct?

A That's correct.

Q All right. Now, in the fall of '86 didn't you give a pressure on your B-18 Well similar to what we've seen here? Isn't that pressure you actually told the Commission existed in that in the March, '87 hearing that is about -- it was about -- I don't know what that number is, 12 -- 1250, or something at that level, what the exact pressure was, but isn't that about the pressure --

A Something like that.

Q -- that 1250, something like that? So beginning in about '85 and certainly during '86 you started taking the gas out of the expansion area and putting it over in the pressure maintenance area.

A Yes, sir.

Q All right, sir. And then when the -- when the Commission reduced the rates in August of 1986, or September of '86, you continued that on through today, to take the gas from the expansion area, putting it over in the pressure maintenance area.

A Oh, yes, sir, and it caused an area of substantial interference effect. As you can see, when we injected higher volumes, that tight area was passed up and those pressures, as you may recall from the surveys from July to November to February changed considerably on those injection wells. They (unclear) down 2-or-300 pounds depending primarily on the -- on the rate of injection preceding, oh, a month or two --

Q Well, then --

A -- that's why it's so difficult to try to arrive at some kind of a weighted average pressure.

Q Then these high pressures in the injection area measured in November of '87 are not necessarily inconsistent with having the barrier, are they, if you over-injected in the pressure maintenance area and it was actually separated, and you over-injected in the pressure maintenance area where you have a tight area?

A The only consistent analysis that we have of that was for the time of the surveys that the

Commission ordered and we were able to analyze that and those analyses of mine appeared in the -- our exhibits for the March hearing, my analyses of how the pressure fell off for the entire time we injected gas, we sold some gas, overall we over-injected and the pressure dropped. That's the only real analysis that we have and it's a problem where -- where there's as much interference effect as there is because of that tight gas cap area. It's something that I watch and study and in fact we've got a bomb in the K-13 right now trying to -- to determine as best we can what's going to happen. One of our faults, as I believe most of the people in this room can understand, is we don't know what the allowable is going to be and we have to be prepared for -- for injecting larger volumes or whether existing wells will take this stacking up of gas, and the interference effect is something that I really have to try to understand; whether we need to drill more injection wells or whatever we need to do. And whether I'll be prepared to make a recommendation to the working interest owners when I get the answer from the Commission on the allowable, or if I don't know it will I have time to work at it.

Q Is the answer yes or no?

A The answer is if we inject at high rates the pressures stack up and there's primarily an interference effect and there's no way to determine if that's increased the over all weighted average pressure in the gas cap other than by the way I just tried to describe that we presented to the Commission in the March hearing.

Q Well, my question was, having these two high pressures in the gas cap area due to over-injection in the tight area is not inconsistent with having a barrier where there's no effective communication, is it?

A It's also not inconsistent with gas moving across that area, so it in itself is inconclusive.

Q During the period of time that you've had this injection project going on out there, you had an observation well, didn't you, Mr. Greer?

A Well, we've -- we've used several different wells for observation wells.

Q And you're observed during the period of time of over-injection that the pressure generally going down in those wells, even though you were over-injecting, slightly.

A I think that's what I mentioned awhile ago. The pressure actually increased up to about 1980 and then it gradually started decreasing.

Q Now, one of the other, I guess, I don't want to call it a complaint, an observation you made, was that we had left a line off of one of your pressure charts, is that correct?

A Yes, sir, well, didn't leave it off but mislabeled one of them. It's a little more difficult on the small scale --

Q I'm sorry, I understood we left off the line. We didn't leave off any lines?

A Where you have the label right there, that shows that bar to be a part of this exhibit.

Q I see.

A But I'm sure that was not a (unclear).

Q Oh, I'm sure it wasn't.

Let me ask you this, Mr. Greer, I think you said you didn't -- you couldn't -- you didn't remember why you were running this build-up on this P-32, I've forgotten when it was, but I guess it was --

A I think that January 31, 1987.

Q January of '87 or '86?

A '87, right.

Q '87.

A About 60 days before we ran the other test. We occasionally run build-up tests and drawdown tests.

Q Well, I don't get to do this very often, Mr. Greer, but I'm going to try to refresh your memory.

A Okay.

Q Yes. Isn't the reason that you had that well shut in, the B-32, in January of 1987, is that you were getting ready to frac another well? Testing your memory, how about the A-20?

A That's possible.

Q Mr. Greer, let me show the rest of the pressure data that you didn't post on your exhibit, and have that identified as Exhibit Fifty-four. I really -- I misstated that. Some of this data you've got posted but the data from just before the change in pressure slope there -- let me show you this.

Where the change in pressure slope occurs, you haven't posted that data on your -- on your C -- on your B-32 Well, January and February of 1987, did you?

A Well, let me see what days -- let see, we shut the well in on the 31st and so that was the fifth and sixth day. I presume we went on and --

Q I think you did. I think you went up right before you fraced the well timewise but you didn't post the date.

A Oh, yeah, it wouldn't have any bearing on that test.

Q Oh, it wouldn't have any bearing on that test. Well, let's see if it does.

Does that Exhibit Fifty-Four look like you've had a frac response in the --

A Well, it would be beyond the point of the --

Q It would be right there. If you put it on this scale it would go practically straight up, wouldn't it?

A Oh, yeah.

Q Yeah. Now, does that look like the same kind of frac response that you say you got from the C-34 a year later? No, not a year later, I'm sorry, two months later?

A Right. Well, this, Mr. Chairman, this is one of the tests that we made and I appreciate him refreshing my memory on it, that convinced us that we had a very high degree of north/south permeability here. At the same time we had a bomb in the B-32 we had one in the B-29 and even though those wells are, say, about a mile apart, the response was almost exactly the same and so here is absolute confirmation of the extremely high transmissibility north and south. It's just -- those wells are a mile apart, they might just as well have been as close as from me to you.

Q How far is the C-34 from the B-32, about two miles?

A About two miles.

Q And how far is the A-20 from the B-32?

A About two miles.

Q About the same distance?

A Yes, sir.

Q There isn't any question about the difference in response, is there, according to your testimony.

A Oh, yeah, there's no question in my mind about the B-32/C34 response we discussed yesterday.

Q It looks to me like when you drew your straight line there that there are a number of points above your straight line down at this area.

A Well, I guess everybody sees certain things different. That seems to like a pretty average line.

Q I see. Are you satisfied that another engineer couldn't actually find that there was a straight line at a lesser angle than you have here and that there was a response in that well in January of '87 that approximately in time was the same as you show your frac response?

A He'd have to have better eyes than I have.

Q Well, you and I, Mr. Greer, you and I are getting close or I think I'm catching up with you, about the same age, and we find that happens sometimes to us when we get older, don't we?

A Oh, yeah, most people have different interpretations.

Q Did I understand in your calculations after your interference test that you found back in '65 or '66, the one that Mr. Elkins analyzed and you analyzed, that you determined that half of the oil was in the fractures and half in the matrix?

A That was my best assessment at that time. That's an almost impossible thing to determine, and my conclusion for that primarily was that I came up with a bunch of different ways of averaging and so on, but if the overall average, which I think that's what we got, that's what Mr. Elkins thinks we got, is one number and it's like 10 times as high as what we get for the tight blocks, then it just seems to me like there's a good possibility that the high capacity system itself must have a higher transmissibility, and it's just kind of a guess; turns out it's a good guess because otherwise the gas would have channeled during the -- all the time that we were -- and we could not have injected gas as long as we did without it channeling if there had not been a lot of it, or a high percent of it in the high capacity fracture system.

So, like I say, it's just a (unclear) --

Q Is the answer to my question yes?

A I didn't calculate it; I kind of estimated it. In fact in all those ideas that I had as to how to go about trying to analyze everything are in the files of the Conservation Commission.

Q Is the answer to my question yes?

A I estimated half of it in the fracture system.

Q Then the answer to my question is yes.

A I believe I answered that.

Q Did you consider the L-11 and P-11 Wells to be wells that were in this major fracture system?

A Well, the L-11, I forget now just how the size of the fracture estimated is. It was in the fractured block, just like the K-13 is in a fractured block and on the block, on the -- when we put the well on production for a test, as I recall, it leveled out in, oh, a matter of hours, and that, too, has been filed with the Commission.

Q Is the answer to my question yes?

A Well, we need to understand what you mean when you say it's in the high capacity fracture system. It's in communication, close communication.

Q It's in close communication but you had -- when you --

A It's in a tight block that has good communication with the high capacity fractures. The tight block itself is estimated to have the transmissibility of about I think around .46 darcy feet. The overall system has 10 or 12 times that.

Q Did you say that when you turned on the other wells that you had almost immediate response in that L-6 and -- excuse me, in the L-11 and the P-11 wells?

A Well, the P-11 was the first one we turned on and we saw a response of quality within a few hours in one or two of the wells and like 24 hours later in the ones farthest away.

Q And how about when you turned the L-11 on?

A About the same thing. The L-11 was a little farther away; took a little bit longer to reach a response over to the A-23, I believe, was the farthest observation well that we had, and at that time we did not have the sensitive pressure bombs and so we don't have the exact time of the response. What we would do is measure fluid levels, we did that twice a day, and we'd extrapolate that back to give some kind of an idea of time.

Q I need to know if you think those two wells were in what you would call the major fracture system as opposed to what you call the hairline fractures.

A They're, well, my concept, Mr. Chairman, is I just don't believe we've ever drilled a well right straight into the fracture system itself. They've nearly all been drilled into a, like I say, a tight block. A tight block has these hairline fractures and -- and it's the high capacity system surrounding that tight block that does the good for the reservoir. You have to have all these sideline -- these hairline fractures or we'd never been able to carry on the pressure maintenance project.

Q Well, let's see if I understand your concept. You say that no wells been drilled into the major fracture system, that they've all been drilled in the areas that you say the hairline fractures are located.

A Yes.

Q And have been communicated in some way out to this pipeline system or spiderweb or major fracture system.

A Right. The E-10 might have been in a -- was in a better -- had a better hookup with the system than the others. I don't know if that's because we fraced right straight into the fracture system or not.

Q But you're satisfied that both the two wells, that the P-11 and the L-11 communicated with this major fracture system.

A Yes, sir.

Q Weren't in but they communicated with it.

A Yes.

Q Now, doesn't your pressure build-up that you show on your Exhibit Seven show that after 60 days, that the -- that those two wells were still building up? Were they shut in?

A Yes, sir. I think I called that to the Commission's attention yesterday.

Q And so after 60 days these two wells that are connected with the major fracture system, although they're in the hairline fracture system, just like every other well in the field is in there --

A Right.

Q -- that these two wells after 60 days hadn't achieved build-up.

A That's right. I pointed that out yesterday.

Q Doesn't that indicate to you the effects of the dual porosity system?

A I suppose, as I stated yesterday, that would be one of the possibilities and of course the other was migration. The information that we acquired later on led me to believe that it was probably migration rather than a dual porosity, and of course, I won't repeat what I said.

Q Mr. Greer, do you disagree that during the normal rate of production in the last four and a half months in '87, in what your side has called the high rate production, that your wells in the expansion area produced 48 percent of the oil?

A I have not calculated, but that sounds reasonable.

Q All right, sir. With reference to the oil in place as calculated by Mr. -- by Dr. Lee, there would be 19-million barrels of oil in place in that expansion area, is that correct?

A I believe so, that's probably a reasonable estimate.

Q And there would be 45.3-million barrels of oil in place in the Gavilan.

A Yes, sir, he has a little higher figures, I think, but they're both very --

Q In other words, there's almost 2-1/2 times as much oil originally in place in the Gavilan as in the expansion area according to Dr. Lee's figures.

A Yes, sir.

Q And you, at the normal rate of production, your wells produced 48 percent of the oil versus 52 percent.

A I think that's probably right. Of course, that's really not significant in terms --

Q You don't consider that significant, all right, I didn't think you would, Mr. Greer.

And at the restricted rate of production you're now producing 54 percent out of the -- out of the expansion area versus the Gavilan and I assume that you don't consider that significant.

A Well, that's -- of course that varies from month to month just how we do it. The important thing right now just like determining a high rate of production, any time, is not how much oil you get out of the ground insofar as the Commission orders are concerned for protection of correlative rights, it's how much reservoir space is voided and of course, with a limited gas/oil ratio, why, we won't void any more space than anyone else, and, of course, according to my analysis, why, our oil production has come from the pressure maintenance project through the restricted area.

Q I understand, but you don't have any analysis to present to the Commission to show that the voidage space that you're taking out of the -- just the expansion area, versus Gavilan, is anywhere equal.

A No, I said that previously when I estimated the amount of migration to and from Gavilan, I think I --

Q Did you use just the expansion area?

A Yes.

Q You did? And what month was this?

A This is a little different way than perhaps computer modeling would -- would go about analyzing migration, but what I show --

Q Mr. Greer, could you tell me what month?

A Okay. I show January 1, 1986, there had been produced from Gavilan 1,500,000 barrels and 170,000 from the expansion area. totals 1,700,000. I'm convinced that a third of the production at that time was coming from the expansion area, so there would be roughly 500,000 barrels that had migrated from the expansion area into -- into Gavilan.

We started to catch up in 1987. The total drainage, January 1, '87, 3.8-million barrels and a third of that should have come from the expansion area, roughly 1,300,000; it actually produced about 900,000, so we were 400,000 barrels short, but we're producing -- gained a little bit in oil, but we're not taking out near as much reservoir space as Gavilan, and to follow through on that same analysis, I feel that overall there's been about 4-to-500,000 barrels more moving from the expansion area into Gavilan on overall migration, which is a little more, I think, (not clearly understood.)

Q You don't have any calculations that you can show us for the normal rate or what you call high rate production or the restricted rate production after that to show what the reservoir withdrawals are between the two areas.

A Only that the gas/oil ratios were much lower right there at the end. On a proration basis, why, I imagine they're about the same, the marginal wells and the Gavilan wells.

Q I heard the term used here "superstar" wells and I think there's an implication that Mallon is the one that's got the superstar wells. If you were grading superstar wells what would be the test that you would use, and I don't mean an individual test, but what would be the qualifications that you would say would be a superstar well?

A Well, I presume that the implication is wells that produce at high -- high rates, and that the high volume wells would be the superstar wells.

Q How about cumulative production, is that a pretty good test?

A Cumulative is not quite so good as the just comparing, for instance, one well's been on production for 10 years would have a high cumulative and another one might be on for only a month and still be a good well.

Q Mr. Weiss likes cumulative production to be an indicator of whether you've got an injection project successful, didn't he?

A Well, that's one of the characteristics or one of the qualifying factors whether pressure maintenance is being successful.

Q And that would be over a period -- that qualification would be over a period of about 20 years for an injection project and maybe 25 years producing, is that right?

A The main thing is the amount of production accompanying the low gas/oil ratio.

Q The --

A Large production with a high gas/oil ratio is not so good.

MR. DOUGLASS: We'd like to offer Exhibit Fifty-four, Mr. Chairman.

MR. LEMAY: Without objection, Fifty-four into the record.

Q And let's identify as Exhibit Fifty-five a list of Gavilan superstar wells and this time we're using Gavilan as we understand it and suggest as opposed to what you call the Gavilan. In other words, we're including the expansion area there.

Exhibit Fifty-five, would you agree that that looks like a pretty good ranking of the superstar wells according to their ability to produce?

A Well, I presume so but it's my understanding when the Howard 1-11 came on, I remember Mr. Mallon telling us one day that it was capable of about 3000 barrels a day and that one ranks with our B-29, so I won't say that that's really that far down the line for -- if you're talking about quality of reservoir. The problem, of course, that's happened here, I think, is depletion and so the (unclear) has changed.

Q The -- that happens when you deplete a reservoir is the ability of the wells to produce goes down, doesn't it?

A Yes, so this is where you can see the difference there, that the expansion area wells being recharged with the pressure maintenance project manage to stay up there.

Q Well, it's not necessarily inconsistent with the barrier being there, is it?

A Oh, yeah, it is.

Q You think it is?

A Oh, yeah, it is, because if the barrier were there, why, those wells, the B-29, B-32, F-18 and F-30 in the unit, they'd be right on down there with the others.

Q Well, all these wells -- all your wells were drilled later in the life of the field, weren't they?

A Yes, sir, but in this instance the communication is such that the area was depleted just as though they had been there and producing themselves.

Q The -- in the superstar ranking there, how many wells do you have?

A Well, by your list it looks like 1, 2, 3, 4, 5, 6, 7. I'm not sure I'd call the N-31 a superstar well, but there would be 7, anyhow.

Q How about Sun?

A Let's see, Sun, I'd count 1, 2, 3, 4.

Q You might cut superstar off at some other level than those 18, is that right?

A Yes, sir.

Q Let me show you what we'll have identified as Exhibit Fifty-Six. I understand there's a correction that needs to be made on this. It says, Cumulative Oil (DTB). I believe that's (STB), if you'd correct that on your copies, I'd appreciate it.

Now, your -- cumulative productionwise, looks like BMG has got the first two wells and Sun's got the next two, is that correct?

A Yes, sir.

Q Where are those Sun wells located? Are they over here in the Unit area?

A They're in the central Gavilan area.

Q These are Sun, yeah, I see them. There's one, Native Son 2 and 1. There's the 2, I believe, there's the 1, okay.

A They are two miles further away from the expansion area.

A Yes, sir.

Q About 10 miles -- 8 or 10 miles from the nearest injection well, and then of these on a cumulative basis, the top two are wells -- let's see, you have 1, 2, 3, 4, 5. 5 of your wells have already gotten in the top 20 producers and you just started your production, I believe you said, in '85, or say approximately January of '86.

A Yes, sir. In fact, we kind of held off in January of '86 when it looked like --

Q Mr. Greer, is the answer to my question yes?

A Yes.

Q Thank you. If Gavilan is separated by this barrier and has the expansion area and Gavilan as a common pool or common reservoir or common source of supply, do you think gravity drainage would be an effective drive mechanism in the Gavilan as described as far as producing economical rates of oil?

A Not now. There was a time when I believe they could have gotten a substantial amount.

Q I believe one of the -- D-10, one of the exhibits that you showed us, was a -- I said D-10, your Exhibit Ten, comparison with Boulder, is that correct?

A Let me find it.

Q This is what it looks like here.

A Yeah, okay, I know which one you're talking about.

Q And I believe you described that the proration that was in effect for Boulder was a good proration; that was a good system.

A Yes, sir, good (unclear).

Q Were you -- were you aware that under that good system of proration that Boulder had produced almost 90 percent of its -- 90 percent of its pressure in the first 3-1/2 years?

A Yes, sir.

Q You were?

A Yes, sir.

Q Well, Gavilan has only produced about a little over 50 percent of its pressure in 6 years, hasn't it, and you say that's bad proration that you've had it here.

A The thing I pointed out, or tried to point out, I guess I failed to do that, apparently didn't make my point, is that had it not been for proration, that

Boulder would have produced at a higher rate than that, might have exceeded their gravity drainage greater than the wells could recover. They had wells that were capable of producing far in excess of the 80 barrel a day allowable. I think I mentioned one that actually was over 4000 barrels a day.

Q Mr. Greer, do I understand that -- that part of your exhibits here show some problems with bottom hole pressures and trying to see if they're accurate, and trying to take care of the column that's on there, to see really what the pressures are?

A Well, the problem which I was afraid would occur, and it did, when we started surveying, was to point out that these pressures would not be -- should not be used to try to determine small pressure differences across the reservoir. We could use them for certain things but I think the way I used them is wrong as a way of using this kind of pressures.

Q In this major communication system, this major frac system out there, very small differences in pressures can move large quantities of oil, can't it?

A They can lead to large rates of production, yes, sir.

Q Now that's the same thing you do --

A They can --

Q -- almost like a pipeline, isn't it?
A Yes, sir. Yes, sir.
Q And yet you're proposing to this Commission that we use pressures measured along this now common boundary to determine whether oil is moving from one side to the other.
A Yes, sir.
Q Mr. -- Mr. Greer, have you calculated how much Unit production would be increased if the Proponents application is granted, their position is granted in this hearing?
A No, sir, I'm not sure there would be a substantial increase.
Q Well, if you hold it back it wouldn't be substantially increased, would it?
A That's been the nature of our operation.
Q If you elect to produce your wells at capacity out there, you could produce well in excess of 700 barrels a day additional right now, couldn't you?
A Oh, yes.
Q How much more do you think you could, if you wanted to?
A Well, I'll invite your attention to the way the pressure is dropping now, the capacity may be smaller than before.

Q Are you aware how much Sun's wells would increase if the Proponents position is granted here?

A No, sir, I'm not.

Q Do you think it makes good reservoir sense to conserve gas and produce oil wells at the lowest gas/oil ratio possible?

A (Not clearly understood.)

Q If that principle is good to produce four months production in one month, why isn't it consistent to do that during the entire producing life of a well at the stage that Gavilan and the expansion are if the barrier's in place?

A Well, whether they're in place or not, I just feel that there is too much possibility of violating the correlative rights, and I tried to describe that this morning, in which the high capacity wells could pull all the products out from under their land in looks like 150 days, or something, and then be draining something else, and that just seems to me to be extremely high.

Q So as I understand, your objection is that you think that the expansion area won't be able to keep up.

A That's one. That's one of the reasons.

Q Have you got any others?

A Well, the main one I just mentioned,

protection of correlative rights is just not there, and I'm speaking now of within Gavilan itself, concerning one well against another, the high capacity wells would drain their tracts and then their neighbors' tracts.

Q Well, that's what I asked you. You don't think the expansion area would be able to keep up with Gavilan at the --

A Oh.

Q -- high rates?

A Oh, I don't know, it's hard to say. It might be able to but I just don't like to produce at high rates.

Q That would be an election that you'd have to make.

A Yes, sir, that's the policy, that we just do not want to produce at high rates and we'd be losing some good stuff.

Q If the Commission were to restore it back to 702 oil and 1404 for gas for a 320, do you think that would be a rate that -- that you would produce your wells in the expansion area?

A Oh, well, we'd have to.

Q If the did -- if the Commission set that kind of rate, then you would consider that, first of all, that would be a rate that's -- that's statewide allowable, although I understand it's actually written, but it was the allowable that was in effect before the restriction was put in, is that right?

A Yes, sir.

MR. DOUGLASS: Pass the witness.

MR. LEMAY: Thank you. Additional questions of the witness?

MR. DOUGLASS: Oh, I need to offer Exhibits Fifty-Five and Fifty-Six.

MR. LEMAY: Those exhibits will be taken into the record without objection.

Mr. Lopez, do you have any questions?

Mr. Chavez.

QUESTIONS BY MR. CHAVEZ:

Q Mr. Greer, your calculations in the efficiency of the operation of the pressure maintenance project, have you included the acreage within the project area or within the Unit area for calculating your volumes of reserves?

A I calculated only the Unit area plus I estimated 800,000 barrels, I believe, that had crossed the tight streak in the expansion area and been produced there.

Q Have you ever considered that there might have been drainage from either the north or from the south into the Unit during its production?

A I did not. I did not.

Q Is there any reason why you didn't?

A Well, the -- from the north it will still be Unit lands. From the south we might have enjoyed some migration.

MR. CHAVEZ: That's all I have. Thank you.

MR. LEMAY: Additional questions of the witness?

Mr. Brostuen?

QUESTIONS BY MR. BROSTUEN:

Q Mr. Greer, yesterday I asked Mr. Roe several questions about the status of some wells that appear to be currently shut in along the -- what the Proponents are claiming to be the barrier.

I was wondering, perhaps, if you could update me as to what the status of those wells are, whether or not they have any appreciable production from the Mancos Pool, they're complete in this pool, or what have you.

For example, the Canada Ojitos Well No. 22.

A Is that the F-20?

Q If you prefer to use the F-20 or the designation --

A That's how I've got them --

Q Okay, fine. That's the F-20 Well, yes, sir.

A Yes, sir. That well we have pipe set through the Mancos, through the Dakota. We perforated the Dakota, gave it an acid treatment, and the Dakota under those conditions appears to be capable of, oh, something less than 100 MCF a day (not clearly understood) of oil. Our plan is to frac the Dakota and to -- I believe we've got the frac tanks on location now, or are going to this week. We'll frac the Dakota and we're still (unclear) about fracing the Mancos, and so I think we'll test the Dakota first, see what it is, what it will do, and then we'll frac the Mancos and I would imagine that we would get that work completed sometime this summer.

Q When was that well drilled?

A Oh, several years ago.

Q 1986?

A It was one of the first wells we drilled after we got the expansion area approved.

Q I see. Okay. How about your G-32 Well?

A Okay, G-32, the well has been fraced,

appears to be a very poor well. We fraced it with a jelled kerosine and we found that one of the other wells that we fraced with jelled kerosine, that something happened, the kerosine didn't break, and we went back and gave it a shot of water and, what is it, one of the other chemicals, and that seemed to help it.

We don't know if that's the problem with the G-32. We've kind of set that well aside while we try to find out what's the best way to frac the wells. We've tried everything we could think of from water to jelled oil, to carbon dioxide, and we still don't know what's the best thing to do.

So the answer to that is that right now it appears to be a small producer, very small, and whether we're going to do any good with it or not, remains to be seen.

Q And the well is currently shut in at the present time?

A I think we've tested it a couple times, so I believe we haven't cleaned the sand out and pulled the tubing and we've run some tests on it this month and I -- or last month and I'd have to review to see what --

Q Okay, but it appears to be a very poor producer --

A Well, in any event I don't expect --

Q -- a marginal producer.

A Yes, marginal.

Q Okay. How about the F -- when was that well drilled?

A About, oh, a few months after the N-22. It would have been probably (unclear).

Q Okay, so that well's been sitting there since '81, has it not?

A Yes, sir.

Q And you fraced it, the first attempt at completion was back in '81?

A Yes, sir. We have two problems with it. One is we're currently thinking about another well in the same canyon. We've not built a pipeline up that canyon yet, so the only time we've produced the well is for short periods and getting a small volume of gas. We do not have it tied into our pipeline system. So our plan is to drill another well, I forget which section it is, I believe it's Section 30 up northwest of it, and when we do that we'll probably lay a pipeline system up the canyon and tie in then before we run definitive tests on them.

Q Okay. How about the J-20 -- pardon me, J-8 Well?

A J-8 is a real sorry well.

Q And that's completed in the Mancos?

A Yes, sir.

Q And when was that drilled?

A My recollection is about two years ago.

Q Okay, so we're talking about 1986. The B-17, is that a well you've been utilizing for observation?

A We've been using it for observation. Its capacity is probably, seem like 10 or 12 barrels day. It's a small well.

Q Okay, and that well is currently shut in or producing?

A It seems like a pretty useful purpose for that well is to use it for an observation well.

Q And when was that well drilled and completed?

A It seems to me like we completed it, oh, maybe a month or two before we put it on observation, which I think was about a year ago.

Q Okay. The Benson-Montin-Greer A-16 Well.

A Okay, that well is a -- about all I can say is they don't -- they don't do things like they -- like they used to.

We produced that well for, oh, I guess, 20 years with a hydraulic pump out of the C Zone and went in last year and fraced the A and B Zones, and then we from time to time work on it and we ran a new string of tubing in it, plastic-coated tubing, the kind we had before, but we just can't make the thing go. We set the pump back up and tried some repair and in year's past we used to have really good luck with those hydraulic pumps, and now we --

Q Is --

A -- can't get the blamed thing to go. So it's another problem but it is one that I'm going to get solved one way or another.

Q And that well was completed in the C Zone initially?

A The C Zone. I think it made like a 100-to-150,000 barrels of oil out of the C Zone.

Q And did you deplete your -- or --

A It was still making, as I recall, about 20 barrels a day.

Q 20 barrels a day, and you've been unsuccessful with it so far in getting production from the A and B.

A I wouldn't say we haven't got any production; just don't know what -- we've not produced it.

Q The well off to the southeast of the A-22 Well, it appears to be 3/4 of a mile or a mile, or over a mile, perhaps, to the east of the Proponents barrier, what's the status of that well?

A It's shut-in.

Q Shut it in?

A Yes, sir. We were toying about completing in the A and B Zones and then if we put in a gasoline plant, using it for cycling.

Q It has been completed in the C Zone?

A Completed in the C Zone. I think it produced maybe 3-or-400,000 barrels.

MR. BROSTUEN: Thank you very much.

MR. LEMAY: Commissioner Humphries.

QUESTIONS BY MR. HUMPHRIES:

Q Mr. Greer, in some of Mr. Hueni's testimony he showed some production information records on wells in the Gavilan Mancos that took what appeared to be a long -- longer than normal period of time to sort of hit their stride after they went to the high rate. It took a longer period of time for those wells to come back up than what they had anticipated.

How would you explain that? The first few days were slow production and they -- they kind of came back to what they were supposed to, what they had expected of them, in barrels of oil produced.

A Yes, sir. The only explanation I have, the one that seems logical to me, is we know that those zones are stratified. Normally we did not have this kind of a problem when the gas/oil ratios were lower, at least I hadn't heard of a discussion of it and this gravity segregation, which I'm sure some has taken place; it's possible that one zone has lower pressure than another, and the A Zone could force some of it back into the -- back into the B Zone, and this could just go on, you just have to get that gas bubble out of there before it goes on. That would be one possible explanation.

Q The idea of converse or reverse rate sensitivity certainly has some logical explanation. You don't give that merit?

A The only direct case that we have that's been given as an example in this hearing, I know was not -- did not have that relation. That's our E-6 Well. It was shown as an example well for the issue of high rate and low gas/oil ratio.

What happened on that well was that the high volume was established, the offset wells came on and started producing oil and gas. They pulled the gas out from under our well and its gas/oil ratio went down and that was like for a month and a half. The allowable started July 1. The drainage to the offset well took place until about mid -- mid-August, and then at that time we finished the modifications to our equipment, where we could produce at higher rates, and then we increased the rate about mid-August on that well.

And so it's a confusing thing that develops, that for that month of August the gas/oil ratio is low and the oil production is high, and it would appear that would be cause and effect, but that's not the case. I had excellent information, producing pressures, injecting gas, record of the drop of bottom hole pressure in the area, and there just absolutely is no question for that particular well that it had no bearing on efficiency. I had, I think, some exhibits on that at the March hearing.

The other wells in Gavilan, we just have not operated any there and I just don't have a feel for it. I can understand from the statistics the concern that the people in Gavilan have had wells that appear to have that characteristic. I believe there was -- all of them that I looked at, there was nothing but depletion, but I think that there were few that clearly seemed to have that relation, so that was, I think, why John Roe came up with the suggestion that, well, let them produce as high as they can and they perceived that to be the efficient way to do it, to letting them go ahead and do that, but to protect correlative rights, balance out occasionally on allowable.

Q In Mr Elkins' testimony he mentioned that he thought West Puerto Chiquito was being produced exceedingly, that's his word, slow. I understand your theory for producing it the way you are, but for the way you do or your method of operation, but his emphasis on exceedingly slow, certainly kind of escaped me. Is there another reason that could be operated --

A Well, the only reason was to try to get the gravity range recovery. I think (unclear). My analysis shows about 20 --16 to 25 percent of oil in place recovered so far. We still have along way to go, and I feel that it's worked excellently.

Gavilan, on the other hand, is going to get 6 or 7 percent.

Q In some speculation, is there another reason why a reservoir would be operated exceedingly slow?

A Another reason?

Q Right.

A I had no other reason. I was the only one that made the decision about how -- how fast to produce the wells.

Q In the Exhibit Twenty that Mr. Hueni prepared, showing the relative difference in pressures for Gavilan Mancos and West Puerto Chiquito, it's something that has bothered me since the first time we looked at that exhibit, and I'm not sure if that was March of '88 or last year, but that when Gavilan Mancos came on and that rapid increase in production was there, it appears to not show a corresponding drop in pressure from West Puerto Chiquito, indicating some kind of difference between the two sides, and you've explained that as, I believe, restriction, I'm not sure exactly how you explained it, but that's it, I'd like you to tell me one more time so I understand --

A Okay.

Q -- why you don't think that that would indicate that there's some kind of a barrier.

A Well, I think it indicates a restriction, a permeability restriction, and it just doesn't need to be a barrier, and I am most thankful that it's there. you know, if it hadn't been there, Canada Ojitos would have gone over to Gavilan, so we're fortunate that that restriction is there, that we still have an opportunity to recover that oil by gravity drainage; otherwise we would have not.

Q Well, let me ask you, if -- with or without the barrier, if you're taking the gas for your over-injection, theoretically, from the expansion area or transition area, whatever you want to call that, do you feel that that in some fashion sets up a pressure sink that advantageously moved liquid from west around Range 1 and Range 2 line, or the pool boundary, to the transistion area?

A Well, I certainly don't -- don't think so. I've seen no evidence of it so far and I don't think that is happening now. If the barrier was there, why, of course, if we produce at higher withdrawal rates than the others, why, then that could happen, and so I understand some of the opposition and that's why we're willing, you know, to submit to any kind of monitoring by the Commission to -- to guarantee that that isn't happening. We can't just inject an excessive amount; that is just mechanically and physically we can't do it; and if we can't, then there's only one other thing we can do, we can sell that gas. If we sell the gas, then we lose our gas injection credit. So it's sort of a self regulating system the way the pressure maintenance formula works, and that alone gives a lot of protection to the parties on the west side of the boundary.

But absent that, I mean even with that, we're willing to do anything else.

Q In your theory of pressure plateaus, that this row of sections going from north to south just west of the alleged barrier, and I can't -- I think the K-13, B-29 and the B-32, and right in that row of sections, when would you expect to see some kind of demonstrable pressure results from the injection if the barrier is not there and the next plateau is achieved that I suspect is demonstrated under color in the rainbow map, if you will, between there and the next row of sections, because there's a fairly significant amount of distance between those producing wells and the wells along the pool boundary?

A Well, I believe the wells in the expansion area and Gavilan are so well connected that we'll never see much of a pressure difference.

I think we'll see enough difference that we can tell if there's migration but just generally that area is going to be lower pressure than the rest of it.

Q Wouldn't those wells show some response as the next plateau was achieved prior to the ones farther west, or do you think --

A Do you mean as the gas works through?

Q As you achieve the next plateau or the next color in the rainbow?

A I don't guess I quite follow your line of questioning.

Q Well, if -- if you move -- you've suggested that it takes awhile for each of these plateaus to achieve a higher pressure and you demonstrated that by the rainbow map, and it appears to me me now that if the barrier is either more permeable than is alleged or -- or is not there, that the next response in a pressure plateau would be in that row of sections where those wells that I named exist in --

A Okay, under the circumstances where you say it might be more permeable, what I think is going to happen is as the gas works down through it, and it has a higher mobility than the oil, and we're going to see an increase in gas volumes into the expansion area, and then it's just a question of what -- what happens with that gas when it gets over there, whether we produce it or whether it moves on over to Gavilan or what, and right now we've already seen in many of these wells some free gas coming across. So --

Q I recall in, I believe, Mr. Elkins' testimony that in the Spraberry deal they injected nitrogen or helium in -- well, I think both, actually, at different injection points and retrieved it at some other point.

Have you contemplated doing something like that to test your theory that the barrier doesn't exist?

A I certainly hope that we don't have the problem that they had in Spraberry when they saw such gravity movement of gas across the lease lines.

The gas cap that we discussed has maybe an 8-to-10 billion cubic feet in it and when we inject gas like, oh, say 5, 5-BCF a year, making 5-million feet a day, that's what's happening here, that might take like 12 years to reach across that township.

MR HUMPHRIES: I have no further questions. Thank you.

QUESTIONS BY MR. LEMAY:

Q Mr. Greer, I think you've testified that because of different engineers using different reservoir fluid density, that you can get bottom hole pressure calculations that will vary roughly 20 - 21 pounds maximum.

A I believe around 20, I forget which well had the maximum, but somewhere in that range, maybe 30 pounds.

Q Uh-huh, well, accepting the 21 pounds figure, and assuming that you have a 20-pound differential across what is now the Gavilan and now the West Puerto Chiquito fields, with high permeability, how would you translate that into oil migration per month, or can you do that?

A Well, I think we can, on that famous formula. I'd suggest we use the linear flow formula. We have Q is equal to 1.12 Kh Delta T.

Let's see, we used the simplified form over here. Q is going to be equal to 1.127, Kh/mu, and (unclear) over F. I presume a one mile wide section and one mile long, and W/L-1, Q then becomes approximately 1 x Kh. If we use Koh, if you'll remember one of the examples I used in the B-29 and B-32 area had about 1.3 darcy feet, so -- so let's take 1.127 times and this is Koh, then 1.3 Delta T, so in round numbers that's 1.5 Delta T. If Delta T is 20 pounds that would be 30 barrels a day.

Q 30 barrels a day across a one mile area?

MR. DOUGLASS: With a 20-pound pressure drop?

A That's a 20-pound pressure drop and it's about 1.3 darcy feet per Koh, like I used.

MR. DOUGLASS: Could we have what you used for viscosity?

A I used -- I just used Koh. That was --

MR. DOUGLASS: What's mu?

A Let's see, is the sand colored book Two? In our Exhibit Two under Section M we just used the Koh there. Koh there came out to be 1.2 darcy feet and that is -- that's just total Koh, so you don't need the word mu. If we want to go to reservoir barrels and total gas volume, and all that, then you'd need another, another (unclear).

MR. DOUGLASS: I thought -- didn't I recall that you used 1.3 as the Koh across the barrier?

A I just showed them that we had 1.3 was the Koh in that area, to try to be consistent with what we're producing from those wells, but I think any --

MR. DOUGLASS: And you -- I just want to make sure --

A I might -- if I might, I think Bill Weiss came up with 5, 5 darcy feet on the build-up test, and that would be from our highest capacity well. All the other wells, of course, are substantially less than that.

Q Well, proportionately, if you double that differential to 40 pounds differential, you just double the number or does it --

A Yes, sir, that's correct.

Q So it's in linear feet, basically?

A Yes.

Q Would that be of concern to the operators, a 20 pound differential across that line, migration of that much fluid?

A Well, let's see, what did I come up with, what was that, 20 --

Q Well, just using rough figures, 30 barrels of oil per day. That's about 7 to 10,000 barrels per month across the field boundary.

MR. DOUGLASS: Per mile.

Q Well, that's per mile. I'm just taking the miles involved in the boundary, that's what I was looking at.

A 30 barrels a day is about 900 barrels per month.

Q Times a 30 day period month.

A Yes, sir.

Q Are we talking about 30 days -- 30 barrels per day or 30 barrels per month?

A 30 barrels per day or per month?

A 30 barrels per day.

Q Per day, so 900 barrels per month.

A Right.

Q Times however you want to -- how many miles do you want to use along that boundary? I was just looking at total migration between the two fields.

A Okay. Now, let's take a look at that. There's only a small area that has that kind of capacity and that really not on the boundary, that's our B-32 and B-29 area. I'll point out the rest of it --

Q Roughly --

A -- there's nothing along the boundary there that has anything near that capacity.

Our F-30, F-19, F-18 (inaudible).

Q Well, I was looking within the range of predictability, 20 pound differential appears to be about as close as you control that boundary and not something that either side would worry about.

A Well, yeah, my concern, I think, would be about the accuracy, can be pretty well taken care of inthe methods that I suggested.

I think what --

Q Just using the difference, relative differences rather than absolute value.

A If we do that, we can deal with absolute values if we use the method I suggest, and --

Q Well, what do you consider a significant pressure differential that could be a voidage problem?

A Well, 20 pounds would be significant.

Q 25, anything over 25 should be avoided, that there's significant drainage going one way or the other.

A Yes, sir, and of course that's going to depend on the authorization level it has.

Q Right, yes. Just one other question, it's brought up some questions I had concerning your expansion area well, the B-29. I think you used that example in this book here under Tab M, I believe, to show the support that well was receiving, pressure support, it was receiving from what you considered the pressure maintenance area.

A Well, I just -- what I was showing there was what I felt was consistent with what we observed in the field.

Q And that, I think you mentioned, was just a C Zone producer?

A Yes, sir, these are --

Q Assuming the barrier is there, it wouldn't have to extend into all three zones, would it, A, B and C?

A I suspect it could be -- would be in varying -- in different amounts, unless it's just an absolute fault. It's unlikely it's going to be the same in all zones.

Q It's very difficult, I take it, in order to separate the relative production attributable to each zone. I know Mr. Bush tried to do that earlier and said many wells, it's just -- you can just say that there's some contribution. Initially I thought West Puerto Chiquito was characterized as being predominantly C; Gavilan, predominantly A and B, and is that still your contention with the pressure information you see?

A Well, it seems to me like it's still pretty much that way. Just by happenstance our -- our best C Zone wells now seem to be right up to the Gavilan boundary and stop. There just doesn't appear to be -- there appears to be some C Zone production in Gavilan but certainly nothing like we've got in the Unit, and why that is, Lord only knows.

Q Could that also account for the fact that generally I think you're showing the expansion wells at lower GOR?

A Yes, sir, I think --

Q That it could be more C Zone?

A The C Zone with the gravity drainage and pressure maintenance is why those wells are flowing so much different from the others.

Q Could it also be because of the Bear Canyon and possibly support from the south that these pressures remain fairly constant due to migration into the, say, the expansion area or the pressure maintenance area from the north and south, or the northwest to the south?

A There is no doubt -- I say no doubt, I feel like -- like Bear Canyon area is probably A and B. I just can't believe that core on their analysis. We could be getting some help from the north.

Q Thank you.

MR. LEMAY: I have no further questions.

Additional questions?

MR. CARR: Just a couple on redirect.

MR. LEMAY: Mr. Chavez, do you have a question?

MR. CHAVEZ: One.

QUESTIONS BY MR. CHAVEZ:

Q Mr. Greer, I just want to clear up a misunderstanding that may have occurred on how you're measuring your injection gas.

A Okay.

Q Is the injection gas measured to pressure record it on the (unclear) of the choke or by daily instantaneous recordings by an operator?

A The injected gas --

Q Yes.

A -- as opposed to gas lift gas.

Q I'm sorry, the gas lift gas.

A Oh, the gas lift gas. The gas lift gas we measure with -- through chokes and gas, injected gas we measure through the meters and the total gas from the well we measure (inaudible).

Q Is the gas lift gas measured, up stream pressures recorded on a daily basis?

A Yes, sir.

MR. CHAVEZ: That's all.

REDIRECT EXAMINATION

BY MR. CARR:

Q Now, Mr. Greer, you testified there was over-injection in the project area.

A Yes, sir.

Q Could the pressure gradient have moved to the east from that injection?

A I'm sorry, say again?

Q From that over-injection could there have been a pressure gradient moving to the east because of that injection?

A There could be no pressure gradient from west to east from the over-injection.

Q And why is that?

A Because that's just excess pressure with no relevant injection.

Q Could it have gone to the north or the south?

A Oh, no way it could go north or south because you've got virgin pressures up there and so there's just no place for it to go.

Q And did it go to the west, in your opinion?

A I think that there's no doubt that some of it did.

Q And do you have a reason for that?

A Simply that there's not enough restriction to stop it.

Q And the fact that you and Dr. Lee may have reached some different figures on the gas injection, does that cause you to reach a different conclusion from Dr. Lee that the migration is in fact going from the injection area into what's being called the expansion area?

A Oh, no, he was working on a different kind of analysis than I was and his (unclear) don't have any bearing on what I did.

Q In the F-20 Well, has that well been perforated in the Mancos interval?

A No, sir.

Q It would not be possible, therefor, to frac that zone, would it?

A Not in the Mancos Zone.

Q If you're called upon because of increased withdrawals from Gavilan to increase withdrawals from the wells in the west portion of this unit, what effect will that have on your overall pressure maintenance project?

A Well, I feel that it will hurt it. I just hope we wouldn't have to produce at higher rates.

MR. CARR: That's all I have.

MR. LEMAY: Thank you. Additional questions?

RECROSS EXAMINATION

BY MR. DOUGLASS:

Q Mr. Greer, on Mr. -- on Dr. Lee's study what -- what millidarcy feet did he use between the 8-mile area where you join the Tank 2 and Tank 3?

A Well, I'd have to look and see his mark there. Looks like he's got 5 and 3.

Q Is that 5 darcy feet or 5 millidarcy feet?

A That's 5 darcy feet.

Q 5 darcy feet.

A That's the numbers we were talking about awhile ago in the B-32.

Q And when you ran the D-17 you got 55 darcy feet in that well, didn't you? Do I recall correctly?

A Say again.

Q I said when you did the interference test in the D-17 and you had a circle around all these wells, you had 55 darcy feet, if I recall your testimony.

A That 55 darcy feet was Kh/u. The transmissibility we showed -- that's in our Exhibit Two under

Section C, when you come to the yellow sheets, at the top of the page it says Kh/u -- 55. Then if you go a couple of pages further over you find the green sheet and if you'll look at the 1009 volume and for gas/oil ration of 1000-to-1, you'll have 16 darcy feet. Now that would be like the B-29 and B-32. You've got 4 and 8000 cubic feet per barrel, we're in the range of 2 to 4 darcy feet, which is what would be along the boundary. So what we've been talking about in the Koh in the range of 1 to 5 darcy feet is about what the interference test shows, about what Bill Weiss' test shows, pretty reasonable.

Q I think you said Mr. Weiss used 5 darcy feet?

A He used 5 for the best well in the area.

Q Let me ask you, if the Commission should adopt a production plan that permitted, say, 1200 barrels a day to move from the -- that's 1200 barrels of stock tank oil -- to move a day across into the Gavilan area, would that be a plan that you would endorse?

A Well, we would hope for a plan in which there would be essentially no migration. And the judgment, Mr. Chairman, if the judgement, that we believe was left strictly to the Aztec Office of the OCD, and I believe they're capable of being able to tell whether they're getting information, whether they can rely on it, or if there is a problem, if they think there's a problem, we could come back to the Commission and show you that something else needed to be done.

Q Thank you.

MR. LEMAY: Additional questions?

Let's take a fifteen minute recess.

(Thereupon a recess was taken.)

MR. LEMAY: This is a schedule of how we're going to close out this thing.

The Commissioners are going to ask some questions of specific witnesses, calling them back without the opportunity for examination by lawyers or cross examination. We just want to, because we've heard all the testimony, want to zero in on those things that we don't have a clear picture of, or we want some clarification for.

Beyond that we'll close. Each side will have forty-five minutes to -- for closing arguments.

We'll take the case under advisement and we'll ask -- we'll leave the record open for a week. I think there were some exhibits that were wanted

-- they wanted to add to with some written comment, I think maybe concerning fractured fields that might produce with pressure maintenance.

Is there any comment on that procedure, any -- yes, sir, Mr. Douglass.

MR. DOUGLASS: Might I suggest that since I think some of us are making comments, why don't we just close it down, and I don't think whether we hear about fractured fields somewhere else is going to be important now. I hope it wouldn't be significant to one side or the other as far as what we want.

MR. LEMAY: I have no problem. I thought there was a desire on the part of someone to submit that.

MR. DOUGLASS: I'll put it in a motion for rehearing.

MR. LEMAY: You got a problem with that, Mr. Kellahin?

MR. KELLAHIN: Our preference is to accommodate the Commission. If you want that information we will provide it, but I'm like Mr. Douglass, there's perhaps more than we can all understand and maybe you've had enough.

MR. LEMAY: You're testing me,

Mr. Kellahin. That's an understatement. We have lots and lots, according to Mr. Weiss' testimony, to digest.

No, I think if it's important to us, that research, we can go on on it, so if there is a quick answer to that by one of the experts I would have liked to hear it but it's not a probing question that's going to decide the case. So I'll accommodate that. I think we can close the record at the end of the closing statements.

So does that sound like a good schedule?

Let's continue, then, with I think Mr. Hueni. Commissioner Humphries would like to ask you some questions, Greg, if you don't mind.

GREGORY B. HUENI,

being recalled and remaining under oath, testified as follows, to-wit:

QUESTIONS BY MR. HUMPHRIES:

Q Mr. Hueni, yesterday or day before yesterday, I asked Mr. Roe about some conditions in the Gavilan Mancos Pool as it's recognized today, and they had to do with what I called the superstars and I don't think I'm the creator of that term, but my question was that there seemed to be an indication that that contribution to those so-called superstars was poolwide and not discussing at this point the expansion area, you've studied the Gavilan Mancos a great deal and it strikes me that regardless of whether it's Gavilan Mancos or some other field or some other pool, there are from time to time going to be wells that are better than other wells.

Is it your opinion that the contribution to the very good wells is poolwide or is it unknown, due to sort of a jagged lightning pattern macrofracture or whatever you call it, fractures?

A Mr. Humphries, I -- I believe that it's largely unknown. We've testified before that while we could use, for example, pressure production history to determine oil in place for a field as a whole, that we really have no very good method of carrying that back to individual areas of the field.

The factors that influence the amount of oil within any given area have to do with frequency of fracturing, the spacing, the amount of matrix that's being contacted by the fractures, the width of the fractures, as well as whether you have A and B production, A, B, maybe some C, maybe just A production. There are so many variables in there that we really don't think that there is a method of saying that -- well, we don't think it's correct to say each spacing unit has the same amount of oil under it and should be given the same -- same recovery.

We can make the case just as easily that wells that have high deliverability must have favorable reservoir characteristics underneath that particular portion of the pool, so that its -- that its rate is a demonstration of its -- its -- what's underneath it, as well.

But there's no denying there is communication between wells within the pool and, as such, for example, when you go to a restricted rate scenario, then in particular in our opinion what we've seen is that there have been certain beneficiaries and certain people that have been highly hurt by that restricted rate.

We see in particular the pressure proposed expansion area as being a particular beneficiary of the restricted rates and, obviously, other wells, particularly in the Gavilan Mancos Pool proper have hurt.

But basically we have no method of going to back to specific tracts and saying that -- saying exactly what's underneath each of those tracts.

Q I interpret the second part of the question that was that if, again minus the expansion area that we've discussed, it strikes me that there is a fundamental question there about the correlative rights of the people who own the superstars as well, and there seems in your recommendations about allowables, et cetera, you didn't address that, and yet some of the body of the testimony led me to believe that perhaps we're talking about just equalizing its production over the entire Gavilan Mancos Pool, yet I clearly believe that there could be good wells as well as bad wells within the pool, and I don't want to see the people who have off production units or spacing leases be damaged but on the other hand I'd hate to see the people who have the good wells get (not clearly understood) the source be punished for having good wells.

Is there, in your opinion, a way to determine that, because I think that's becoming sort of a secondary issue in my mind, is what's happening within the -- especially Gavilan Mancos?

A Well, you know, I don't believe that's there any way that you're going to do it with pressures, and for example, pressure -- pressure comparisons across this boundary. There's just too much flow rate that can occur as a result of small pressure differences, even the 20 psi pressure differential that Mr. Greer talks about as being ascribable just to different assumptions with respect to the density difference of the fluid.

There -- there have got to be significant differences in the quality of the reservoir under the area. We go to the southern part of the Gavilan Mancos Pool and we have wells down there that will produce 2 or 3 or 4 barrels a day and there's just no way that the reservoir quality is the same as the wells that are up in a highly fractured area in the vicinity of, for example, Mallon wells.

As a consequence, and I don't know whether it's even appropriate, we obviously are not presenting rebuttal testimony, but we did prepare an exhibit that showed, for example, on Mallon's wells, we've talked all along about barrels per psi rock that has occurred, changes that have occurred during the field, and for example, we have plotted for Mallon's wells under initial conditions, a number of barrels that they were making per psi drop, and I believe that was around 1200 barrels per psi.

The initial rate restriction went into effect and they decreased then down to 450 barrels per psi drop.

The normal rate testing period came back into effect and they went up to 850 barrels per psi drop.

The restricted rates came back in effect at the end of the start -- well, the middle of November, and their barrels per psi is now down to 150 and they would appear to have less than I would say 50,000 barrels of oil remaining to be assigned to them under the existing restricted allowable conditions.

So obviously there is a commonality of the reservoir. There are good wells and there are poor wells and I guess in my own mind I would make the assumption that the good wells probably have better reservoir quality associated with them, more fractures, more intensive fractures, maybe wider fractures, maybe they contact more matrix, and -- and therefor they -- they should have a chance to -- or be given -- well, all the wells should be given the same opportunity to produce and I think it's our recommendation that from a reservoir standpoint to maximize production, that opportunity to produce should be at least the statewide allowables and preferably in terms of the ultimate recovery standpoint a capacity type rate.

Q I would ask, I asked you once and I want to just clarify again, and I've asked a couple of other people, in your theory of this interspersed matrix and your perception of the structures of producing rock, you'll have to humor me a minute, because I had to finally tell Bill Lemay, or the Chairman, excuse me, that I at least can see the three dimensional part. The best thing I can do is to give on analogy. I remember one time when I was a pretty young kid and we had marbles that we called cat eyes, they were clear marbles with some kind of stuff in the middle of them, I don't know what it was, and I -- I decided I was going to find out what this stuff was in the middle of them and I learned two things. I went and got a big hammer and I was going to break that marble to see what this stuff in the middle of it was. The first thing I did was knock my thumb nail off and the second thing I did was split that and it didn't break open, it just shattered in every different direction and those weren't linear, they weren't right angle, they were -- I remember they bent and twisted and they went back and forth through this colored stuff in the middle of them.

And that's the way I foresee the fracture system going through your matrix. Is that a fair assumption?

A Well, I think that's a fair assumption. Certainly some of the geologic witnesses that we've had, and past exhibits, are better qualified to tell you. Mr. Elkins indicated that in his experience fractures are, this perfect model that we have, is a three dimensional model, a constant width, a constant frequency, that they vary in many different aspects and I think you're right in assuming that if this network is not just an equally spaced network, it is probably a very broken up and irregular shaped solid bodies of rock that are encased in basically these high capacity fractures, such that if you inject anything, whether it's oil or whatever you inject, you wouldn't inject oil, but whether you inject gas or you inject water the tendency is not going to be for the fluid to flush through that very hard rock, but it is going to be basically to -- to pass around that rock. The only thing that can work to get the oil out from inside that rock is going to be some sort of imbibition process where it will suck in, for example, maybe water and dispel out oil, but that, once again, has been proven to not be particularly effective in this very, very (not clearly understood).

I'm afraid that I didn't really answer your question.

Q Well, you're saying that that three dimensional pattern is obviously not linear or small, it has all kinds of widths and diameters, down to very barely measureable and you have a lot of formulas for calculating those kinds of things.

But if that matrix exists and those fractures, micro-fractures, macro-fractures, or whatever they are, go back and forth through it.

The one thing that's hard for me to visualize is that in that if you're able to put some kind of pressure behind, that just going back and forth in there, that you may be able to move stuff through that even with the imbibition theory, and it's hard for me to disregard that completely, also, although I understand that your differential concept, it strikes me that if you pass through this matrix, it has multiple directions and multiple dimensions and widths, that you may have the opportunity by the fracture going through the matrix or the more porous area, to move stuff between the micro-fractures or macro-fractures that is in the matrix. I see the difference that you drew and I understand the concept between pressure differentials. It's hard for me to imagine with the fractures going every way, multiple dimensions and shapes, that you couldn't move between fractures if you have some kind of --

A Let me try again, then. What we're looking at is a piece of matrix rock surrounded in a three dimensional sense or somewhat by this high capacity fracture system.

When you inject gas into that high capacity fracture system and you, say, pressure that gas up to 2000 psi, that 2000 psi gas pressure exists on both sides of the matrix, so it can't really push anything through the matrix. It's a pressure on both sides. There is no pressure difference to push through the matrix itself.

So the only way that you get fluid out of the matrix is for the matrix to be, let's say, at 3000 psi and then through its natural process of flow out of the matrix have a lower pressure in the fracture than you have in the rock itself. But if you try to inject gas and push it out of the matrix, basically that gas pressure is going to be the same on both sides of that matrix rock and there's no way you're going to be able to push gas or any other type of fluid through that matrix rock because the gas will not want to go through -- through the matrix rock itself. It will want to go strictly down the fractures, fracture system.

Q And that's -- that slow give up or slow rise to original production you believe to be the amount of time it takes to drop the pressure or to make the pressure differential between the fractures and the matrix or porous --

A Yes, we -- we do not believe, in fact I think you've seen a number of exhibits presented by various parties here today where they've shown build-ups that occurred over a period of time in the past. I think even the 1965 pressure interference test that Mr. Greer showed, showed that after 72 hours pressures were not anywhere close to build-up in his wells. They were still building. And this analysis that you do, that compares a barrel of oil to a psi pressure drop, if it's done on a well by well basis, and those pressures are not fully built up, then the analysis is totally distorted by the lack of getting up to a reservoir pressure in -- during that build-up period, and that is why -- that is why we don't see these build-ups occurring, because it's a very slow feed in from the matrix into the fracture system that's going to occur over an extended period of time. Mr. Elkins referred to, I think in the West Edmond Field, build-up that was still going up after, I think, 2 or 400 days of shut-in, but they were still seeing increases in pressure.

So it's a very slow feed in that occurs from the matrix system into the fracture and it means that if you take a pressure of 72 hours, regardless of how well intentioned you are, you probably are not, particularly after a high rate of production, you are probably not going to get anywhere close to an initial reservoir -- or to the true reservoir pressure.

Q Is that slow recovery time what you expected production to be -- have been from -- in addition to the -- assuming that there was no matrix contribution or that that was only part of it, could that have been merely a function of how far it had to come down the fracture system?

A That's right. It's -- that, I think, is the other part of this problem that is particularly a problem with analyzing production for psi pressure drop on a well by well basis, because you have within the Gavilan Mancos Pool and the proposed expansion area, you're going to have a number -- you're going to have the fluids rearranging themselves in the reservoir in response to these restricted rates, normal rates, restricted rates. It's going to change back and forth, and as a consequence, that's right, there is -- there is -- I don't know if you want to call it influx or efflux (sic) that will occur within the given drainage area of any given well, and as a consequence of that, the amount of production that you achieve per psi pressure drop on an individual well in this particular area, because of the -- some -- the large degree of commonality of reservoir pressure, is -- is going to also measure the influx/efflux between the different wells in the -- in this Gavilan Mancos proposed expansion area pool, and it can reflect influx or efflux from other areas outside the pool to the north, to the south, to the east and west.

Q Thank you. I have nothing else. I appreciate it.

MR. LEMAY: Bill Weiss, you want to educate us a little bit?

BILL WEISS,

being recalled to the witness stand and remaining under oath, testified as follows, to-wit:

QUESTIONS BY MR. LEMAY:

Q I just want to concentrate on terminology, barrier, permeability restriction. Let's assume that we have some restriction there between the expansion area and the pressure area project, but that thinking of it in terms of maybe a -- I'll use the term semi-permeable membrane, whatever that can conjure up, but the idea that something can get through there, because very few things are completely, at least within a porous formation, are just like cement. Isn't it -- can't that be a function of pressure differential on both sides as to what might pass that thing and then what might not?

A Yeah, I think we've heard it this week, many different things could be called a barrier. There's a no flow barrier which is a fault or this igneous dike that was mentioned, water leg, something of that nature. No, not a water leg but a dike is certainly a good example of a no flow barrier.

Then we have things mobility cages. You see the -- and this is in homogeneous rock; in a waterflood, maybe you'd see the -- the oil bank, that would -- might look like a barrier and a pressure test.

And then, of course, that's just a

change of mobility. Mobility that is permeability divided by viscosity, so there's two factors in there, and I don't think it's there.

Q You've been listening to all this testimony all week. Have you changed any of your ideas initially?

A No.

Q What about the fact that we've got this permeability restriction, then? You're building up pressure on one side. Is there a tendency for that gas to break through that restriction, first to the oil to follow, do you expect some of those wells to gas out now?

A Yes.

Q As soon as that gas front gets close you're going to start -- you anticipate breakthrough?

A Yes. That would be -- well, I don't know as that would be definitive, either, unless you have a feeling of that.

Q Yeah, right. Yeah, you wouldn't know because you're also getting higher GOR's and so you're trying to find a point in time and you may not have that particular pause at the time.

A Yes, that could be a problem.

Q We're just trying to focus in things like barrier and rates and what -- what would be your impression if we did go to high rates and that was a barrier that was a permeability restriction. It was -- there would always be a pressure differential across that restriction but some of the gas would be coming through, by reducing the voidage both in the expansion area and to those sections adjoining it in the Gavilan Field, by having withdrawals there, would that -- that would cause a greater pressure differential, I guess, and quicker breakthrough, would you say?

A Yes. You could very possibly suffer from gas fingering, then. That -- in that fractional flow equation I had before, I had what was called the critical rate. You could use that approach for pushing down dip. If you go too fast, the gas fingers. If you stay just right, it doesn't finger. But you have to know the permeability to do that.

Q The rates themselves being more efficient, have you come to grips with the idea of how can you have more efficient rates and higher production but still on the barrels per pound pressure jump have a reverse relationship?

A Well, we did go ahead and check the -- on the column I had on Table IV. We converted those, added the gas in terms of reservoir barrels and all we did was get more barrels; we didn't change anything; the ratios were still 5-to-1 in favor of more barrels produced per psi pressure drop than during the high rate.

But -- so we didn't change anything there.

The more I listen to it, I'm sorry, I think in terms of fluid migration in terms of what's been expressed here earlier, but I've not had time to go back and look and see how that affects the build-ups with time, that type of thing. For instance, these build-ups that -- there's a number of them that the engineering committee has collected and I don't know what the effect would be with time. You'd think if it was fluid migration it wouldn't be as evident when the pressure is high as it is at the end, where in the last group the pressures were down around 900 pounds, and there you can certainly see that, in many of the curves, see that the tail end of the build-up would go up, which I was -- in the B-37 interpreted it as a naturally fractured reservoir. It might have been influx. It might have been a barrier. I did look at that. The barrier is either 300 or 2500 feet away, depending on what you use for what you plug into the equation.

QUESTIONS BY MR. HUMPHRIES:

Q Did the idea now -- I can't remember who advanced it, that there might be an opportunity to go with high rate production for a little longer periods of time than one or two days and I think that would be the idea, to overcome the lag time to get the liquid into production. If we went with that kind of operational procedure and got your production back up to the highest or more desirable levels, highest production, and then shut it back in, if that imbibition period was there, it strikes me that when you're shutting it in you still would have that; you might, in fact, exacerbate it.

A Well, imbibition is a tough one and these experts here can tell that. I did get a textbook and I found that it was proportional to the size of the block, which there are lots of guesses to. So during this shut-in period, where you could have, in fact, gravity segregation in a big block, which would overcome the capillary forces and maybe you'd get some oil out of it along with some shut- in.

This problem of rate sensitivity is -- is a real problem and I happen to like the idea of a secondary gas cap forming. That one suited me the best.

But there are valid reasons for wanting to produce at a high rate. As well as whether to produce at a high rate per month and then shut the field in for a year, I don't know. I don't know how that -- I think that's your problem.

MR. LEMAY: Thanks.

MR. WEISS: You're welcome.

MR. LEMAY: We appreciate it.

Okay, we'll close with that line. If nothing else, Mr. Weiss, you gave us the terminology of lots, lots and lots.

We're going to close, I think, in reverse order that we opened. Do you agree?

MR. DOUGLASS: I don't know if we have the right to open and close.

MR. LEMAY: Well, someone told me that fairness was the other way.

MR. DOUGLASS: No, that's the way that --

MR. CARR; I think as a Proponent he opened first and he closes last, I think, unless you want to do it otherwise.

MR. LEMAY: Well --

MR. KELLAHIN: We're prepared to close now and give Mr. Douglass the last comments in the case. I think that's the way it's supposed to be.

MR. LEMAY: It's your choice.

MR. DOUGLASS: I just get one? In other words I don't get to open and close?

In administrative procedure in

a jury trial, that's it, the plaintiffs get to open and they get to close.

MR. LEMAY: Uh-huh, well you certainly get to close but in which order to you want it?

MR. DOUGLASS: Well, I think I'd rather close, if I just get one, if I've got any choice, then I'd like to close.

MR. LEMAY: Well, normally what we do, were you thinking of closing, then having their close and then you're closing again?

MR. DOUGLASS: Yes, to rebut what they said.

MR. LEMAY: Generally we haven't done it that way.

MR. DOUGLASS: Well, I can play around or through. You tell me what the rules are and I'll abide by them.

MR. LEMAY: Okay, generally we just have closing once but it's your choice, whichever, if you want to close at the end or close at the beginning?

MR. DOUGLASS: If I've got a choice, I want to go last.

MR. LEMAY: Fine.

MR. KELLAHIN: We'll give Mr. Douglass that choice.

MR. LEMAY: I appreciate that.

MR. KELLAHIN: Gentlemen, I'll be the first to tell you there is lots I don't know about this case. There are some things I did learn, however. I learned some things about how the Railroad Commission of Texas operates and functions from Mr. Powell.

I was pleased to learn how that in Texas in these tight fractured reservoirs that they do, in fact, have pressure maintenance projects for primary production in only parts of the reservoir.

I was pleased to hear from him in Texas that they do allow those pressure maintenance operators to reinject their gas into that reservoir in order to replace reservoir voidage and they get a credit for that.

I don't want to tell you that I know a lot about reservoir engineering, but there are some things which I do know.

I know that in New Mexico the rule of capture is not the rule in this state, where this Commission has been a pioneer among states in the southwest and in the United States in protecting correlative rights and preventing waste.

I don't think you have to take advise from Texas or any other state about how you run this

Commission.

You have the comfort and confidence to act as a Commission knowing that in some fifty years of operation this Commission has been reversed by our judicial system only once or twice, but there are some significant cases in Commission orders for which I do know.

I know that if the rule of capture were in place, then these superstar wells that we've talked about of the Gavilan Mancos could produce at capacity and drain the other wells in Gavilan and drain the other pools in the immediate area and there would be no need for this Commission to exist and we would not be here today.

I know that the statutes of New Mexico and the rules of the Oil Conservation Commission are there to keep order in the Gavilan Mancos Pool and to create balance in this pool where the operators cannot do it for themselves.

I know from the Continental Oil case of 1962 the Commission can use a pure acreage formula among the spacing units for each of these wells and allocate that share of production based upon acreage; in the absence of convincing data, that you can determine the total portion of the pool reserves underlying each spacing unit.

I know that from the Continental Oil case, from the Viking Petroleum case, from the Faskin case, from Duke City Lumber, the Trujillo case, that the Commission must in its deliberations review the whole record of this proceedings and consider the entire record, both the evidence for a decision and against that decision, whatever that decision is you must consider the evidence on both sides of that issue. You cannot simply look at that evidence that supports the conclusion that you believe you want to reach.

I also know from reviewing those cases and practicing before this Commission that the order itself that you write must be clear in giving us specific findings that disclose the reasons of this Commission in reaching its ultimate conclusions and in doing so you must explain yourself.

In writing that order I know that you can reject the competence of Mr. Hueni's dual porosity computer modeling because I know there is an alternative explanation from Dr. Lee, because Dr. Lee can take that model with observed reservoir performance and factors and he can match with his model both historical facts without using the dual porosity hypothesis, and without having a barrier hypothesized into the model.

I know that you can reject Mr.

Hueni's concept of the inverse rate sensitivity conditions because Mr. Roe has told us that all that is occurring in this reservoir is not dual porosity operations, it's simply the migration of fluids in the reservoir. We have wells competing against one another, and that's the explanation he sees for the inverse rate sensitivity.

I know that you can reject Mr. Hueni's dual porosity hypothesis and explain that rejection very clearly and convincingly in the order that you write based upon the fact that no other well but the Mobil Lindrith B-37 Well has a build-up curve that has a shape that can be attributed to dual porosity.

I know that you can reject Dr. Kohlhaas' testimony in support of a barrier, about not seeing that interference between the B-52, the B-32, and the C-34 Well and explain that with conviction because Mr. Greer has told us that Dr. Kohlhaas has used the wrong plots and he didn't see it. He didn't see it because it wasn't there. He simply used the wrong plot.

I know that you can reject that barrier hypothesis because of the observations of the situation that your own witness, Mr. Bill Weiss, has found from the project area into the expansion area, and he is the only witness that's been before you in the entire proceedings that is not -- has not been paid by either side by being here for his testimony.

I know that you can adopt an order that rejects Mr. Hueni's conclusion that the high rate is more effective for Gavilan Mancos because you know from his own Exhibit Number Twenty-two, for which Mr. Roe had calculated that there are 6,089 more reservoir barrels per pound of pressure loss recovered at the lower rate than at the high rate from Mr. Hueni's own work.

We have a significant contrast in styles here between the opponents and the proponents. I thought Mr. Douglass and Mr. Kohlhaas had a wonderfully nice style when they took that display and they showed the interference test on both sides and they had the red lines across the hypothesized barrier and Mr. Douglass had that wonderful opportunity to rip off the tape every time Mr. Kohlhaas told him to take it off. That was great style, but that style does not remove the fact that Mr. Greer has measured the interference across that barrier, so-called barrier, lease. Removing that tape from that exhibit does not remove the fact that Mr. Weiss finds that there is pressure response in the expansion area directly attributable to the project area. It's in his report; he committed it to writing; he committed it in a preliminary report and in the final report and he did not change it.

Let me direct my attention for

a moment to some of the comments that Mr. Lund made earlier today. It's unfortunate that he could not stay for the rest of the day with us, but let's address ourselves for a moment to some of this comments.

How would you adopt a position that Mr. Lund urges you to adopt and explain away the fact that his own witness tells us that the initial pressures in the Bear Canyon Unit are lower than Amoco expected to find when they drilled the discovery well?

How do you explain the fact that Betsy Lough had forgotten Mr. Roe's testimony from the day before when he said he had examined the results from the Amoco core and it did not bleed?

Mr. Lund drew a comment to Dr. Lee providing a correction in the number of barrels of oil to be recovered in Gavilan Mancos in the absence of pressure maintenance. On Monday Dr. Lee gave us one number; the following Wednesday, I believe it was, when he testified, he had another number on that portion of his exhibit. Isn't it interesting that Mr. Lund did not remind us of the basic conclusion of Dr. Lee that regardless of what that number was, the 5-million barrels of oil under primary recovery in Gavilan or the 7-million, the fact of the matter is Dr. Lee tells us under pressure maintenance we're going to get 10-million. The basic conclusion was the same.

And isn't it refreshing when witnesses of the caliber of Dr. Lee and John Roe and Al Greer get before you and run the risk of letting the opposition argue that they have changed a calculation. They take that risk just so they can give you the most accurate number upon which you then can rely to make your judgments.

How do you explain with confidence if you go to a higher allowable rate in the Gavilan Mancos and rely upon the dual porosity reservoir hypothesis when you are shown only 1 well out of 87 wells in the study area, a well that is isolated in the western portion of Gavilan that has that shape on the build-up curve? How do you rely with confidence on the Mobil well core in the southwest corner of this reservoir? Is it not easier to explain that simply related to the situation an anomalous example that you can reject?

How do you explain with confidence to Mr. Greer that the barrier does not leak when he has shown you the interference across that barrier?

How do you explain to Dr. Lee with confidence that you have a dual porosity reservoir when he knows that the better engineering explanation for the shape of those multiple build-up plots is one where we have phase redistribution in the wellbore?

And how do you explain with

confidence to Mr. Roe that you have matrix contributing in the Gavilan Mancos when Mr. Roe has looked at the information from the Mallon Davis core and under visual observations, that core shows no oil?

How do you explain with confidence to Dr. Lee that the matrix is contributing, when in his six section sponge that he gave you in his report, with the eight wells, that we squeeze that sponge as hard as we can under those conditions and we do not improve recovery in those eight wells?

How do you explain to Mr. Roe that you have increased the allowables to the higher rate when he knows at the higher rate it recovered only a third of the oil per pound of pressure loss in Gavilan Mancos that the lower rates did?

And how do you explain to the operators of the 23 wells during the high test rate that had decreased oil recoveries, that you're going to increase the allowables for the benefit of those operators of the 15 wells that are going to benefit? How are you going to resolve that?

How do you explain to the operators of the 43 wells that had their productivity reduced by the high rates that it's okay because we need to help the 15 better wells?

How do you explain to Mr. Greer that his pressure maintenance project is not a success and not entitled to an injection gas credit when he knows he's recovered 15 percent more of the original oil in place in his unit compared to Gavilan Mancos and its 6 and 8 percent recovery?

How do you explain the fact that Mr. Powell finds that the pressure is constant in the unit between June 30th, 1987, and February 29, 1988, when we know there is over-injection in the unit and as a result of that injection Mr. Weiss sees pressures being supported across the barrier into the expansion area on those three wells that he's put in his report?

How do you find an effective barrier and explain away the fact that the pressure maintenance area was providing pressure support to the D-17 Well and the B-29 Well in the expansion area?

And how do you explain away the conclusion Mr. Greer gave you, that at the higher rate of withdrawals in Gavilan the pressure maintenance project cannot keep up with the withdrawal rates in Gavilan and there will be a pressure sink, where at a lower rate, the rate of injection of gas in the main project area is allowed to come across the permeability restriction area and recharge the expansion area and recharge Gavilan?

The simply basic conclusion is that without the pressure support from the project area across this assumed barrier, the pressure and the production in the expansion area and in Gavilan will sink like a rock.

How do you adopt a higher allowable rate in Gavilan Mancos based upon the credibility of Mr. Hueni as an expert when you have before you his conclusions of the August, 1986 hearing; the conclusions of the March '87 hearing; the conclusions of the hearing this week, each of which contain at least one fundamental, basic, essential conclusion that is different each time he testified?

How do you explain to Mr. Greer why you have decided to put at risk a lifetime work of effort to maximize recovery in the Canada Ojito Unit in order to satisfy and receive an erroneous assumption that higher rates for certain high capacity wells is in the best interest of all parties?

Mr. Lund earlier today gave you some definitions about correlative rights. Correlative rights is written in your rule book, it's in your statutes, and it says simply this: Correlative rights is an opportunity to produce your fair share of the reserves underlying your spacing unit. It is not an opportunity to take advantage of the adjoining spacing units and produce their share of the oil with your superstars. Capacity allowables in Gavilan Mancos will take us back 50 years to the worst days under the rules of capture.

I told you on Monday that we had a solution to this case. I did not tell you until Thursday when Mr. Roe testified what we proposed with Mr. Roe as a solution to the allowable rates in Gavilan; however by Tuesday afternoon Commissioner Lemay had already found that solution in his questioning of Mr. Hueni concerning how to handle the liability of the flexibility of producing rates for the superwells.

I think that fact can be resolved by proposing a flexible rule for the producing rates of Gavilan Mancos that we discussed with Mr. Roe; that we reconfirmed with Mr. Greer; and I have taken the time to write out what I think is the solution to your problem. If I might have a moment, I will pass those out.

Gentlemen, I appreciate the opportunity to appear and practice before this Commission. It's always a privilege and honor. I have enjoyed that privilege this week. I have enjoyed meeting and participating against Mr. Douglass and the other attorneys on the other side. I thank you for your time.

MR. LEMAY: Thank you, Mr.

Kellahin.

MR. CARR: May it please the Commission, this is the time in these proceedings where the incompetents get to finally take over. This is the last opportunity that anyone in this group is going to have to address you in the context of this hearing. For those people who want to maintain the current allowable rates in the Gavilan Mancos Area and after I sit down you're going to hear a great deal from Mr. Douglass and others. You're going to hear about the barrier, and about the porosity and interference and whether or not it's there or not. You may get to look at some more exhibits, and you're probably going to even get to hear something about Mr. Greer.

The reason that they go last, they get the last say, is because they have the burden of proving that change is really warranted and they have to meet that burden, and I'm convinced that when you stop and deliberate on the (not understood) they've made after 17 days of hearing and review this with your staffs, that you will conclude that they have failed to meet that burden.

Now the incompetent lawyers, I think, in our own defense it's fair to say, have tried to keep lawyer damage in this proceeding to a minimum and I think I can speak for both sides in saying we have stepped back and we have let the competent experts come forward to lead you through the wilderness and they took the same data and they ran in opposite directions, and so now we tender to you what has got to be a difficult decision and as you retire to reach your final decision in this case, there are two people who have appeared before you who I believe stand in unique positions.

The first one of those is obviously Al Greer. He's different from all the rest. Long before there was Gavilan, long before there was imbibition, Mr. Greer with his slide rule walked out into northwest New Mexico and he found a reservoir that I think one thing we all agree on is if it isn't unique, it's complicated. I think that fact is underscored by even Mr. Hueni's testimony. One time we see Mr. Hueni, he talks about the existence of a barrier and how effective it is. The next time something else; the next time imbibition, and I'm not saying those are wrong but I'm saying it underscores the fact that this is a complicated and a difficult question.

Mr. Greer went out and he took the data as it has been developed over the years. He has interpreted it. He has found tight blocks in a reservoir connected by an extension fracture system, gravity drainage, and all of those things you've heard about, and he has instituted in this Canada Ojitos Unit a pressure maintenance project. This has not been something Mr. Greer has done alone.

If you go back through the records of this Commission, there aren't 17 days of hearing there are many times that, for as he has developed the area he has done it in close association with the regulatory authorities of this state.

Now the concepts that were developed by Mr. Greer, I think it is important, and I've told you this before, the concepts that were developed by Mr. Greer are, unlike so many of the concepts you've had presented to you, they were not developed for the purpose of the hearing. They were not developed to produce the reserves that are in the Gavilan Mancos area. They were developed to produce oil and as we have through these hearings seen experts come forward one after another, we believe that Mr. Greer's theories still stand before you and they stand before you basically unrefuted.

Mr. Elkins comes before you and we believe he in fact confirms you use the EI approach and that you interpret the interference tests as Mr. Greer has done.

We saw Dr. Kohlhaas come before you and I don't want to suggest that we were having engineering games played but we -- I do submit to you that the analyses of the interference test that he made were incorrect; his results were wrong.

Mr. Greer, on the other hand, has come before you and explained how you read those graphs and what they really show. He has shown you why the interference tests look like they do and he's shown you that they show there's interference in the area of the boundary -- of the barrier. There's communication and we submit that we can couple this with the normal pressure gradients that you see across the reservoir with the evidence of pressure support in the expansion area during very recent test periods, that you must conclude the barrier was in fact there -- that you must conclude that the barrier is in fact not there.

I think when you look at the evidence you're going to find that pressure maintenance is working, that it must be, and that it is only a clever trick to move the boundary of the Gavilan into our unit and then claim the down dip production and say that the unit, Mr. Greer's unit is dying and the Gavilan is continuing to produce at a more effective rate.

So the bottom line, I think, is that we believe what we have told you over the years remains true, and it remains true today, and I ask you when you retire to consider this evidence, that you think about what the two parties have come before you to propose. On one side, we want to produce it all; we want to do it now. On the other hand we want to do it slowly. We want to do it right, and we have come before you and we have shown you how we offer to continue to work with you to monitor that migration across the boundary both ways, to assure that correlative rights are protected and that people are not harmed.

I can tell you I'm proud to stand up with Mr. Greer. I'm convinced I stand before you with one of the most respected men in this industry and he has come before you to tell you what he believes; to tell you what he knows, and he knows it because it's been confirmed by 26 years of experience, 26 years of actual field information.

Mr. Kellahin pointed out that we didn't have, perhaps, the razzle-dazzle of the other side, and I'm not willing necessarily to concede that, but we are convinced that however we presented it, what we told you was right. We're asking you not to destroy a pressure maintenance project that benefits the interest owners in the unit, that benefits the State of New Mexico, and will continue to benefit the people of this state and the interest owners in this unit for years to come, and we're asking you to do that instead of just returning a quick buck to somebody else.

Now the second person who I think stands before you in a very unique posture is a person that you turned to for advice, the man that you asked to come in and help you understand the very complicated matter, give you some neutral opinions and some independent counsel on the engineering side of this case. In this room full of experts there is probably only one who's not being paid one penny extra for being here and that is, of course, Bill Weiss.

Now I can tell you that we don't agree with him on some things. He took the information from one core. He finds this to be evidence of dual porosity, and in fact we don't disagree with that statement so much but with the implications that can be drawn from it but we still contend that the evidence on dual porosity looks a heck of a lot more like an anomaly than a reservoir wide characteristic.

But there are areas where we also agree with Mr. Weiss. He finds absolutely no barrier and we think that is obviously the situation in this reservoir.

He finds that the reservoir is rate sensitive and we agree with that.

I can tell you too that I was

surprised last month to see you release his report when you did. With this kind of help I don't think Mr. Weiss would have written anything at all that could not have been seriously attacked by one side or the other. I will tell you that after five days of hearing this week I think his report stands before you in a pretty good position and it still stands as an honest, competent, professional job and it should be given, when you consider this case, substantial weight, and that's lots.

Now, if we look at the case, there are some things here that are easy to dispose of. Those can be gotten out of the way quickly. Separating the C Zone one time may have sounded like a great idea but I just don't think in this record it really poses a sure thing.

Moving the boundary, furthermore, accomplishes nothing; it's a political boundary. We can move from one political boundary to another political boundary, but that doesn't accomplish anything, when the boundary that counts is the unit boundary. It's a creature that has been blessed from time to time by this Commission, but it is a creature of private contract. It's an approved Federal unit and the unit boundary is going to remain. I think those questions are out of the case.

The harder question is for you

and that's what do you do to make sense out of all that's been presented to you. You're doing today what Mr. Greer tried to do 26 years ago. You're trying to take the information available and decide what is right to efficiently produce the reservoir.

We submit it need not be, however, as difficult as it may appear, for we have attempted to show you how it can be done, expand the pressure maintenance project, obtain reasonable rates, monitor the flow across this boundary both ways and we're ready to work with you in doing that to assure that no one gains an advantage and no one's rights are impaired.

We think that you should permit production at whatever rates are necessary for short periods of time, if it is necessary to get the oil out of that reservoir and to do it in an efficient fashion if this is what needs to be done, and when you do this, we are convinced that you will have acted to prevent waste, your primary statutory responsibility, and you will have acted to protect correlative rights and you will have met all of your duties as members of this Commission.

Thank you very much.

MR. LEMAY: Thank you, Mr. Carr.

Mr. Douglass?

MR. DOUGLASS: First of all, let me thank you gentlemen for letting me participate here. This is a very serious case. I'm not going to cast aspersions on co-opposing counsel for being against my position here. That's not my style. I do not play games with clients, opposing counsel, juries, judges, or administrative bodies.

My client's rights and property have been severely and adversely affected by what's taken place previously. Production of my client's wells under the normal allowable is 1000 barrels of oil per day, and it's been reduced to 50 barrels a day, still going down as a result of strict allowables.

Let's put an exhibit on here to show you how Mallon was going to benefit from restoration of the normal allowable rates. All I can say is that that's the best exhibit I know to show you what these restrictive rates have done to my client, because only by producing normal rates will he get his fair share from this field.

He's not just by himself and I think this shows exactly what that -- how and why that restricted rate was designed. It was designed to affect only Mallon and only next to the expansion area because the expansion area had not gotten their wells (unclear), had not gotten their numbers in, and according to Mr. Greer would be (unclear).

Others are impacted. You've seen the list of them. Those that have stood up and are going to stand up with Mallon, because Mallon does not stand alone. He does not ask to us to do what's right by himself, although I think he's entitled to do so. All of these parties agreed to a detailed study. Their position has been the same as a result of that study. And the question that you now have to decide are the issues and I think it's clear from your questions that you know what the issues are in these cases and you don't need me or anyone else to tell you what they are. You've seen them, you've asked the questions (not clearly understood>)

Let me say that it's obvious that everything doesn't fit, and I think we know the reason why. It's Mother Nature. If she let everything fit what good would be on this earth? How would we think? How would we find? How would we expand, if every question had a finite solution?

Administrative bodies such as yours have two functions. You're the judge and you're the jury; quasi judicial is what these sessions are, what it is here. That's what it is in almost every state that has judicial authority.

Now there's no dispute about the law. I don't think there's any question about the rules. I'll accept them. Mr. Kellahin's definition of what correlative rights are, Mr. Roe's. In every state I've been to it is essentially identical, even a backward state like Texas it is essentially the same. Fair share has been used in our Supreme Court opinions for years and years and years. And let me suggest to you that in order to get a fair share you don't restrict a field down to 40 (unclear). That's clear, I think, in New Mexico or anywhere else. That's not the standard. That's not what's going to cause oil and gas to be produced. That's not what's going to cause outside capital to come into New Mexico to drill and produce wells, is to set the standard at the lowest level, and you haven't done that. You have set fieldwide yardstick allowables and that's what was in effect in this field before and that's what brought about drilling of these 80-something wells that were out here.

The operators had an opportunity to produce.

And let me suggest something else; competition is not bad. Our country has been built on it. Obviously there are some opportunities when you have freedom, when you have equality. Obviously a lot of times that is an efficient way but it has to be economically feasible, economically practical, for that to happen.

My suggestion to you gentlemen is that the best way to decide that is the ones who are spending the money. I think you have the duty to make sure that waste does not occur, and I think that that's why this original restriction was put in because that Commission had a question about whether waste would be caused by continuing to produce oil at normal rates and I think the evidence since that date and you can see it now and the result of your test shows without question that producing at normal rates (unclear) producing at normal rates caused low GOR and low GOR is more efficient. Every witness has testified and ascribed to that. That has been a uniform and tested theory through every witness that has been here.

Since there is no dispute on the law, then your function has obviously got to be to decide the facts and then the remedy; oftentimes juries do that; and they do it, I think, in the same manner that you will be called upon, and that is with the preponderance of the evidence. It's not the great weight of the preponderance of the evidence. It's not beyond a reasonable doubt. Let me say, if it was beyond a reasonably doubt, and if I was a barrier, I would be convicted, because the evidence is beyond a reasonable doubt that it exists.

Upon a preponderance solely

it's a scale. The evidence appears to tip the scale one way and that's the way the facts should be decided and unless there is enough evidence, even though there may be some evidence, unless there's enough evidence to tip the scale the other way, the preponderance of evidence rules.

In this case I think you could even go to a great preponderance of evidence. I think there are some things that are even beyond a reasonable doubt on the preponderance side. Let me say that the Proponents did not create this barrier. This barrier was recognized by Mr. Al Greer twenty years ago. He knew that he found something that stopped flow down dip from where he was located and that's obviously the reason that he didn't go develop one of the nicest, biggest, substantial oil reservoirs that you've probably got in New Mexico. If he didn't think there was a barrier down dip, then why didn't he go develop it.

I think Mr. Al Greer is a smart operator. I think you've seen him enough on the stand to realize exactly how smart he is and I think that the situation that we have here is, Mr. Weiss says that he has to have a geological barrier in there before he thinks it's one that stops the flow. I think that the more reasonable situation would be that obviously there's at least one barrier in that reservoir or this oil and gas wouldn't have stayed there. This formation, as I understand it, outcrops on top of the ground, so obviously there's a permeability barrier in this reservoir that you cannot find geologically, that stops the flow of oil and gas, and I suggest to you there are at least two. A barrier is shown by our Exhibit Twenty. Mr. Greer has been in the business for 26 years and I think he's an excellent petroleum engineer, and we've run an interference test that's almost as long as the 26 years in this reservoir and nobody yet has told us how these two reservoirs can be in effective pressure communication when you start out with the pressure down here, continue the pressure all the way across, have pressures in between that fall at or near this line, and you have another reservoir that comes in at least 350 or more pounds above, it will come down, and we're now at a 5-to-825 pounds versus 1400 -- we're now 525 pounds pressure below and we're 350 pounds or more above, gentlemen, that is not effective (unclear). You gentlemen recognized it in your order as the result of the March, 1987, hearing. You had a serious question at that time. You wanted test data and information, and that test data and information has shown communication as far as the wells on the west of the boundary are concerned. It has shown communication as far as the wells east of the boundary are concerned. But it has shown no communication across the barrier.

They chastise Mr. Hueni about being inconsistent. I think not. I think that Mr. Hueni is an excellent petroleum engineer and I think he's given forthright opinions that he's had, and I believe that as far as this case is concerned that they found no error by Mr. Hueni.

I think Dr. Kohlhaas, when he put on his case, showed clearly that there were no fracture responses in the four wells that Mr. Greer said there were, and as I understand it, Mr. Greer has to do a different type of analysis to show that data, and I suggest to you gentlemen that all you need to do is to look at the tests themselves in the same scales and these four tests show fracture response and we offer it in this case, it ought to be in communication, these four tests -- he submitted another one to you just on the stand that shows another pressure response in the B-32 Well and you saw what type of response. These fracture tests were across the barrier and they do not show any response.

Dr. Lee's model in order to create pressure across the boundary use erroneous data and information. He showed a pressure that both Mr. Roe and Mr. Greer say is not correct, and then they just sort of fluff off for that reservoir.

John Lee is not that bad an engineer. He is a good, smart engineer. He has done some oil in place calculations and he has compared those oil in place calculations with what's taking place in the reservoir. They're consistent with the data and information that's available. I'm not saying that they're completely correct, I don't think that Dr. Lee would say they were, but they are something that you can certainly look at and see whether the fair share is being produced here; what's happening in the reservoir.

I think that the evidence on the barrier is clear, it exists. There is no data, there is no interference test across the barrier. This barrier was so easy to show it wasn't there, why didn't they show an interference test pressure. Mr. Greer's rainbow map shows pressure differential across that map. Let me see, got one? Incidentally, my able assistant here is Mr. Mallon's son, so we're -- this shows, even using Mr. Greer's Greer's pressure, the way he measures pressure, he says surface is better than bottom hole. I don't know about that. I've always heard the other way around, but even taking his, you see that they're consistent with the barrier being in place where it is, and also the explanation for the higher pressures in the gas wells in this tight area that exist, the over-injection. Let me tell you about that over-injection. That over-injection that took place then went exactly the same place that it did for the 10 years that he over-injected and he couldn't keep up with the pressure. That's what the evidence shows as far as that's concerned.

I suggest to you that the barrier does exist. It's an effective barrier to effective communication across there and that's the first step. When you take that step, then you can analyze what's going on in this reservoir, once you get that problem out of the way.

The efficient rate of production is one that I think we could show without question. All of the data, you remember I started with Mr. Roe in January of '87 at a time when they said there weren't any problems involved when we were at the low rate. Every month increased oil production, low GORs, lower GORs;. lower oil production, increased gas/oil ratios. It is true each and every month during the higher rates production, during the lower rates production that occurred. During the normal rates and during the restricted rates that happened, and that's inefficiency. It's inefficient to produce this reservoir at high gas/oil ratios. You conserve energy, you prevent waste, no one has told you that you do not prevent waste by producing at lower gas/oil ratios and as Mr. Powell says, that's getting it, and it's an opportunity that you have to prevent waste in the future.

400,000 barrels in the past, 600,000 barrels in the future, 602,000. If you're going to take this scheme that's been proposed of four months and one month, shut it in for the next three months, the problem with that is that that means 3/4ths of the waste that we say is going to occur, is going to occur because you're still only producing those wells at one quarter of the rate. Waste is going to occur if you continue restricted production here. The loss to the State has been $4-million already; it's going to be more. The loss to these operators is $22-million and that is significant as far as these operators are concerned. That's the kind of thing -- if you go to Sun's proposal and put it down to 94 MCF, you can't even pay out a well. When you get down to the rates that we are now with the gas/oil ratios, you can't pay out a new well. You don't have any new wells being drilled when you produce at the rates that are being submitted in this reservoir.

If you will recall with reference to the production rate, the effect, I've shown under any test of correlative rights, you'll recall that -- that if you take March's production, that they are producing 5.35 in the expansion area, 5.35 barrels per acre while we're producing only 1.22 under the restricted rates, and accepting Mr. Kellahin's definition as set forth in the Continental case, that you can use acreage unless you can determine or detect the reserves that are in each tract and I haven't heard anybody say that they can't determine reserves in each tract, and if you're applying acreage, that's not what's happening here. You're not using acreage allocation when you permit 1.22 barrels per acre over in the Gavilan and 5.25 -- now that's using Mr. Roe's Gavilan. That's using the Gavilan that has really been hurt by these restrictions that are there. That's not an opportunity to produce a fair share.

If you go to oil in place, and using their figures, you understand this calculation up here is using their figures as far as they acreage, but if you go to the -- using their oil in place figures that they have submitted to you, the percents that they put their wells on, they have recovered 8.4 percent of the oil in place under their tracts while Gavilan has only produced 5.5 percent. That is a 52.79 percent.

Maybe Mr. Greer is entitled to be (unclear) for his pressure maintenance project. I'm certainly not going to say that you shouldn't encourage people to put in a pressure maintenance project, if they want to put in a pressure maintenance project. Certainly that is sufficient reward. He has already received a substantial advantage that's occurred and you should not continue an allowable system that substantially restricts my client's wells and others in order to reward Mr. Greer.

I've got no quick bucks involved here. I've got no razzle-dazzle. I got no great style, but I do have one thing that the other side doesn't have. I've got great facts.

Thank you.

MR. LEMAY: Thank you, Mr. Douglass.

Mr. Pearce.

MR. PEARCE: Thank you, Mr. Chairman.

May it please the Commission, I am not in a comfortable position. It's late in the week and it's late in the day and I am following some gifted rhetorical gentlemen.

We began just a little while ago with the Commission being told that you can do certain things. I understand that. I've practiced before the Commission and on behalf of the Commission for a number of years and I understand that you can do a lot of things with this case. After the number of years I've been doing this I am willing to be presumptuous because I propose to tell you what I think you should do.

I read the Oil and Gas Act; I read your rules and regulations; I deal with them a lot and I for one have an opinion on what you should do.

Mobil is one of 11 companies, both majors and independents, who have spent two years studying the Gavilan Mancos Pool. We've also studied the expansion area. Mobil has done this because it, as well as other operators, desire to utilize their geological, engineering, and financial resources to recover as much oil as they can. That's why Mobil's here. Mobil seeks the opportunity to produce a fair share of reserves under its acreage and use a fair share of the reservoir's energy.

If the Gavilan Pool is allowed to produce as the Proponents of the study, members of the study committee have indicated is the most efficient, which is allowing those Gavilan wells to produce whatever they can, the maximum amount of oil will be produced from that reservoir and that reservoir is the present Gavilan and the expansion area, and if what we're about is trying to prevent waste and get as much oil out of that reservoir as we can, we're going to let those wells go.

Now, there was an exhibit blown up which Mr. Douglass showed to you earlier which dealt with percentages to be recovered. I want to assure you that my client is not in the business of raising its relative percentage of a smaller number. Those numbers may be true. Our share of a daily production number may go down but if the oil we recover is higher, that's fine with us, because we're going to get more ultimate recovery and in that sense our aim in this process is exactly the same as yours is. We're both here to try to recover more oil. And Mobil will pay a smaller percentage of a bigger number but we want the oil.

Now I'm not going to restate Mr. Douglass' argument summarizing the evidence about a barrier between the proposed expansion area and the pressure maintenance project. That barrier is there. Mobil has spent two years studying the question. Mobil is convinced. We think this record is clear. Yeah, two years ago we started a 90-day study in the Gavilan reservoir. I calculate we've studied it about 690 days now. My client's position has not changed. We indicated to the Commission at that time that this reservoir be turned loose so we could recover more oil. That is still our position.

I'm not going to restate Mr. Douglass' summary of the high rate/low GOR data. That data shows that producing this reservoir at higher rates is more efficient.

With regards to the possibility of gas injection, Mr. Elkins has presented conclusions resulting from the two year or, if you will excuse me, 690 days, of money spent in studying, and I want to recall for you what those conclusions are.

He concluded that the bulk of Gavilan oil is in the matrix.

He concluded that injecting gas into this fractured system will not recover more oil. We wish it would; we'd inject gas; but it won't.

He concluded that oil will be lost unless you maintain the highest pressure differential between the fractures and these tight blocks.

If there is a single individual who can help the Commission with the problems before it, dealing with fractured reservoirs, it's Linc Elkins. Mr. Elkins has got 47 years of hard core engineering (unclear) of secondary recovery projects in fractured reservoirs. He's got practical experience and he's got theoretical writings and everybody relies on his theoretical writings.

And he is a world renowned expert in petroleum engineering. He's discussed for you several analogous projects and he said I think you ought to know that gas injection won't help you, and he named the places where it had been tried and there was immediate breakthrough and immediate project failure and it didn't help anybody, it just cost everybody money, which causes premature abandonment and wastes more oil, and that's all you get for gas injection out here.

I wish that weren't so, but the experts tell us it is.

All the parties agree that the Gavilan and the expansion area are relatively flat. They are in relatively good communication. There is not a poolwide gas cap. If you inject gas in that pool you're going to get fast breakthrough. It's happened over and over and over again and the people have related those stories to you, and nobody's come up with a gas injection project in a fractured reservoir. The people who have been studying this all their professional lives haven't done it.

And we believe it's significant that Dr. Lee has come to this hearing and has abandoned the model he used before. We're not surprised. We think it's interesting, we're not surprised. We thought that model was flawed; we still think it was flawed. We're not surprised he didn't use it.

Mr. Elkins also confirmed that the Gavilan and the expansion area are a dual porosity system. By applying measured reservoir parameters and recognized calculations, Mr. Elkins has concluded that the matrix will produce oil. As I said, Mr. Elkins has 47 years of practical and theoretical expertise and, you know, he's been proven absolutely correct.

In this hearing you have heard evidence which proves that that conclusion about dual porosity is correct.

Mr. Mallon, regretably maybe, I'm sure for him, drilled the Davis Federal Well. Everybody agrees that that well is in one of what Mr. Greer calls tight blocks and that well produces oil. It doesn't produce enough to make the man who paid for the well happy, but it produces oil and if the tight blocks weren't giving up oil, that well couldn't produce. That well is proof of a dual porosity system. He can't see anything else. We've got dual porosity. We've got dual porosity which needs to have the pressure differential between the tight blocks and the fracture reduced as much as possible so the oil can get out of the tight blocks. That's what we're talking about here.

If we don't maximize that pressure differential we will waste more oil.

Mobil believes that allowing an injection credit to wells in the expansion area is unfair. Those wells are not receiving pressure support from that pressure injection area. That pressure injection area was at a different pressure first below and then above for 26 years. They're not in pressure communication.

I hope the Commission will review, I don't want to be insulting, but I do want to remind you of something.

When I started today I hadn't planned to do this until a few minutes ago, but I want to remind you that drilling and having a good well is not a punishable offense. What we're talking about here is taking an operator who goes out and drills a good well to produce oil being punished. We're going to reward somebody who drills a well that's not good in order to punish somebody who drills a well that is good.

You've heard Mr. Hueni comment that he's convinced that the better wells are in better parts of the reservoir.

Allowing a better well to produce more oil is fair. Punishing somebody for coming into New Mexico or spending money in New Mexico to drill a good well-- I'm sorry, it just doesn't make sense to me. I don't think that's what we're supposed to be about and I'm talking about the Commission and all the lawyers who practice before the Commission and all the companies who bring cases before the Commission. We all want more oil and to punish somebody for having a good well doesn't make good sense.

In summary, Mobil joins other proponents in asking the Commission to avoid waste and to protect the parties correlative rights by setting the allowables equal to whatever those wells will produce so that we can recover the maximum amount of oil; by including the expansion area in the Gavilan Pool, in which it is in pressure -- with which it is in pressure communication; and by determining that it is unreasonable to cause further waste by holding down production rates in frankly a false hopes that the parties will get together, form a unit, and come up with some better way to produce this reservoir.

The best way to produce this reservoir is to let wells go. My client is in the business of producing oil. We're not in the business of wasting it and we're not in the business of figuring out what relative percentages are, how those percentages change. We're in the business of producing oil.

The way to get the most oil out of this reservoir, to distribute that production most correctly and to get the most benefit for the operators, is to let this reservoir go, and we ask you to do that.

Thank you.

MR. LEMAY: Thank you, Mr. Pearce.

Mr. Lopez.

MR. LOPEZ: I'm sorry that Mr. Lund is not here so I could explain why I use this script. Some of my friends and clients are afraid to turn me loose without one.

Mr. Chairman, and members of the Commission, I'm making this statement on behalf of Mesa Grande.

As I mentioned in my opening, hopefully we've come to the last bend in the road. We are now at the moment of truth. It's been a great fight and personally, and on behalf of my client, and surely for the Proponents and Opponents alike, I want to thank the Commission, its staff and Mr. Weiss, for the dedicated attention and the time and energy you have given, and in allowing us to come before you in an open forum to debate and contest the issues that will affect the ultimate recovery of thousands of barrels of oil and millions of dollars in lost revenues to the operators, mineral owners, and the State of New Mexico. That this is a very important case and I know that both the Opponents and Proponents are in agreement on this issue.

This is obviously a case where reasonable men disagree and I know for certain that both the Opponents and Proponents have put forward their very best cases with some of the country's preeminent experts on petroleum engineering, a very distinguished club on both sides of the aisle.

And still, while I'm at it, I would like to state publicly to all the members of our team, the geologists, engineers, landmen, not to mention the big bosses, that I consider it a real privilege and a high point of my career to have worked and vigorously debated with all of you in endless discussions the issues before the issues before us. As I mentioned five days ago, I first started living with this thing called Gavilan five years ago, and so as the Commission, I'm sure, realizes, there are a bunch of folks, landmen, geologists, et cetera, who may not be here today but who have provided valuable, talented testimony and who contributed greatly to helping frame the issues.

Besides congratulating this effort, the point I hope I'm making is these reservoirs called Gavilan and West Puerto Chiquito have been intensively scrutinized by the best people our industry has to offer. Complete and thorough studies have been made on the areas in question, so it's time for a decision, time for calling it one way or the other, and it's up to you three Commissioners to weigh the evidence and to reach your conclusions in accordance with the laws of this state.

Actually, this is where we incompetent lawyers come into the picture. And incompetent we are perceived because, as my father, who happens to be an engineer, has told me more than once, noting offends him more than to pay the damned lawyers their ungodly hourly rates trying to educate them about things they're incapable of comprehending.

Be that as it may, our democratic form of government has provided laws and a judicial process where the interpretation and enforcement of those laws take place and that is the lawyer's game.

That is also why our dispute is before you three gentlemen who are empowered and whose duty it is to prevent waste and protect correlative rights. So you all must do your best.

Where do we begin? Section 70-2-3 of the New Mexico statutes states that the term underground waste embraces: "the inefficient, excessive or improper use or dissipation of the reservoir energy, including gas energy and water drive, of any pool, and the locating, spacing, drilling, equipping, operating or producing, of any well or wells in a manner to reduce or tend to reduce the total quantity of crude petroleum oil or natural gas ultimately recovered from the pool..."

The Oil Conservation Commission Rules

and Regulations define correlative rights to mean: "the opportunity afforded as far as practicable to do so, to the owner of each property in a pool to produce without waste his just and equitable share of the oil or gas, or both, in the pool, being an amount, so far as can be practically determined, and so far as can be practically obtained, without waste, substantially in the proportion that the quantity of recoverable oil or gas, or both, under such property bears to the total recoverable oil or gas, or both, in the pool, and for such purpose to use his just and equitable share of the reservoir energy."

In a word, correlative rights means the opportunity to drill and compete with for the hydrocarbons available without causing waste.

Your task is to now examine the evidence and apply the law. As Mr. Greer stated, there are some things that we agree on.

We agree that the Gavilan Pool is in direct communication with the expansion area. We strongly disagree, however, that the expansion area is in effective communication with the West Puerto Chiquito Pressure Maintenance Project.

We also agree, or at least Dr. Lee testified, that if the Gavilan Mancos is solely a solution gas drove reservoir, it is then not rate sensitive, and that if Gavilan has matrix, that matrix contribution might be an explanation for observing lower gas/oil ratios at higher producing oil rates.

We both disagree on the significance of matrix contribution, however, and its contribution to ultimate recovery. The Proponents believe that the matrix is a significant contributor of oil production to the fracture systems and the most efficient way to produce the matrix is to produce the wells at capacity, creating as large a pressure differential as possible between the fractures and the matrix system. This minimizes the imbibition effects in the reservoir, which at restricted producing rates, causes waste. As John Roe said yesterday, "once you get the oil moving, you better keep it moving." And we totally agree with that testimony.

I might again divert from my script, but imbibition is a new thought for me but I know it's not for my wife, because she's accused me on more than one occasion when we're at a cocktail party that I seem to suck up everything in sight like a sponge and I know it's harder than hell to get me to expel it.

There may be disagreement, but there is no denying on any account, that during the test periods performed at the Commission's direction since July of 1987, when the reservoir was produced at normal allowables and then restricted allowables, that oil was produced more efficiently at normal allowables as witnessed by the observed lower gas/oil ratios in the pool.

Another area of disagreement is whether there exists an effective permeability barrier separating the two pools and whether it lies two sections east of the present Gavilan boundary.

Our evidence has indeed shown that there exists an effective barrier separating the expansion area and the pressure maintenance project. The Proponents have strong evidence to support their position.

First, we have the 25 year interference test, Exhibit Twenty, that Mr. Douglass referred to, which shows that Gavilan on first discovery came in at virgin pressures, although West Puerto Chiquito had been producing by then for 20 years and had experienced a pressure decline that did not affect Gavilan.

Conversely, the substantial Gavilan and expansion area production over the past six years has not affected the production from the West Puerto Chiquito Pressure Maintenance Area.

Also the Commission ordered interference tests have provided additional proof that no effective pressure communication exists across the barrier. Actually, as Dr. Kohlhaas explained, the correct Horner plot analysis of the interference tests conducted across the barrier by BMG confirms the existence of the barrier and its approximate location.

Moreover, Mr. Max Powell presented isobaric pressure maps showing the distribution of the pressure gradients in both pools for three separate time periods, and that testimony has not been refuted with hard facts.

Second, reason for supporting this is that there really has never been much disagreement about the permeability pinch out in the trough separating the West Puerto Chiquito monocline from the Gavilan Dome until recently when Mr. Greer sought gas injection credits for the expansion area wells.

However, yesterday Mr. Roe testified that this part of the reservoir is not high in transmissibility and Mr. Greer also yesterday referred to it as "fuzzy boundary" where there exists a "change in permeability." Also, as I also mentioned in my opening statement, this very Commission on June 8th, 1987, in Case 8950, Order R-6469-D, found that by Finding (5), "the evidence shows that there is limited pressure communication between the two designated pools and that there are two weakly connected areas separated by some restriction at or near the common boundary of the two pools."

Mesa Grande believes that the pool boundary should be moved to reflect the true boundary separating the two pools because again by Commission definition, "pool means any underground reservoir containing a common accumulation of crude petroleum oil or natural gas or both... pool is synonymous with common source of supply." Under any circumstance, the expansion area must be treated identically as the rest of the Gavilan under the rules adopted by the Commission.

Turning to the second matter the Commission must address, namely the protection of correlative rights, there again should be no disagreement on what it means, but there is sharp disagreement on who is doing what to whom.

It has been inferred by the Opponents that Mallon superstar wells have a formidable advantage over other wells in the area. However, the facts of the matter are the first five highest ranked superstar wells are operated by BMG in the expansion area and BMG and Sun operate 11 of the 18 superstar wells compared to Mallon's 3. If drainage is occurring, then it is clear that the expansion area is draining the heart of Gavilan. Restricted rates substantially benefit expansion area wells, a clear violation of correlative rights, which will be clearly exacerbated if injection credits are allowed.

One thing is clear, however, and that is that the issue of correlative rights disappears if the expansion area is included or treated the same as Gavilan and if capacity allowables are instituted, or at least allowables no less than the statewide allowables.

The Commission should bear in mind that there are many pools in the state that enjoy allowables much higher than the statewide rules call for, but we know of none except Gavilan that suffer from restricted allowables.

Finally, I come to the last item on which there is very strong disagreement, and that is the issue of unitization. The opposition has supported unitization since day one and still does. Mr. Kellahin said in his opening comments that untiization is the appropriate solution. Mesa Grande strongly disagrees, and why?

Mesa Grande believes the only reason that makes sense for forming a unit is to provide a mechanism for efficiently and economically recovering more oil from secondary recovery operations as required by State law.

As I have stated, because we are convinced that Gavilan together with the expansion area is a fractured, dual porosity, solution gas driven reservoir we have concluded that gas injection for pressure maintenance won't work but, in fact, will inhibit ultimate recoveries from the pool from primary operations.

Moreover, as both Mr. Elkins and Mr. Powell testified, comparable fractured reservoirs have proved to be very poor candidates for secondary recovery operations whether through gas injection or waterflood operations.

I fervently hope the Commission will see these cases the way the Proponents do and find, as Mr. Hueni stated, "We're not wrong." I believe the evidence is overwhelmingly in our favor and that the ad hoc committee composed of the Gavilan proponents by their present unanimity, sees it the way it is. Please don't let the 243 barrel per day tail continue to wag the dog that can produce 6,000 barrels per day.

As I stated in my opening, these hearings will have an irreparable and irreversible effect on Gavilan's future.

These cases also have represented one of my very best professional experiences and have for the most part been a great deal of fun since my oil and money are not at risk, and I thank all concerned.

MR. LEMAY: Thank you, Mr. Lopez.

MR. BUETTNER: Thank you. I had eight minutes, I've cut out about half.

Mr. Chairman, members of the Commission, distinguished Professor Elkins, ladies and gentlemen.

I'm Bob Buettner. I'm General Counsel and Secretary of Koch Exploration Company.

Koch, as you know, is a wholly owned subsidiary of Koch Industries of Wichita, Kansas. Koch Industries is the largest privately owned oil company in the United States. If we were publicly owned, we'd rank between 15 and 18 on the Fortune 500 with revenues in the range of $17-billion annually.

We have available to us, thus, huge capital resources and fairly large experience in the oil business generally. We've invested, perhaps, $100-million in feasible enhanced recovery projects, both conventional and exotic, in the last few years.

I can't begin to improve on the summaries of the Proponents' overwhelming evidence that Mr. Pearce has made for Mobil; that Mr. Lund has made for Amoco; that Mr. Lopez has made for Mesa Grande; further, that Mr. Douglass has made for all of us.

I know at this stage that promises of brevity are laughable, but I'll make a comment on regulatory policy and I'm going to try to take one more stab at an analogy on the part of the physical process that -- that's been difficult for me to grasp and I am still not sure that Mr. Humphries is comfortable with it, as I am not.

The idea that you can't cure this problem of reimbibition by injecting gas into a fractured reservoir, the best analogy I could think of that the engineers would agree was correct was if I blow into a balloon hard enough to blow out a candle, I'll push out the sides of the balloon because the air can't go anywhere else, but if I hold that balloon out in a wind that's strong enough to blow out a bonfire, I won't inflate the balloon, and that's because the wind just whistles right on around it, takes the path of least resistance.

The original gas in the matrix or the hairline fractures or whatever, the smaller, tighter spaces, can go no place but out to the big fractures and that pushed oil ahead of it.

The injected gas just whistles like the wind through the fractures and around the matrix. The actual results received from the physical processes in the reservoir, we're seeing 300 barrel a day wells that are plummeting to 3 barrel a day abandonment levels and all the oil is being sucked back into the rock forever.

These rates are not only killing this field and the smaller businesses that live by it, but if they're continued, they're going to kill the confidence of responsible operators in New Mexico regulatory policies.

Finally, a word on history and regulatory policies, the industry learned the hard way 30 to 40 years ago that gas injection into fractured reservoirs is a disastrous mistake.

Chairman Lemay asked if it worked anywhere in the world. With an auditorium full of experts on fractured reservoirs, the closest we could come is Mr. Greer's (unclear) example, which is a nonfractured limestone with a water drive and any number of other non-analogous conditions.

It doesn't work and the people who have to pay for it know better than to try and that's why you can't find examples.

Now, 25 years ago the predecessors to this Commission allowed Mr. Greer to try to disprove that lesson for the noble purposes of conservation. For 20 years the experiment continued without affecting others in the industry.

Since the early eighties this Commission and its predecessors have continue to protect the experiment to the concern and later to the injury of others and to the state itself, but again in the name of a noble cause.

Now it seems some want to hold primary recovery hostage until the Proponents agree to try the experiment again.

It's time to end the indulgence, declare the experiment was noble, but declare enough. Gas injection in fractured reservoirs was waste in 1950, it is waste today, and it will be waste tomorrow.

High rates will maximize the ultimate recovery; low rates jeopardize it. This Commission should not risk primary recovery in the vain hope of forcing another doomed experiment.

Those who do not learn from history are condemned to repeat it. That thought is attributed to the philosopher Santana. That name sounds New Mexican. I think that thought certainly should be.

Thank you.

MR. LEMAY: Thank you, Mr. Buettner.

Additional comments in the case?

Statements?

I want to thank everyone for

the professional manner in which this week has been conducted, including the lawyers and the expert witnesses. It's been a fun week.

We'll take this case under advisement. Thank you.

(Hearing concluded.)

C E R T I F I C A T E

I, SALLY W. BOYD, C.S.R., DO HEREBY CERTIFY the foregoing Transcript of Hearing before the Oil Conservation Commission was reported by me; that the said transcript, contained on pages 991 through 1245, inclusive, is a full, true and correct record of this portion of the hearing, prepared by me to the best of my ability.

Sally W. Boyd CSR