

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 CASES
in Cases Nos. 7980, 8946, 8950, 7980, 8946,
9111 and 9412. 8950, 9111,
9412.

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

TRANSCRIPT OF HEARING

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I N D E X Cont'd

BETSY LOUGH

Direct Examination by Mr. Lund	992
Cross Examination by Mr. Kellahin	1006
Cross Examination by Mr. Carr	1009
Questions by Mr. Chavez	1012
Questions by Mr. Brostuen	1014
Questions by Mr. Lemay	1014

CLOSING ARGUMENT BY MR. LUND	1018
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A. R. GREER (Recalled and Continued)

Direct Examination by Mr. Carr	1030
Cross Examination by Mr. Kellahin	1095
Cross Examination by Mr. Douglass	1100
Questions by Mr. Chavez	1145
Questions by Mr. Brostuen	1146
Questions by Mr. Humphries	1152
Questions by Mr. Lemay	1160
Questions by Mr. Chavez	1167
Redirect Examination by Mr. Carr	1168
Recross Examination by Mr. Douglass	1170

I N D E X Cont'd

GREG D. HUENI (Recalled)	1174
Questions by Mr. Humphries	
BILL WEISS (Recalled)	
Questions by Mr. Lemay	1186
Questions by Mr. Humphries	1189
CLOSING ARGUMENT BY MR. KELLAHIN	1193
CLOSING ARGUMENT BY MR. CARR	1204
CLOSING ARGUMENT BY MR. DOUGLASS	1212
CLOSING ARGUMENT BY MR. PEARCE	1223
CLOSING ARGUMENT BY MR. LOPEZ	1231
CLOSING ARGUMENT BY MR. BUETTNER	1241

E X H I B I T S Cont'd

Amoco Exhibit One	994
BMG Exhibit Seven B, Readjustment	1030
BMG Exhibit Eleven, Fractures	1034
BMG Exhibit One, Green Book	1035
BMG Exhibit Twelve, Fisher Federal	1051
BMG Exhibit Two, Tan Book	1055

E X H I B I T S Cont'd

Proponents Exhibit Fifty Four A, Pressure Data	1124
Proponents Exhibit Fifty Five, List	1136
Proponents Exhibit Fifty Six, List	1138

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

5
6 MR. LEMAY: The meeting will
7 come to order.

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

15 MR. LUND: Thank you Mr.
16 Lemay.

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

19
20 (Witness sworn.)

21 MR. LUND: Thank you, Mr.
22 Chairman, and I thank the participants for letting us go
23 out of order.
24
25

1 BETSY LOUGH,
2 being called as a witness and being duly sworn upon her
3 oath, testified as follows, to-wit:
4

5 DIRECT EXAMINATION

6 BY MR. LUND:

7 Q Would you please state your name?

8 A Yes. My name is Betsy Lough.

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

11 A Yes, I am.

12 Q Briefly state your educational back-
13 ground from college on.

14 A Okay. I graduated from Stanford Univer-
15 sity in 1980 with a Bachelor of Science degree in petroleum
16 engineering.

17 Q And briefly what was your work exper-
18 ience since graduation?

19 A I worked in one of Amoco's District
20 Offices in Colorado for two years, 1980 to 1982. My pri-
21 mary responsibilities were with well completions and evalu-
22 ating wells for workovers.

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

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

1 Denver Region Office. My responsibility there was evalu-
2 ating secondary recovery projects, projects that were both
3 operated by Amoco and projects in which Amoco had a work-
4 ing interest. These included waterflood, secondary gas in-
5 jection projects, and CO₂ floods.

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

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

11 Q And then '85 to '86?

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

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

18 A '86 to '87 I performed another reservoir
19 simulation study on a dry gas field in southeastern Okla-
20 homa.

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

23 A I've been working this area since May of
24 1987, performing a reservoir simulation in the Northeast
25 Ojito Area, as well as reviewing the general operations in

1 the Gavilan Mancos Pool.

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

5 A Yes, I have.

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

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

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

16 Would you please turn to --

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

19 MR. LUND: Oh, I'm sorry.

20 MR. LEMAY: That's fine.

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

23 MR. LEMAY: Her qualifications
24 are accepted.

25 MR. LUND: Thank you.

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

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

4 Q Oh, I'm sorry.

5 A Thank you.

6 Q I'm sorry.

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

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

14 A Okay, the Gavilan Mancos Area, I've in-
15 cluded here the Gavilan Mancos Pool and also the wells in
16 the proposed expansion area.

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

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

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

25 A Yes. The Bear Canyon Unit, we measured

1 the initial reservoir pressure there in November of 1987 in
2 the C Zone using a pressure bomb corrected to the -- to the
3 datum of 370 feet is 952 psi.

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

5 A Yes, that's correct.

6 Q Then go on to the Gavilan Mancos.

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

10 Q Okay.

11 A The Canada Ojitos Unit pressure mainte-
12 nance initial pressure, 1890 psi in September of '62 and
13 again that's taken from Hueni's Exhibit Twenty.

14 Q Next is the bubble point pressure.

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

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

24 A Yes, that's correct.

25 Q Next the Gavilan pressure.

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

4 Q Was that from Mr. Bush's testimony?

5 A Yes. Yes, that's correct.

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

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

10 Q How about the bubble point pressure for
11 Canada Ojitos?

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

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

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

20 Q The Gavilan?

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

24 For the Canada Ojitos Pressure Mainte-
25 nance area the pressure as of February, '88, 1400 psi,

1 again from Mr. Hueni's Exhibit Twenty.

2 Q Then we go to the current field
3 producing GOR.

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

8 Q Is that from the May of '88 production?

9 A Yes, that's correct.

10 Q Gavilan Mancos?

11 A The current producing field GOR, 4000
12 standard cubic feet per barrel. That would be in March of
13 '88 and that's taken from the -- some production data that
14 was put together in the course of Mr. Hueni's study of the
15 area, of which Amoco was a participant.

16 Q And finally Canada Ojitos Unit.

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

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

25 A Yes, that's correct.

Q All right. Let's go next to the cur-
age per well oil rate.

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

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 well, that's per producing well, again taken
data compiled in the course of Mr. Hueni's study.

And then 40 barrels of oil per day in
pressure Maintenance Area.

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

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

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

The Gavilan Mancos Area, those wells are

1 primarily being produced from the A and B Zones, and the
2 Canada Ojitos Pressure Maintenance Area wells primarily
3 produce from the C Zone.

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

7 A Yes, that's correct.

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

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

16 Q Now, were you present when Mr. Roe tes-
17 tified that in his opinion there was communication between
18 Bear Canyon Unit and the Gavilan Mancos Area?

19 A Yes, I was.

20 Q Do you have an opinion about that?

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

1 that there is other data that's shown here on our exhibit
2 that indicates that there are some significant differ-
3 ences in the Bear Canyon Unit compared to the Gavilan
4 Mancos Area.

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

7 A Yes.

8 Q What about well producing information?

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

12 The Amoco operated Siefert Well --

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

15 A The Siefert Well is located in Section
16 22 of 2 West, 26 North.

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

19 A Yes.

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

23 A Yes, that's right.

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

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

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

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

14 Q And finally the Tapacitos Well.

15 A Yes. The Tapacitos No. 2 Well has a
16 cumulative production of about 31,000 barrels of oil. In
17 1987 it averaged about 11 barrels of oil per day and for
18 the first three months of 1988 it's averaged about 4 bar-
19 rels of oil per day.

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

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

1 A Yes, that's right.

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

5 Were you present for that testimony?

6 A Yes, I was.

7 Q Do you have an opinion on that question?

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

13 Q Do you see any evidence on the informa-
14 tion you've studied to date that the Bear Canyon Unit and
15 the Canada Ojitos Unit are in communication?

16 A No, I don't believe they are.

17 Q What's the basis of that opinion?

18 A The basis for that, first of all, is the
19 difference in current pressure in the Bear Canyon Unit com-
20 pared to the Canada Ojitos Unit. That's a difference of
21 about 500 psi.

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

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

25 Q Okay. That -- is your primary conclu-

1 sion that there's no communication between Bear Canyon and
2 Canada Ojitos the pressure difference?

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

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

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

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

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

22 We took the core out of the -- out of
23 the tubes and put the core in the black light and the core
24 did fluoresce, which indicated the presence of hydrocar-
25 bon. We saw the hydrocarbon -- we saw the fluorescence

1 both on the fracture faces as well as on the matrix itself.

2 Q Did you examine thin sections also?

3 A Yes, we've had some thin sections pre-
4 pared from the Bear Canyon Unit core in which you can also
5 see the fluorescing hydrocarbons in the matrix.

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

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

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

17 A Yes, I was.

18 Q Do you agree with that?

19 A Yes, I do.

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

22 MR. LEMAY: Thank you, Mr.
23 Lund.

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

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

3 Were you going to be a Pro-
4 ponent and ask questions on this, Mr. Douglass?

5 MR. DOUGLASS: No questions.

6 MR. LEMAY: Anyone else in the
7 Proponents side?

8 Mr. Carr, do you have some
9 questions?

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

12 MR. LEMAY: Mr. Kellahin,
13 please proceed.

14

15 CROSS EXAMINATION

16 BY MR. KELLAHIN:

17 Q Your last name is Lough?

18 A Yes, that's correct.

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

23 A Not necessarily. As I stated, the ini-
24 tial pressure we saw in the Bear Canyon Unit was lower than
25 we expected but the only reason we had expected a higher

1 pressure was because of the pressures we had seen re-
2 corded from the -- from the areas around the Bear Canyon
3 Unit.

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

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

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

16 A Yes.

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

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

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

24 A Yes.

25 Q And when we look at the last column to

1 the right, the Canada Ojitos Unit, that pressure number,
2 the 1400, that does not include the pressures taken out of
3 the expansion area?

4 A Yes, sir, that is correct.

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

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

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

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

17 Q And have you conversely taken the Gavi-
18 lan Mancos Area pressure, the 825 pounds and calculated
19 what that pressure is when you take the expansion pressures
20 out of that number?

21 A No, I haven't.

22 MR. KELLAHIN: Thank you.

23 MR. LEMAY: Mr. Carr.
24
25

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

1 that was in the well had been sitting there for quite
2 awhile. We purged the tubulars of that fluid to allow
3 fresh fluid to enter the wellbore. We did shut in the well
4 to allow these pressures to stabilize and then we took our
5 fluid sample.

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

8 A I don't recall that number.

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

11 A Yes, it would.

12 Q You did a core analysis that you talked
13 about?

14 A Yes.

15 Q Now what well was that?

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

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

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

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

25 MR. CARR: Thank you, very

1 much.

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

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

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

10 Q Do you have photographs of the core?

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

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

16 A All photographs or the thin sections or
17 --

18 Q Yes, all of the thin sections?

19 A Yes, I will.

20 Q Do you have a written analysis or sum-
21 mary of how that well was actually conditioned prior to
22 taking the sample?

23 A Prior to the fluid sample?

24 Q Yes.

25 A I would -- I would think that there

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

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

5 A Okay.

6 MR. CARR: That's all I have.

7 MR. LEMAY: Additional ques-
8 tions of the witness?

9 Mr. Chavez.

10
11 QUESTIONS BY MR. CHAVEZ:

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

14 A Higher than what we saw.

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

21 A Yes, I have done that.

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

25 Never mind that question. Let me ask

1 another instead.

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

4 A Yes.

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

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

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

16 A The C Zone?

17 Q Yes.

18 A Yes, absolutely.

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

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

24 Q Thank you.

25 MR. LEMAY: Additional ques-

1 tions of the witness?

2 MR. BROSTUEN: I only have one
3 for clarification.

4 MR. LEMAY: Mr. Brostuen.

5
6 QUESTIONS BY MR. BROSTUEN:

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

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

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

14
15 QUESTIONS BY MR LEMAY:

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

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

7 We have to --

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

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

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

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

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

12 A Yes.

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

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

24 Q Okay. So it would be your conclusions
25 that you would not expect zones to the south to communicate

1 through the these -- because they'd have to have a wide
2 zone of fractures -- through three marginal wells to draw
3 on areas that are beyond that, those three marginal wells.

4 A Yes.

5 Q Thank you.

6 MR. LEMAY: Additional ques-
7 tions? If not, you may be excused. Thank you very much.

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

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

14 MR. LEMAY: Appreciate that.

15 MR. LUND: Be happy to.

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

19 MR. LEMAY: Yes.

20 MR. DOUGLASS; -- from BMG?

21 MR. LEMAY: Yes.

22 MR. DOUGLASS: Have those been
23 furnished yet?

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

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

5 MR. CARR; I have no objec-
6 tion.

7 MR. LEMAY: Carry on, Mr.
8 Lund.

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

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

23 Mr. Carr was a little less
24 strident and said that his intention is not to violate any-
25 body's correlative rights and his intention is to show that

1 Mr. Greer's pressure maintenance project needs to be pro-
2 tected and he's going to show how the pressure maintenance
3 project is working and why, and, of course, their evidence
4 would be that there's no barrier here.

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

19 One is, is there matrix con-
20 tribution or is this a dual porosity system over in Gavi-
21 lan, and the second major issue is, is there an effective
22 barrier here as the proponents have drawn?

23 And I think that's a good way
24 to look at it and I think we have to focus on the evidence
25 of those two big areas and I'm sure that the others will

1 talk more about the evidence and there's going to be re-
2 buttal and there's going to be some very interesting
3 squabbling and I hate to miss it, but the first -- it seems
4 to me if we look at the first issue, is there dual porosity
5 and matrix contribution, what is the major evidence, and I
6 sat down with my engineer and tried to figure out what's
7 important for you to consider as a Commission.

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

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

20 Next is the core data and this
21 is some of the hard data that Mr. Kellahin invited us to
22 review, and the core data from the Mallon Davis Federal
23 315 took fluid into the matrix which their geologist on
24 this panel, my geologist told me that that's significant
25 and that's something that you should consider and in addi-

1 tion, prior testimony, Mr. Faulhaber testified about the
2 televiewer information that showed intense fracturing from
3 that data.

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

8 Next the evidence of Mr. Hueni
9 is that Mr. Greer's pressure maintenance project has the
10 lowest and slowest production per acre of any fractured
11 matrix field, and it's the only one that is engaged in se-
12 condary recovery operations for any extensive period of
13 time.

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

22 And again, our evidence is
23 quite to the contrary.

24 The next piece of evidence
25 that's significant is the Bergerson model study, which when

1 they're matching actual observed field performance they had
2 to have a dual porosity system, which is also persuasive.

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

6 Now, in the 1987 hearings one
7 of Amoco's petrologists, a man named John Thomas, wrote a
8 letter dated March 30, 1987, that was included in the Ber-
9 gerson exhibits and that indicated, I thought, quite suc-
10 cinctly, what's going on here and I'd like to read just a
11 little bit of it.

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

17 And what he said is based on
18 his continuing studies of Gallup cores, bit sections, core
19 analyses, and xray distraction data, he believes that there
20 are three components contributing to the pore network in
21 the subject pools, and they are, number one, pore space
22 within and around sand grains; number two, abundant tiny
23 hairlike fractures that cut across and parallel layering in
24 the Gallup zones; and three, large scale fractures that cut
25 across multiple beds of rock. And he said that the discon-

1 tinuous nature of types one and two cores are intercon-
2 nected with the larger fractures.

3 And he goes on and talks about
4 the tiny, delicate microfractures and and he says that the
5 microfractures have been well documented in Gallup and
6 Mancos intervals by means of this fluorescent examination
7 and have been recorded by Terra Tech, and additional micro-
8 fracturing evidence is gained -- has been gained by study-
9 ing continuous cores, both wet and dry.

10 And so when we talk about this
11 chicken wire thing, and that's what he references in this
12 letter, he says that because of the fineness of the frac-
13 ture spacing and the "chicken wire" interpenetration of the
14 fractures, this type of porosity is significant as a matrix
15 component in the zones.

16 And then he concludes his let-
17 ter by saying that his observations are based on a number
18 of pieces of data.

19 Number one, the Amoco Jicaril-
20 la Apache 118 No. 14 cores and cores analyses, and that's
21 near the Ojito Gallup Pool; the Mallon Davis Federal 315
22 Well, which is in the Gallup, excuse me, the Gavilan; and
23 the Mobil Lindrith B-38 Well, which is also in the Gallup,
24 and he also said that he used to be a consultant for
25 geology and engineering and he saw similar evidence of this

1 system in other San Juan Basin wells.

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

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

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

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

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

24 The interference testing
25 across the barrier, I realize there's going to be more evi-

1 dence on that, but we thought that Dr. Kohlhaas' testimony
2 was excellent. There were no, as we would say, points made
3 on cross examination.

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

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

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

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

23 Mr. Hueni testified that there
24 is lost oil forever because they didn't produce in the
25 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.

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

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

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

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

18 It's still analogous because
19 it shows that secondary recovery by gas injection won't
20 work. It's kind of hard, Dr. Lee testified about the over-
21 injection but he assumed that it only went straight to the
22 west, but he didn't assume that it went any place else.
23 That's hard to buy, and perhaps even most telling is Chair-
24 man Lemay asked Dr. Lee, well can you give us an example of
25 another fractured reservoir where secondary recovery has

1 been effective? And what Dr. Lee's response was, I think,
2 was, (not clearly understood.)

3 I'm just about done. We
4 caught a lot of heat from the Proponents I can remember a
5 couple of years ago. We wrote a letter and it said, gee,
6 we've heard both sides of the case and both sides are
7 technically competent and if you on the Commission are
8 going to err, you've got err on the side of preventing
9 waste, and we got in trouble with the Proponents. We
10 thought that there was some more study needed and we think
11 you did the right thing by ordering the study and we think
12 now that the data is in and the hard facts are in, that the
13 Proponents are correct, and what that leads us to believe
14 is that, you know, Mr. Humphries talked about correlative
15 rights, what does that mean? It's the opportunity, the
16 fair opportunity to produce your fair share. It's not an
17 equalization, you know, just because you have a poor well
18 doesn't mean you get a piece of the good well just because
19 of correlative rights. That's not the way it works. It's
20 an opportunity and the only difference we have at Amoco is
21 that we'd recommend that the statewide allowables, Rule 505
22 and Rule 506, and we've been chided that apparently 505
23 doesn't apply to spacing over 160. Well, if that's true, I
24 assume the Commission won't worry about statewide allow-
25 ables for more than 160-acre spacing, but we think that

1 particularly the gas/oil ratios should be 2000, just for
2 general reasons more than anything else. We think that you
3 shouldn't allow the original energy to escape that much.
4 That's the only difference.

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

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

23 MR. LEMAY: Thank you, Mr.
24 Lund.

25 We can resume now with the

1 testimony of Mr. Greer. Thank you, gentlemen, for accom-
2 modating Mr. Lund.

3
4 A. R. GREER

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

7
8 DIRECT EXAMINATION CONTINUED

9 BY MR. CARR:

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

13 A That's a fair statement.

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

16 A Yes, sir, I have.

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

19 A It does.

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

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

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

1 Q Go ahead.

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

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

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

20 Q And your conclusion from this exhibit
21 that this is evidence of migration not dual porosity is un-
22 changed.

23 A Right.

24 Q Would you -- before we go to Exhibit
25 Eleven, I believe it would be fair to say that in the

1 course of the hearing we've seen the different results that
2 have been obtained when build-up tests are used as opposed
3 to the information obtained through interference testing.

4 Do you understand why this is?

5 A Yes.

6 Q Would you review that?

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

15 That just doesn't work for West Puerto
16 Chiquito and the reason we just touched on briefly yester-
17 day is that the reservoir comprises a system of fractured
18 blocks and the blocks on the order of 10 to maybe 80 acres,
19 perhaps some of them larger than that, and taking a build-
20 up test, all that the test would show is the characteris-
21 tics of that one small block, so if it's 10 acres that's
22 all it shows. If it's 2 or 3 acres that's all the charac-
23 teristics you get, and along with that, being so small it
24 tends to, characteristics tend to be well covered up such
25 that you can't really tell what they are. You can postu-

1 late them, and I discovered this first by observing the
2 pressure build-up test and drawdown test and there's just
3 no question that this concept is how the reservoir is made
4 up. It cannot be any other way. When a well builds up
5 over a short period of time and levels off, no longer
6 continues to build, I'm speaking now of hours, then it just
7 has to be representative of the boundary condition and that
8 boundary can be either a closed reservoir, or a small re-
9 servoir, or it's a reservoir with constant pressure at
10 the boundary. Now you can tell which that is simply by
11 running a drawdown test, pressure drop down and level off
12 and if the well continues to produce and produce and pro-
13 duce, and the working pressure doesn't draw down, then
14 there's a positive pressure at the boundary and it's being
15 supplied from somewhere else. In this instance being
16 supplied by the high capacity fracture system surrounding
17 these little tight blocks, and twenty years after we dis-
18 covered this and had a survey made, a geologic survey, and
19 confirmed, sure enough they found evidence on the surface
20 of these fractured blocks, and in addition we ran an
21 electromagnetic survey and it showed the same thing, ex-
22 cept more fractured blocks, and we ran another one in the
23 area of B-6 and sure enough, it showed a lot of fractured
24 blocks and there we got a good well. We ran one in the
25 area of the P31 and didn't find any fractured blocks and we

1 have a very poor well there. So we believe there is some
2 consistency in our earlier -- in support of our earlier
3 conclusions in a geologic sense as well as an engineering
4 sense.

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

7 Q And that's what's marked as Benson-
8 Montin-Greer Exhibit Number Eleven It was entered in Case
9 9111 and it is a tan plat of fractures.

10 A The E-6 Well is in Section 6, 25 North,
11 1 West, on the lefthand side of the plat up to the top and
12 these fractures can be seen on this plat and we think that
13 the reflection on the surface of these fracture remnants is
14 probably -- represents only a small part of what's there.
15 There's probably even more than these, but to understand
16 this reservoir now and how it works, when I say "this
17 reservoir" I'm speaking particularly of Canada Ojitos, we
18 found, well, we could only determine the real average
19 reservoir characteristics through interference tests, no
20 way we could do it through individual build-up tests be-
21 cause they got too small an area, and the tests of the
22 small tight blocks would show low, low transmissibility and
23 yet the interference tests of a large area shows high
24 transmissibility and in my view the interference tests
25 covered several thousands of acres, to quote Mr. Douglass,

1 and so get a sampling of the reservoir over a very large
2 area and that's how we first determined that had adequate
3 transmissibility and gravity drainage and when we put that
4 into the classic equation we find that yes, indeed, we do
5 have gravity drainage on the order of the figure we dis-
6 cussed yesterday, and I'd like to review briefly, as
7 briefly as we can, how we analyze and know that we've got
8 these tight blocks, or at least short dimensions from the
9 well -- from a well to the fracture system.

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

13 A Yes, sir.

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

16 Q Mr. Greer, would you identify the infor-
17 mation contained behind Tabs A and B of this exhibit?

18 A Yes, sir. Under Tab A is just an intro-
19 duction that explains generally what we've just discussed.
20 I might say how I describe or how I initially analyzed
21 these before a type curve became available. It's clear we
22 were dealing with a small -- a small reservoir with con-
23 stant pressure at the boundary but perhaps the best way to
24 describe those, if I had some sort of an idea of the effec-
25 tive wellbore radius, and can use those classic equations.

1 Well, that gets a little bit involved
2 but I found that I could use an effective wellbore volume
3 and I could approximate that from the results of a frac
4 treatment and from that, when I'd use the classic equa-
5 tion, why I could arrive at an approximation of the size of
6 the block.

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

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

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

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

22 A Tab C just shows a type curve of a pres-
23 sure build-up in a well in which the pressure is shown on
24 coordinate scales vertically against log time horizontally,
25 and the thing I'd like to point out on this first plat is a

1 hodgepodge of phases and effects in early time of what had
2 occurred; very difficult to analyze just what's going on
3 here in the early, so-called early time.

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

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

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

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

21 Both of these curves, one with wellbore
22 storage and one without, we see the increased slope which
23 is characteristic of dual porosity. If the slope picks up,
24 steepens, sometimes it can come back and parallel the first
25 slope, but without that first (unclear) of the line that

1 steepens towards the curve, it does not reflect dual
2 porosity. We've found another fact. None of the wells we
3 tested showed this kind of a general shape.

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

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

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

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

25 If the plotted points fall above the

1 plotted points fall above the line for infinite condi-
2 tions, then we have a closed reservoir.

3 And looking down at the lower graph if
4 all the points fall below the line for infinite conditions,
5 then we're dealing with a constant pressure at the bound-
6 ary.

7 So here, although the curve on a semilog
8 plot will have the same shape, we find now that we can plot
9 differences in pressures and we find that one reservoir
10 will behave one way and one another, so now we can distin-
11 guish between them.

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

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

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

24 Even so, with the sensitive pressure
25 bombs we have now it's possible to analyze this area,

1 whereas earlier engineers were hesitant to do it.

2 This is the area that Dr. Lee and I ana-
3 lyzed in our report to the Commission a year ago in March
4 and we showed, as I recall, 12 or 15 darcy feet. Our ob-
5 servation said that you had to analyze the slope along the
6 shaded area and we got substantially lower transmissibi-
7 lity.

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

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

13 Q And this is a typical build-up curve?

14 A For West Puerto Chiquito, that's right.

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

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

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

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

24 And then if we go to the Plate II, the
25 upper righthand plate, this is the same well with build-up

1 pressure taken at a later time when the relative permea-
2 bility is dropping off and you get a steeper slope now. or
3 the B slope is steeper.

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

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

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

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

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

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

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

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

21 Now, the first approximation that we
22 would make would be from the formula shown on this graph
23 and from the semi-log plot. Now, to prove the information,
24 we used, rather than differences in pressure, which you can
25 use, but more accurately it's best to use a difference in

1 squares of pressures, and better still is to use difference
2 in squares of the pseudo steady state pressure to take into
3 account some of the other possible errors, which we did
4 that, and in 1980 we reported what we found in the 1969
5 test to the Department of Interior hearing at that time.

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

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

22 Now the type curves that came out in
23 1978 in the technical literature was the connection on how
24 to use type curves for concentration value. We can find
25 these type curves themselves, but by taking the report of

1 the calculated interval and calculation made on type curves
2 and we included them here in this book in case anybody else
3 might want to deal with constant pressure at the boundary;
4 save them the exercise of going through the calculations.

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

15 Now, what I've done, which incidentally,
16 here's another little mistake, on the calculations in the
17 center of the sheet it says m equals some numbers equals
18 some more numbers times 1.25 and there should be a times
19 10^6 after that and then it should be 1.07 times 10^6 .
20 That's the trouble in using these formulas.

21 I like to see a plot of this on the
22 semi-log scale also, but first I would point out that the
23 pressure points, the circles on the bottom lefthand side,
24 pretty well fit the fairly straight line on the early part
25 of the graph coming up to the point that says "end of

1 period of linear flow". Now that's the period during the
2 time of the test that we believe that oil or gas is flowing
3 into the fracture and that's the induced fracture that we
4 induced with the fracture treatment, and that's a linear
5 flow; that's not a radial flow as we ordinarily consider
6 otherwise around the wells.

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

14 Then we take this information, I don't
15 make the calculation here, I just take this information and
16 from that derive the dimensionless pressure whereby I can
17 make the semi-log plot, and we do that with the calcula-
18 tions shown next. In terms of the green sheets, I'll just
19 take a minute to talk about why we use these pseudo pres-
20 sures.

21 In the flow of gas to a well from --
22 from the outer reaches of the drainage area to the well,
23 pressure will change and when the pressure changes the gas
24 viscosity changes and the gas deviation factor change, and
25 ordinarily, to simplify it, we just take an average and

1 say, well, this is approximately it, and go with that.

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

13 Then the interbedded characteristics are
14 shown on the bottom plate and, incidentally, in the repro-
15 duction process we missed changing the 10^6 again. Here it
16 should be times 10^6 at the bottom of that.

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

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

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

14 The calculations are shown on the yellow
15 sheet following.

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

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

25 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 x_e/x_f (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 $x_e/x_f = 1$.

I believe I properly prepared the calculations otherwise, then at the bottom on the lower lefthand side where it says $x^2 = .37 \times 9760 = 360/\text{porosity feet}$, 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 270.

Instead of 200 it should be 600.

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

3 Instead of .3 it should be 3.3.

4 Instead of 7 it should be 6.7.

5 Instead of 4 it should be 33.

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

18 I should point out also another charac-
19 teristic. It seems to me like -- like I get a better match
20 when I used the type curve for -- for uniform flux factor
21 rather than one for infinite conductivity. There are two
22 types of curves. One is for the assumption that the frac-
23 tures were produced as an infinite conductivity, no pres-
24 sure drop throughout, and the other is if the flow was
25 feeding into the fracture uniformly along its length and

1 there is a pressure drop. I'm not sure just what the
2 situation would be if we had a log with just absolutely no-
3 where we can go, all we have is the fracture to the -- to
4 the high capacity system. We don't have a fracture drop --
5 a pressure drop in that fracture, too, and whether that
6 might be reflecting here or not, I don't know, but I think
7 it is of interest to know that it appears that uniform flux
8 gets measured, and my concept of these tight blocks is that
9 their reasonable approximate size trends to 30, maybe 80
10 acres, or bigger.

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

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

1 that -- that so-called matrix porosity.

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

7 Q Now, Mr. Greer, the information con-
8 tained in Exhibit Number One confirms your interpretation
9 of the reservoir, is that correct?

10 A Yes, sir.

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

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

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

21 A This is a --

22 Q Just a minute.

23 A Oh, excuse me.

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

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

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

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

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

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

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

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

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

23 We see another thing where it says
24 "Begin semilog straight line" we can see that the points
25 come up and level off before that line is reached and that

1 means that we cannot accurately use any of the information
2 from this test to estimate under the ordinary (unclear) the
3 permeability even though this line appears to be a straight
4 line on the semilog plot. The closest characteristics are
5 such that it's just not balanced.

6 The next sheet is where we have the cal-
7 culations again and then the last sheet, the last green
8 sheet, we have a comparison, and for instance, on total
9 mobility Kh/u , the report says 1.9 darcy feet. I get 1.2,
10 and of course that's not a significant difference. The Koh
11 is .43 compared to .28, again really no significant differ-
12 ence.

13 What is significant is the fracture
14 length. The service company (unclear) with the zero feet I
15 think is unrealistic for a well that's been treated with
16 135,000 gallons of frac fluid and 180,000 pounds of sand.

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

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

25 Q Now, Mr. Greer, this exhibit confirms

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

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

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

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

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

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

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

25 The logs don't tell us anything and I

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

10 And in order to try to get a -- some
11 kind of a handle on pore volumes and barrels per acre, my
12 feeling is the best thing is interference testing and it's
13 difficult to get an interference test when wells are pro-
14 ducing and going on and off production and trying to find a
15 good point to start from. So I was most pleased when the
16 Commission ordered the shut-in period and the pressure sur-
17 veys because that gave us an opportunity to make an inter-
18 ference test that otherwise would have been most difficult
19 to do, and of course there's a complication with it in that
20 when the wells have been producing and we shut them in,
21 then none of those wells can affect the observation well,
22 and one of the problems is -- is how much affect could each
23 well have and what then, when we put it all together what
24 does it mean, and to do that, why we've developed a program
25 that calculates the interference effect for each of the

1 wells and then sums it up to -- for the total.

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

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

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

18 Q Will you now go to the yellow sheets?

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

25 We show the -- at the bottom of the page

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

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

1 gravity drainage and pressure maintenance.

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

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

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

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

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

1 the permeability of oil.

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

6 Q All right, the remainder of the informa-
7 tion in this section is supporting material, isn't that
8 correct?

9 A Yes.

10 Q Would you now go to the material behind
11 Tab D and review the information on this other interfer-
12 ence test?

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

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

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

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

12 Again it's still the same system as be-
13 fore for the percent effect that each of the wells had; in
14 this instance Homestead Ranch has 37 percent of the effect,
15 so we can believe that is actually the bigger share of in-
16 fluence on the test, and here again is a high capacity well
17 like the other wells in the pool, and yet it does not re-
18 flect a lot of oil in place compared to anything else.

19 The next two green sheets are the same
20 information to compare the total mobility and determine the
21 transmissibility of the oil, and in this instance both
22 wells at that time the gas/oil ratio was pretty high, it
23 went to 14,000, I believe, so even with the Kh/u of 110
24 darcy feet, they only had a permeability of oil, Koh,
25 transmissibility of the oil of 2 darcy feet; however, with

1 that much, that gas/oil ratio, I'm convinced had the
2 test been run at a time the gas/oil ratio was lower, the
3 transmissibility would have been much higher, probably in
4 the range of 5 to 10 darcy feet as we'd earlier estimated.
5 High enough that they could have developed some gravity
6 drainage had they been able to affect measures to do it.

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

9 A Yes, sir.

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

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

24 Starting on the lefthand side, the wells
25 had been shut-in, Mallon's wells had been shut-in long

1 enough that the pressure appears to have been leveled off.
2 That's at the 1632 pound level on the lefthand scale and
3 just before we commenced the pumping, the J-6 was fraced.
4 You can see the response to the J-6 frac, and then about
5 the 9th or 10th of May, why, the pressure started falling
6 off after that frac treatment.

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

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

20 One of the things that we didn't go back
21 to correct, that change, the Mallon wells seem to have a
22 real wide variation of production from day to day and we
23 felt like it was probably responding as a consequence of
24 reading at different times, and so we tried to normalize
25 that some and in that process we normalized from 53 barrels

1 a day the first day to 113, and so that -- that probably
2 was a -- did about half that very first day, that prob-
3 ably 53 barrels was about right. So that gives us a higher
4 drawdown from the reservoir than we had starting out.

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

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

16 Q All right, what does the green sheet
17 show?

18 A Again we show here the ratio of Kh/u to
19 transmissibility and for the gas/oil ratio of the dominant
20 well, the Howard 1-11, which is about the same as the
21 Howard 1-8, it shows 10 darcy feet for transmissibility, or
22 Koh, again a fairly considerable difference of opinion. We
23 felt like transmissibility had been that high all the way
24 through, we measured with the frac pulse tests, measured
25 with interference tests, we find the tight blocks, so what

1 we're measuring is the characteristic of a small tight
2 block which means that there has to be a substantially
3 higher transmissibility in the high capacity system and
4 this high transmissibility, I would have to agree with the
5 chairman, it makes one wonder about the Bear Canyon Area.
6 There's certainly a possibility that drainage is occurring,
7 it seems to me.

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

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

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

24 And so we review that briefly on the
25 green sheets. Here is one of the reasons why different en-

1 gineers will get a different set of pressures starting off
2 with the same basic information. We just don't know what
3 the density of the reservoir fluids are.

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

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

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

1 Then we have a density that's consider-
2 ably less. I feel like in time that there's no question
3 in a solution gas drive reservoir that that dotted line ex-
4 tended on out is what it's going to be. The question is
5 when does it drop down from the upper level down to the
6 dotted line?

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

13 Q All right, and on the yellow sheets fol-
14 lowing, you review the ranges shown on the --

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

24 This is one of the reasons why you
25 cannot use reservoir pressures taken in the ordinary method

1 of bottom hole pressures to try to estimate pressure gra-
2 dients across a reservoir. This is one of the unknown
3 quantities.

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

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

12 Take for instance the Mesa Grande Bear-
13 cat, which is highlighted. In June its pressures would
14 range from 1041 pounds to 1061 pounds and in November I
15 would estimate from 768 to 787, but when you take the dif-
16 ference for the different surveys, we find that for one
17 reservoir density we get a difference of 273 pounds, for
18 another one, 275, another 274, so here when we deal with
19 only differences, assuming the wells build up approximately
20 the same, of course is another question, but we've elimin-
21 ated the problem, I think, pretty much, and the problem of
22 reservoir densities, it's unlikely to me that the reservoir
23 density would change substantially in any one well during
24 this pressure survey. I can see it would be different for
25 any one well as compared to another across the reservoir

1 but it probably would not change (not clearly understood.)

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

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

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

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

16 A Then on the tan sheets we've taken a
17 look at recovery in terms of barrels per thousand of reser-
18 voir pressure decline.

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

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

1 what that difference is.

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

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

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

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

16 A Yes, sir.

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

21 Could you identify what is depicted by
22 that highlighted area?

23 A Yes, sir, that's the area that I select-
24 ed to -- to make an estimate of pore volume for the Gavilan
25 Area.

1 Q About how many acres are in this area?

2 A I estimate approximately 27,500.

3 Q Is this the study area that you refer-
4 enced yesterday?

5 A Yes.

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

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

13 I took those pressure declines and the
14 production for wells within the green outlined area and fro
15 the pressure decline I made an estimate of pore volume. I
16 did this with only the information from the test period and
17 I did this because I think it's really about the best in-
18 formation we have to date to make an estimate of pore vol-
19 ume.

20 If we tried to go to the classic method
21 of using material balance, go back to the beginning of
22 production, we run into problems as to what was the origi-
23 nal bubble point and is this that is significant. The
24 problem of an average of pressures and particularly we run
25 into a problem of migration away from the area and

1 migration to the area, and those are pretty difficult to
2 take into account.

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

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

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

14 A Those are shown on the green sheets fol-
15 lowing and here -- here I just used a very simple calcula-
16 tion just to get compressibility itself. For compressibil-
17 ity I've used the Loddy sample, although there's not a lot
18 of difference between it and the other ones. And I made
19 the calculation for a number of assumptions.

20 Now, if, of course, one makes an initial
21 run like this, it's possible to go back and take the calcu-
22 lated recovery and calculate the oil in place and then make
23 a (unclear) calculation of the free gas, and I've not done
24 this here. It seemed to me like there's probably some free
25 gas to begin with and I don't know just how useful it would

1 be, and the volume of free gas isn't going to make that
2 much difference. You can see how it varies.

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

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

12 Q Are you ready to move to Exhibit I?

13 A Yes, sir.

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

18 A Yes, sir. I just listed here a number of
19 the pore volumes that we calculated at different tests,
20 both interference tests and frac pulse tests and the pro-
21 duction with pressure decline that we just now looked at,
22 and it appears to me that the average is pretty clearly in
23 the range of .2 or .25. I have used in order to be a lit-
24 tle bit on the high side, I've used .2 for the next -- next
25 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 allowances. 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

1 of how much gas might be in place, the recoverable down to
2 150 pounds. I've used the two different samples that have
3 been provided by the operators. It comes out very close on
4 line 6), 680 and 640 MCF an acre and I suggest we use the
5 average, 660.

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

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

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

24 And the number of reservoir depletion in
25 terms of acres per day, on 320 acres it would be a little

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

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

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

19 A Oh, well, I hope that's not another mis-
20 take. I'll call on one of our assistants to ask if I used
21 660 or 600.

22 (There followed comments off the record.)

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

25 Q Now if you'd go to the gray sheet that

1 follows and explain what you're trying to show with the two
2 blocks on it.

3 A Here we show the problem of unequal
4 drainage for mixed spacing units. The Commission a year
5 ago moved from 320-acre to 640-acre spacing, or possible
6 spacing, and one of the problems here with mixed spacing is
7 having that well on 640 acres produce as much as two wells
8 on 640 acres. If it can, then there's no problem in pro-
9 tecting its correlative rights, but the higher the allow-
10 able, the closer the wells will come to the producing capa-
11 city and when that happens, then the one well on a tract
12 will not produce as much as two, and so what that means is
13 the correlative rights, then, it's going to be a real prob-
14 lem to protect correlative rights if the allowable is so
15 high that all the wells are -- or most of the wells are
16 producing to capacity.

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

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

22
23 (Thereupon a recess was taken.)
24

25 MR. LEMAY: We shall continue.

1 Mr. Carr.

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

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

11 A year ago we asked the boundary be re-
12 moved just to simplify the rule that all wells would be
13 operated under the same rules, but of course that can be
14 done giving both pools the same rules and under the circum-
15 stances it seems to us like the boundary should stay where
16 it is.

17 There's been a great deal of effort, of
18 hearings to this Commission, and wells drilled in accor-
19 dance with orders of the Commission, to recognize the
20 change in spacing from Gavilan into West Puerto Chiquito,
21 and I would like to point out that there's really only one
22 way that the spacing can be changed in a pool and do it
23 with assurance that correlative rights be protected and
24 that's to make the spacing change at a unit boundary and
25 when the unit boundary coincides with a pool boundary, why,

1 that is what we've taken into account and what would have
2 been done to protect correlative rights across this
3 boundary.

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

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

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

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

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

16 And down below that, Section 7 offset-
17 ting Section 12, there's one well on each section.

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

20 Then we see three rows of sections in
21 which there are two wells in each section on the Gavilan
22 side and one well in a section on the Unit side. Now there
23 we have no problem with protection of correlative rights
24 for the reason that of these units we can look at all three
25 sections here, 19, 30 and 31, and if we take the combined

1 production in those three sections, we find that the value
2 of that production, even though we're injecting gas, just
3 the value of the oil that we sell is substantially in
4 excess of the value of the gas and the oil from the other
5 -- other tracts, and so although reservoir voidagewise
6 we're taking no more reservoir space, we have protected our
7 correlative rights.

8 So right now, the way the situation ex-
9 ists across the boundary, there is a pretty good situation
10 if we look at protection of correlative rights assuming
11 there is pressure maintenance credit, that's a pretty
12 simple way to view it.

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

15 A Here we show again the pressures differ-
16 ences which we developed in surveys and we show the yellow
17 colored area some information we presented in March, 50 to
18 100 pounds the pressure decline during the period from July
19 to February. That's the yellow colored area. which, inci-
20 dentally, I have pointed out before, I'll just point it out
21 again, it's pretty difficult to get a weighted average
22 pressure in the gas cap with the extreme variations in
23 pressures; there's no way to put a real close figure to it,
24 but generally it's something in that range.

25 And then the expansion area, the brown

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

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

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

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

15 Q And if you hadn't had this pressure sup-
16 port from the unit, what would you anticipate would have
17 happened in the brown area?

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

20 Q More than is shown on this exhibit?

21 A Yes.

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

1 A Yes, sir. This shows why when we pre-
2 sented the rainbow map in March and it's presented again
3 now, that this shows a minimum pressure gradient from east
4 to west and the pressures on the rainbow map were surface
5 pressures and we had at that time gas in the wellbores from
6 the surface to the producing formation. And so we know
7 that the pressure gradient, then, from east to west, would
8 have to be higher than that, maintaining would be deter-
9 mined by comparing one pressure to another because as we
10 see here on this sketch, the reservoir density of the
11 fluids would be higher than the density of the free gas in
12 the wellbore and so, as we indicated before, the rainbow,
13 and all it's designed to show is the direction of flow and
14 it has the minimum pressure gradient and compares one pres-
15 sure against another.

16 Q And then behind that is the rainbow map

17 A Yes, sir.

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

20 A It would be about two miles.

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

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

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

4 A Yes, sir.

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

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

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

20 The brown area and the yellow area, even
21 though we're talking now about a small pressure difference,
22 still north and south there's an amazing degree of equali-
23 zation.

24 The only -- the only difference, and
25 that's only a 2 pound difference in Section 6 from the E-6

1 to the J-6, and here we find that the structure is the
2 other direction and so that's probably the reason for that.

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

7 A Yes, sir. I show here on a plat wells
8 that were produced in the expansion area during March, I
9 think it was about mid-March, I think -- March 15th to
10 23rd, and the two observation wells, the D-17, which is a
11 small well, small capacity, and the B-29, which is our
12 highest capacity well, and the producing wells are the
13 F-18, B-32, F-30 and G-5, and we show on the tabulation
14 just above the plat the production rate for those wells
15 during that test period, which, incidentally, was their
16 flowing rate all through the month, and the gas/oil ratios,
17 and we point out the extremely low gas/oil ratios from
18 these wells, whose production is coming primarily from the
19 C Zone, and we've inferred from that that we had effective
20 gravity drainage and pressure maintenance.

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

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

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

3 A Yes, that's right.

4 Q What does that tell you?

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

13 During the high rate test period the
14 pressure decline in the area was around a pound and a quar-
15 ter to a pound and a half a day. I've run that as a com-
16 parative slope to see the difference.

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

19 A Yes, sir.

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

22 A Yes, sir.

23 Q Does it show basically the same thing?

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

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

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

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

20 A Yes, sir.

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

25 A Yes, sir, this just shows that the pro-

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

12 Now this is in the area of the B-32 and
13 C-34 interference test which showed an average Koh of about
14 10 darcy feet and I tried to point out in March when I
15 talked about it, but I guess I was unsuccessful in getting
16 my point across that normally these interference tests or
17 frac pulse tests didn't show the average characteristics
18 for a large area, several thousand acres. If there's a
19 tight streak in the middle of it, it's not going to pick
20 that up and if there's directional permeability, that's not
21 going to be reflected. You can't tell that with just one
22 test across the area. So the effective permeability in the
23 east/west direction can be significantly less than that
24 shown for that average for the area, and we think that on
25 average there's got to be transmissibility and gravity

1 drainage for pressure maintenance; even though there's a
2 tight streak here and there, it's not going to deny its
3 ability to recover oil efficiently.

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

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

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

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

15 Q And in the yellow area?

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

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

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

1 duction in the A and B Zones up there.

2 Q Now using this exhibit, could you ex-
3 plain to the Commission how you believe this area needs to
4 be produced?

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

17 We believe that -- that continued pres-
18 sure maintenance will bring -- keep the project effective
19 by gravity drainage work just as the tight -- the oil moved
20 down to the tight zone and we would cross it with gas drive
21 or effective gas drive above the gravity drainage, goes
22 across the tight streak, we'll have gravity drainage again.
23 Even in the flat reception area that we have now we consid-
24 er the expansion area primarily the collector for our pres-
25 sure maintenance project. In time we'll finally get some

1 gravity drainage down there even though it's (unclear)
2 there is enough high capacity formation there that we'll
3 pick up a little bit, but right now what we're getting is
4 low gas/oil ratio oil, not concentrated in the gas drive
5 where we have high, high gas/oil ratios. That oil is
6 collecting, moving down principally by gravity with the
7 force of the pressure maintenance gas cap behind it to go
8 to some high areas, and we anticipate a very large addi-
9 tional amount of oil to be produced. As we indicated yes-
10 terday, the efficiency so far has been outstanding as
11 compared to other solution gas drive areas, for instance,
12 Gavilan, and all we want is the opportunity to continue our
13 pressure maintenance project into the expansion area. We're
14 not interested in trying to pick up oil off of Gavilan and
15 drain oil in that direction. That just is not our inten-
16 tion at all, and we don't want any of it.

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

24 Q Now, Mr. Greer, to develop these re-
25 serves do you have to balance this pressure maintenance

1 with the migration?

2 A If we attempt to move too fast, the gas
3 will tend to bypass the oil and we will not get as effi-
4 cient recoveries as we'd like to have.

5 Q If you're to continue to operate this
6 area with your pressure maintenance project, of what im-
7 portance is the gas injection credit?

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

16 When we move to the high rate of produc-
17 tion all we can do is try to protect our boundary and in-
18 crease production from our wells and try to keep up with
19 the offsets and our efficiency will be diminished.

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

23 A Yes, sir. As I indicated before, we
24 would like to carry on with the pressure maintenance pro-
25 ject; we have no objection to any kind of a reasonable

1 long term (unclear) of whatever that will assure that there
2 is a balance of withdrawals across the boundary. A sug-
3 gestion was made at the March hearing that one way to do
4 that might be to measure pressures on each side of the
5 boundary and we're certainly willing to do that, and we
6 think that there are certain things that need to be done to
7 be assured that we can measure comparably what the pres-
8 sures are, and we made those suggestions as to what pres-
9 sure gauge should be used, use the same wireline to lower
10 the bombs into the wells and utilize wells that are in good
11 communication with the main producing reservoir, and try to
12 select that wells that have a minimum difference in struc-
13 tural position so that we would not be plagued by the prob-
14 lem of the unknown density of the reservoir fluids.

15 And finally we would suggest that as a
16 practical matter, that the Aztec Division or office of the
17 Conservation Division be charged with the responsibility
18 and authority to establish the procedure, witness the
19 tests, and then, in the event the Aztec Office determines
20 that migration is occurring from Gavilan to the Unit, I
21 won't say anything about the other way, if they find drain-
22 age occurring, migration occurring from Gavilan to the
23 Unit, then to reduce the Unit's percentage of gas injection
24 credit for the expansion area wells, and that adjustment to
25 the gas injection credit percentage be carried until an-

1 other survey.

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

6 A Yes, sir.

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

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

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

24 Q Mr. Lemay raised yesterday a question of
25 whether or not there were examples of injection projects

1 working in fractured reservoirs and do you have examples of
2 those?

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

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

13 A I feel that the ultimate recovery from
14 the Canada Ojitos Unit will be -- be reduced if the allow-
15 ables are permitted to go much higher than they are right
16 now.

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

19 A Yes, sir.

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

22 A Oh, yes, sir, absolutely.

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

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

1 permeability restriction but it's not adequate to complete-
2 ly stop the pressure maintenance project from being effec-
3 tive.

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

8 A Yes, sir.

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

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

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

16 MR. LEMAY: Thank you, Mr.
17 Carr.

18 Mr. Kellahin.

19 MR. KELLAHIN: Thank you, Mr.
20 Chairman.

21

22 CROSS EXAMINATION

23 BY MR. KELLAHIN:

24 Q A point of clarification, Mr. Greer, in
25 response to Mr. Roe's recommendation yesterday with regards

1 to allowing wells in either pool the flexibility to over-
2 produce their allowable, my recollection was that Mr. Roe
3 recommended that the flexibility be the option to produce
4 any well, overproduce up to a maximum limit equal to four
5 months of allowable during any one continuous production
6 period. Is that your understanding?

7 A That sounds reasonable to me, yes, sir.

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

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

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

23 A Yes, sir.

24 Q Way up in here?

25 A Yes, sir, and then as the wells were

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

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

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

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

25 A Well, it seems to me that if that solves

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

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

12 A I --

13 Q I didn't make myself clear.

14 A I'm sorry, say it again.

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

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

24 A Well, in principle, I think it should be
25 but I presume the Aztec Office should be given some flexi-

1 bility there for such problems as mechanical breakdowns and
2 such as that. I guess we haven't given that too much
3 thought.

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

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

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

16 Q Thank you, Mr. Greer.

17 MR. LEMAY: Thank you, Mr.
18 Kellahin.

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

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

24
25 (Thereupon the noon recess was taken.)

1
2 MR. LEMAY: We shall resume
3 with the cross examination of the witness.

4 Yes, Mr. Douglass.

5
6 CROSS EXAMINATION

7 BY MR. DOUGLASS:

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

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

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

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

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

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

25 Then the drainage pressure has dropped,

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

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

7 Q 8 to 10 BCF?

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

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

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

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

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

19 Q You said there were about nine producing
20 wells in the expansion or are there more than that now, ac-
21 tually on production?

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

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

1 A The producing wells, yes. About four-
2 teen.

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

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

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

11 A Well, most months. You know, occasion-
12 ally we get overproduced. We've been trying to stay fairly
13 well within the current allowable.

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

16 A Oh, yes, sir.

17 Q How do you measure it at each well?

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

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

22 A It's a calibrated choke.

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

1 A Yes, he checked it once a day.

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

4 A Yes, sir,

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

7 A Yes, sir.

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

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

12 Q At the well?

13 A At the well.

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

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

18 Q And then you measure the gas at the
19 well.

20 A Yes, sir. And we have a separate meas-
21 urement for each well for the gas volume and the oil vol-
22 ume.

23 Q Each day.

24 A Each day.

25 Q Charts.

1 A Yes, sir.

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

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

4 Q Is that -- are those the charts? Do you
5 add up those charts to get what the gas -- the well pro-
6 duced for the month?

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

12 Q In other words, you --

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

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

21 A That's correct.

22 Q And that's how -- you use those measure-
23 ments to calculate your gas/oil ratio.

24 A Yes, sir.

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

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

2 A Yes, sir.

3 Q Now --

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

8 Q Is it flowing, then?

9 A Oh, yeah.

10 Q The E-6 is flowing.

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

15 Q Mr. Greer, you've submitted some injec-
16 tion figures here, is that correct?

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

20 Q Let's see if I understand what is hap-
21 pening.

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

24 A Yes, sir.

25 Q And you took the gas that was being

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

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

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

7 A I believe it was closer to '85.

8 Q '85, I think you're right. I believe
9 the first well went on in January, '85, and so from '68 to
10 '85 you had gas production the brown area injected in the
11 brown area.

12 A Yes, sir.

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

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

18 A Before we started injecting?

19 Q Yes.

20 A We'd had a period of time when gas at
21 that time was worth, I think, the high was around, oh, 12
22 or 13 cents a thousand. We tried to get pipeline companies
23 to lay to us so we could market the gas but we were unable
24 --

25 Q I'm sorry, Mr. Greer, were you flaring

1 the gas?

2 A Yes, sir, so until 19 -- about 1967 or
3 '68, we made arrangements whereby we could deliver gas to
4 the towns of Dulce and Chama, made a swap out arrangement
5 with the -- to the pipeline companies so that we could
6 market gas. We sold gas for I think 6 or 8 months and at
7 that time I had concluded by studies and decided instead of
8 selling gas we should inject it. So we turned around and
9 instead of selling gas we started buying make-up gas.

10 Q And the gas was pretty cheap in those
11 days.

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

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

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

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

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

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

4 A Well, I'd have to ask the people who
5 prepared this schedule. It doesn't look like I can inter-
6 pret it myself here.

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

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

11

12 (Thereupon a discussion was had off the record.)

13

14 Q Mr. (unclear) has conformed that accord-
15 ing to these figures, that's BCF figures if I put the deci-
16 mal in, and I'm going to say it's about 1.4, roughly you
17 got about 1.4 BCF over-injection, is that correct?

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

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

22 A (Not understood.)

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

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

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

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

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

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

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

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

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

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

1 I don't whether I have a misunderstanding or what, but
2 there was -- if these are Dr. Lee's pressures, it's my un-
3 derstanding that he was running a study for Sun, a direc-
4 tional study. Sun is very much concerned about migration
5 and Sun feels very strongly that we have an oil bank effect
6 and they wanted some information from him, I think, on pre-
7 liminary -- (unclear) preliminary basis, and I made my own
8 calculations for migration and I know we had the same cor-
9 rections. They're substantially different from Dr. Lee's.

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

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

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

23 A Well, yes, sir, the situation is there
24 but again, as I explained in my 1980 hearing, is that in
25 addition to replacing the gas with the volume of oil that's

1 produced, as the oil moves down dip you have to increase
2 the pressure of the gas cap just to maintain the pressure
3 in the oil flow, so even though we over-inject, why, we
4 don't see a substantial increase in the pressure.

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

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

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

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

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

18 A Oh, no, it's not.

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

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

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

1 Q Sure, I think I had feeling, too.

2 A Okay.

3 Q I sensed that, Mr. Greer.

4 A You're very perceptive.

5 Q One country boy to another country boy,
6 I sense that.

7 A If this area is a barrier, okay, what
8 about that?

9 Q It's not going to affect your gas
10 injection project you've got carrying on.

11 A Well, if it's an absolute barrier, it
12 would affect it to the extent that we'd have to do some-
13 thing different. We'd have to find just where the blamed
14 thing is and drill some more wells down there right next to
15 it.

16 Q Now, when you say absolute barrier, have
17 you put on any absolutes in this case so far, Mr. Greer?

18 A Oh, in this business I think there
19 hardly are any absolutes.

20 Q In other words, even if there's not ef-
21 fective communication across that barrier, it's not going
22 to affect your injection project, is it?

23 A Well, only to the extent that there's
24 additional stuff. We feel there is lots of oil down dip
25 from the existing producing wells and if we're going to

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

4 Q Let me ask you, if -- what are these
5 wells up here to the north, directly north of your injec-
6 tion wells?

7 A That's the East Puerto Chiquito Mancos
8 Unit.

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

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

15 Q Answer no?

16 A We have not started the injection yet.

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

19 A Not yet.

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

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

1 west.

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

5 A Well --

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

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

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

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

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

22 A Yes, sir.

23 Q How much?

24 A Well, if you're speaking of the injec-
25 tion wells, of course, apparently you have a different view

1 of them and

2 Q Well, how about --

3 A -- injection well but they're --

4 Q How far --

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

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

10 A It was 1200.

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

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

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

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

22 Q Now if the (unclear) exists, as I under-
23 stand what's taking place, is that you've over-injected in
24 the unit area and I notice here that after a period of
25 time, according to these figures, you quit the over-injec-

1 tion, according to the figures that you've submitted to the
2 --

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

8 Q I guess one of the problems I have, I
9 can't tell that on this list because it goes from 1975 to
10 1980 and so I can't tell what happens in there, but you
11 think it's about 1978 or '79?

12 A Somewhere in there, and I apologize, if
13 I'd known you wanted this information, why, I'd have pre-
14 pared it and tried to help you.

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

18 A Okay.

19 Q Yeah.

20 A I just don't know enough about it, any-
21 way.

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

24 A I think I can pretty well tell you that.

25 Q So then I notice even after that,

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

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

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

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

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

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

23 A Well --

24 Q -- the pools now?

25 A No, sir, it's identified as stopping

1 right along the (not understood).

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

5 A No, it was along the permeability re-
6 striction.

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

9 A Oh, yeah.

10 Q Well, I still don't understand how if
11 you started selling gas in '78 that you continued overin-
12 jecting until '82 or '83.

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

15 Q Uh-huh.

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

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

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

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

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

3 Q Well, this --

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

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

12 A That's correct.

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

21 A Something like that.

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

1 A Yes, sir.

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

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

15 Q Well, then --

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

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

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

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

22 Q Is the answer yes or no?

23 A The answer is if we inject at high rates
24 the pressures stack up and there's primarily an interfer-
25 ence effect and there's no way to determine if that's in-

1 creased the over all weighted average pressure in the gas
2 cap other than by the way I just tried to describe that we
3 presented to the Commission in the March hearing.

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

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

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

13 A Well, we've -- we've used several dif-
14 ferent wells for observation wells.

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

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

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

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

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

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

8 Q I see.

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

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

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

15 A I think that January 31, 1987.

16 Q January of '87 or '86?

17 A '87, right.

18 Q '87.

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

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

24 A Okay.

25 Q Yes. Isn't the reason that you had that

1 well shut in, the B-32, in January of 1987, is that you
2 were getting ready to frac another well? Testing your
3 memory, how about the A-20?

4 A That's possible.

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

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

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

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

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

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

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

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

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

6 A Oh, yeah.

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

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

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

24 A About two miles.

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

1 A About two miles.

2 Q About the same distance?

3 A Yes, sir.

4 Q There isn't any question about the dif-
5 ference in response, is there, according to your testimony.

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

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

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

14 Q I see. Are you satisfied that another
15 engineer couldn't actually find that there was a straight
16 line at a lesser angle than you have here and that there
17 was a response in that well in January of '87 that appro-
18 ximately in time was the same as you show your frac res-
19 ponse?

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

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

1 A Oh, yeah, most people have different
2 interpretations.

3 Q Did I understand in your calculations
4 after your interference test that you found back in '65 or
5 '66, the one that Mr. Elkins analyzed and you analyzed,
6 that you determined that half of the oil was in the
7 fractures and half in the matrix?

8 A That was my best assessment at that
9 time. That's an almost impossible thing to determine, and
10 my conclusion for that primarily was that I came up with a
11 bunch of different ways of averaging and so on, but if the
12 overall average, which I think that's what we got, that's
13 what Mr. Elkins thinks we got, is one number and it's like
14 10 times as high as what we get for the tight blocks, then
15 it just seems to me like there's a good possibility that
16 the high capacity system itself must have a higher trans-
17 missibility, and it's just kind of a guess; turns out it's
18 a good guess because otherwise the gas would have channeled
19 during the -- all the time that we were -- and we could not
20 have injected gas as long as we did without it channeling
21 if there had not been a lot of it, or a high percent of it
22 in the high capacity fracture system.

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

24 Q Is the answer to my question yes?

25 A I didn't calculate it; I kind of esti-

1 mated it. In fact in all those ideas that I had as to how
2 to go about trying to analyze everything are in the files
3 of the Conservation Commission.

4 Q Is the answer to my question yes?

5 A I estimated half of it in the fracture
6 system.

7 Q Then the answer to my question is yes.

8 A I believe I answered that.

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

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

18 Q Is the answer to my question yes?

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

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

24 A It's in a tight block that has good
25 communication with the high capacity fractures. The tight

1 block itself is estimated to have the transmissibility of
2 about I think around .46 darcy feet. The overall system
3 has 10 or 12 times that.

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

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

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

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

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

24 A They're, well, my concept, Mr. Chairman,
25 is I just don't believe we've ever drilled a well right

1 straight into the fracture system itself. They've nearly
2 all been drilled into a, like I say, a tight block. A
3 tight block has these hairline fractures and -- and it's
4 the high capacity system surrounding that tight block that
5 does the good for the reservoir. You have to have all
6 these sideline -- these hairline fractures or we'd never
7 been able to carry on the pressure maintenance project.

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

12 A Yes.

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

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

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

23 A Yes, sir.

24 Q Weren't in but they communicated with
25 it.

1 A Yes.

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

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

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

12 A Right.

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

15 A That's right. I pointed that out yes-
16 terday.

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

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

25 Q Mr. Greer, do you disagree that during

1 the normal rate of production in the last four and a half
2 months in '87, in what your side has called the high rate
3 production, that your wells in the expansion area produced
4 48 percent of the oil?

5 A I have not calculated, but that sounds
6 reasonable.

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

11 A I believe so, that's probably a reason-
12 able estimate.

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

15 A Yes, sir, he has a little higher fig-
16 ures, I think, but they're both very --

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

20 A Yes, sir.

21 Q And you, at the normal rate of produc-
22 tion, your wells produced 48 percent of the oil versus 52
23 percent.

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

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

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

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

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

22 A No, I said that previously when I esti-
23 mated the amount of migration to and from Gavilan, I think
24 I --

25 Q Did you use just the expansion area?

1 A Yes.

2 Q You did? And what month was this?

3 A This is a little different way than per-
4 haps computer modeling would -- would go about analyzing
5 migration, but what I show --

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

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

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

25 Q You don't have any calculations that you

1 can show us for the normal rate or what you call high rate
2 production or the restricted rate production after that to
3 show what the reservoir withdrawals are between the two
4 areas.

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

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

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

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

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

25 Q Mr. Weiss likes cumulative production to

1 be an indicator of whether you've got an injection project
2 successful, didn't he?

3 A Well, that's one of the characteristics
4 or one of the qualifying factors whether pressure main-
5 tenance is being successful.

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

10 A The main thing is the amount of produc-
11 tion accompanying the low gas/oil ratio.

12 Q The --

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

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

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

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

24 Exhibit Fifty-five, would you agree that
25 that looks like a pretty good ranking of the superstar

1 wells according to their ability to produce?

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

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

13 A Yes, so this is where you can see the
14 difference there, that the expansion area wells being re-
15 charged with the pressure maintenance project manage to
16 stay up there.

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

19 A Oh, yeah, it is.

20 Q You think it is?

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

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

1 A Yes, sir, but in this instance the com-
2 munication is such that the area was depleted just as
3 though they had been there and producing themselves.

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

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

9 Q How about Sun?

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

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

13 A Yes, sir.

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

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

22 A Yes, sir.

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

25 A They're in the central Gavilan area.

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

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

6 A Yes, sir.

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

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

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

17 A Yes.

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

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

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

4 A Let me find it.

5 Q This is what it looks like here.

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

8 Q And I believe you described that the
9 proration that was in effect for Boulder was a good prora-
10 tion; that was a good system.

11 A Yes, sir, good (unclear).

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

16 A Yes, sir.

17 Q You were?

18 A Yes, sir.

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

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

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

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

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

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

22 A They can lead to large rates of produc-
23 tion, yes, sir.

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

25 A They can --

1 Q -- almost like a pipeline, isn't it?

2 A Yes, sir. Yes, sir.

3 Q And yet you're proposing to this Com-
4 mission that we use pressures measured along this now
5 common boundary to determine whether oil is moving from one
6 side to the other.

7 A Yes, sir.

8 Q Mr. -- Mr. Greer, have you calculated
9 how much Unit production would be increased if the Propo-
10 nents application is granted, their position is granted in
11 this hearing?

12 A No, sir, I'm not sure there would be a
13 substantial increase.

14 Q Well, if you hold it back it wouldn't be
15 substantially increased, would it?

16 A That's been the nature of our operation.

17 Q If you elect to produce your wells at
18 capacity out there, you could produce well in excess of 700
19 barrels a day additional right now, couldn't you?

20 A Oh, yes.

21 Q How much more do you think you could, if
22 you wanted to?

23 A Well, I'll invite your attention to the
24 way the pressure is dropping now, the capacity may be
25 smaller than before.

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

3 A No, sir, I'm not.

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

7 A (Not clearly understood.)

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

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

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

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

24 Q Have you got any others?

25 A Well, the main one I just mentioned,

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

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

8 A Oh.

9 Q -- high rates?

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

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

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

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

22 A Oh, well, we'd have to.

23 Q If the did -- if the Commission set that
24 kind of rate, then you would consider that, first of all,
25 that would be a rate that's -- that's statewide allowable,

1 although I understand it's actually written, but it was the
2 allowable that was in effect before the restriction was put
3 in, is that right?

4 A Yes, sir.

5 MR. DOUGLASS: Pass the wit-
6 ness.

7 MR. LEMAY: Thank you. Addi-
8 tional questions of the witness?

9 MR. DOUGLASS: Oh, I need to
10 offer Exhibits Fifty-Five and Fifty-Six.

11 MR. LEMAY: Those exhibits
12 will be taken into the record without objection.

13 Mr. Lopez, do you have any
14 questions?

15 Mr. Chavez.

16

17 QUESTIONS BY MR. CHAVEZ:

18 Q Mr. Greer, your calculations in the
19 efficiency of the operation of the pressure maintenance
20 project, have you included the acreage within the project
21 area or within the Unit area for calculating your volumes
22 of reserves?

23 A I calculated only the Unit area plus I
24 estimated 800,000 barrels, I believe, that had crossed the
25 tight streak in the expansion area and been produced there.

1 Q Have you ever considered that there
2 might have been drainage from either the north or from the
3 south into the Unit during its production?

4 A I did not. I did not.

5 Q Is there any reason why you didn't?

6 A Well, the -- from the north it will
7 still be Unit lands. From the south we might have enjoyed
8 some migration.

9 MR. CHAVEZ: That's all I
10 have. Thank you.

11 MR. LEMAY: Additional ques-
12 tions of the witness?

13 Mr. Brostuen?

14

15 QUESTIONS BY MR. BROSTUEN:

16 Q Mr. Greer, yesterday I asked Mr. Roe
17 several questions about the status of some wells that
18 appear to be currently shut in along the -- what the
19 Proponents are claiming to be the barrier.

20 I was wondering, perhaps, if you could
21 update me as to what the status of those wells are, whether
22 or not they have any appreciable production from the Mancos
23 Pool, they're complete in this pool, or what have you.

24 For example, the Canada Ojitos Well No.
25 22.

1 A Is that the F-20?

2 Q If you prefer to use the F-20 or the
3 designation --

4 A That's how I've got them --

5 Q Okay, fine. That's the F-20 Well, yes,
6 sir.

7 A Yes, sir. That well we have pipe set
8 through the Mancos, through the Dakota. We perforated the
9 Dakota, gave it an acid treatment, and the Dakota under
10 those conditions appears to be capable of, oh, something
11 less than 100 MCF a day (not clearly understood) of oil.
12 Our plan is to frac the Dakota and to -- I believe we've
13 got the frac tanks on location now, or are going to this
14 week. We'll frac the Dakota and we're still (unclear)
15 about fracing the Mancos, and so I think we'll test the
16 Dakota first, see what it is, what it will do, and then
17 we'll frac the Mancos and I would imagine that we would get
18 that work completed sometime this summer.

19 Q When was that well drilled?

20 A Oh, several years ago.

21 Q 1986?

22 A It was one of the first wells we drilled
23 after we got the expansion area approved.

24 Q I see. Okay. How about your G-32 Well?

25 A Okay, G-32, the well has been fraced,

1 appears to be a very poor well. We fraced it with a jelled
2 kerosine and we found that one of the other wells that we
3 fraced with jelled kerosine, that something happened, the
4 kerosine didn't break, and we went back and gave it a shot
5 of water and, what is it, one of the other chemicals, and
6 that seemed to help it.

7 We don't know if that's the problem with
8 the G-32. We've kind of set that well aside while we try
9 to find out what's the best way to frac the wells. We've
10 tried everything we could think of from water to jelled
11 oil, to carbon dioxide, and we still don't know what's the
12 best thing to do.

13 So the answer to that is that right now
14 it appears to be a small producer, very small, and whether
15 we're going to do any good with it or not, remains to be
16 seen.

17 Q And the well is currently shut in at the
18 present time?

19 A I think we've tested it a couple times,
20 so I believe we haven't cleaned the sand out and pulled the
21 tubing and we've run some tests on it this month and I --
22 or last month and I'd have to review to see what --

23 Q Okay, but it appears to be a very poor
24 producer --

25 A Well, in any event I don't expect --

1 Q -- a marginal producer.

2 A Yes, marginal.

3 Q Okay. How about the F -- when was that

4 well drilled?

5 A About, oh, a few months after the N-22.

6 It would have been probably (unclear).

7 Q Okay, so that well's been sitting there

8 since '81, has it not?

9 A Yes, sir.

10 Q And you fraced it, the first attempt at

11 completion was back in '81?

12 A Yes, sir. We have two problems with it.

13 One is we're currently thinking about another well in the

14 same canyon. We've not built a pipeline up that canyon

15 yet, so the only time we've produced the well is for short

16 periods and getting a small volume of gas. We do not have

17 it tied into our pipeline system. So our plan is to drill

18 another well, I forget which section it is, I believe it's

19 Section 30 up northwest of it, and when we do that we'll

20 probably lay a pipeline system up the canyon and tie in

21 then before we run definitive tests on them.

22 Q Okay. How about the J-20 -- pardon me,

23 J-8 Well?

24 A J-8 is a real sorry well.

25 Q And that's completed in the Mancos?

1 A Yes, sir.

2 Q And when was that drilled?

3 A My recollection is about two years ago.

4 Q Okay, so we're talking about 1986. The
5 B-17, is that a well you've been utilizing for observation?

6 A We've been using it for observation.
7 Its capacity is probably, seem like 10 or 12 barrels day.
8 It's a small well.

9 Q Okay, and that well is currently shut in
10 or producing?

11 A It seems like a pretty useful purpose
12 for that well is to use it for an observation well.

13 Q And when was that well drilled and
14 completed?

15 A It seems to me like we completed it, oh,
16 maybe a month or two before we put it on observation, which
17 I think was about a year ago.

18 Q Okay. The Benson-Montin-Greer A-16
19 Well.

20 A Okay, that well is a -- about all I can
21 say is they don't -- they don't do things like they -- like
22 they used to.

23 We produced that well for, oh, I guess,
24 20 years with a hydraulic pump out of the C Zone and went
25 in last year and fraced the A and B Zones, and then we from

1 time to time work on it and we ran a new string of tubing
2 in it, plastic-coated tubing, the kind we had before, but
3 we just can't make the thing go. We set the pump back up
4 and tried some repair and in year's past we used to have
5 really good luck with those hydraulic pumps, and now we --

6 Q Is --

7 A -- can't get the blamed thing to go. So
8 it's another problem but it is one that I'm going to get
9 solved one way or another.

10 Q And that well was completed in the C
11 Zone initially?

12 A The C Zone. I think it made like a
13 100-to-150,000 barrels of oil out of the C Zone.

14 Q And did you deplete your -- or --

15 A It was still making, as I recall, about
16 20 barrels a day.

17 Q 20 barrels a day, and you've been
18 unsuccessful with it so far in getting production from the
19 A and B.

20 A I wouldn't say we haven't got any pro-
21 duction; just don't know what -- we've not produced it.

22 Q The well off to the southeast of the
23 A-22 Well, it appears to be 3/4 of a mile or a mile, or
24 over a mile, perhaps, to the east of the Proponents
25 barrier, what's the status of that well?

1 A It's shut-in.

2 Q Shut it in?

3 A Yes, sir. We were toying about com-
4 pleting in the A and B Zones and then if we put in a gaso-
5 line plant, using it for cycling.

6 Q It has been completed in the C Zone?

7 A Completed in the C Zone. I think it
8 produced maybe 3-or-400,000 barrels.

9 MR. BROSTUEN: Thank you very
10 much.

11 MR. LEMAY: Commissioner
12 Humphries.

13

14 QUESTIONS BY MR. HUMPHRIES:

15 Q Mr. Greer, in some of Mr. Hueni's testi-
16 mony he showed some production information records on wells
17 in the Gavilan Mancos that took what appeared to be a long
18 -- longer than normal period of time to sort of hit their
19 stride after they went to the high rate. It took a longer
20 period of time for those wells to come back up than what
21 they had anticipated.

22 How would you explain that? The first
23 few days were slow production and they -- they kind of came
24 back to what they were supposed to, what they had expected
25 of them, in barrels of oil produced.

1 A Yes, sir. The only explanation I have,
2 the one that seems logical to me, is we know that those
3 zones are stratified. Normally we did not have this kind
4 of a problem when the gas/oil ratios were lower, at least I
5 hadn't heard of a discussion of it and this gravity segre-
6 gation, which I'm sure some has taken place; it's possible
7 that one zone has lower pressure than another, and the A
8 Zone could force some of it back into the -- back into the
9 B Zone, and this could just go on, you just have to get
10 that gas bubble out of there before it goes on. That would
11 be one possible explanation.

12 Q The idea of converse or reverse rate
13 sensitivity certainly has some logical explanation. You
14 don't give that merit?

15 A The only direct case that we have that's
16 been given as an example in this hearing, I know was not --
17 did not have that relation. That's our E-6 Well. It was
18 shown as an example well for the issue of high rate and low
19 gas/oil ratio.

20 What happened on that well was that the
21 high volume was established, the offset wells came on and
22 started producing oil and gas. They pulled the gas out
23 from under our well and its gas/oil ratio went down and
24 that was like for a month and a half. The allowable
25 started July 1. The drainage to the offset well took place

1 until about mid -- mid-August, and then at that time we
2 finished the modifications to our equipment, where we could
3 produce at higher rates, and then we increased the rate
4 about mid-August on that well.

5 And so it's a confusing thing that de-
6 velops, that for that month of August the gas/oil ratio is
7 low and the oil production is high, and it would appear
8 that would be cause and effect, but that's not the case.

9 I had excellent information, producing pressures, injecting
10 gas, record of the drop of bottom hole pressure in the
11 area, and there just absolutely is no question for that
12 particular well that it had no bearing on efficiency. I
13 had, I think, some exhibits on that at the March hearing.

14 The other wells in Gavilan, we just have
15 not operated any there and I just don't have a feel for it.
16 I can understand from the statistics the concern that the
17 people in Gavilan have had wells that appear to have that
18 characteristic. I believe there was -- all of them that I
19 looked at, there was nothing but depletion, but I think
20 that there were few that clearly seemed to have that re-
21 lation, so that was, I think, why John Roe came up with the
22 suggestion that, well, let them produce as high as they can
23 and they perceived that to be the efficient way to do it,
24 to letting them go ahead and do that, but to protect corre-
25 lative rights, balance out occasionally on allowable.

1 Q In Mr Elkins' testimony he mentioned
2 that he thought West Puerto Chiquito was being produced ex-
3 ceedingly, that's his word, slow. I understand your theory
4 for producing it the way you are, but for the way you do or
5 your method of operation, but his emphasis on exceedingly
6 slow, certainly kind of escaped me. Is there another
7 reason that could be operated --

8 A Well, the only reason was to try to get
9 the gravity range recovery. I think (unclear). My analy-
10 sis shows about 20 --16 to 25 percent of oil in place re-
11 covered so far. We still have along way to go, and I feel
12 that it's worked excellently.

13 Gavilan, on the other hand, is going to
14 get 6 or 7 percent.

15 Q In some speculation, is there another
16 reason why a reservoir would be operated exceedingly slow?

17 A Another reason?

18 Q Right.

19 A I had no other reason. I was the only
20 one that made the decision about how -- how fast to produce
21 the wells.

22 Q In the Exhibit Twenty that Mr. Hueni
23 prepared, showing the relative difference in pressures for
24 Gavilan Mancos and West Puerto Chiquito, it's something
25 that has bothered me since the first time we looked at that

1 exhibit, and I'm not sure if that was March of '88 or last
2 year, but that when Gavilan Mancos came on and that rapid
3 increase in production was there, it appears to not show a
4 corresponding drop in pressure from West Puerto Chiquito,
5 indicating some kind of difference between the two sides,
6 and you've explained that as, I believe, restriction, I'm
7 not sure exactly how you explained it, but that's it, I'd
8 like you to tell me one more time so I understand --

9 A Okay.

10 Q -- why you don't think that that would
11 indicate that there's some kind of a barrier.

12 A Well, I think it indicates a restric-
13 tion, a permeability restriction, and it just doesn't need
14 to be a barrier, and I am most thankful that it's there.
15 you know, if it hadn't been there, Canada Ojitos would have
16 gone over to Gavilan, so we're fortunate that that restric-
17 tion is there, that we still have an opportunity to recover
18 that oil by gravity drainage; otherwise we would have not.

19 Q Well, let me ask you, if -- with or
20 without the barrier, if you're taking the gas for your
21 over-injection, theoretically, from the expansion area or
22 transition area, whatever you want to call that, do you
23 feel that that in some fashion sets up a pressure sink that
24 advantageously moved liquid from west around Range 1 and
25 Range 2 line, or the pool boundary, to the transistion

1 area?

2 A Well, I certainly don't -- don't think
3 so. I've seen no evidence of it so far and I don't think
4 that is happening now. If the barrier was there, why, of
5 course, if we produce at higher withdrawal rates than the
6 others, why, then that could happen, and so I understand
7 some of the opposition and that's why we're willing, you
8 know, to submit to any kind of monitoring by the Commission
9 to -- to guarantee that that isn't happening. We can't
10 just inject an excessive amount; that is just mechanically
11 and physically we can't do it; and if we can't, then
12 there's only one other thing we can do, we can sell that
13 gas. If we sell the gas, then we lose our gas injection
14 credit. So it's sort of a self regulating system the way
15 the pressure maintenance formula works, and that alone
16 gives a lot of protection to the parties on the west side
17 of the boundary.

18 But absent that, I mean even with that,
19 we're willing to do anything else.

20 Q In your theory of pressure plateaus,
21 that this row of sections going from north to south just
22 west of the alleged barrier, and I can't -- I think the
23 K-13, B-29 and the B-32, and right in that row of sections,
24 when would you expect to see some kind of demonstrable
25 pressure results from the injection if the barrier is not

1 there and the next plateau is achieved that I suspect is
2 demonstrated under color in the rainbow map, if you will,
3 between there and the next row of sections, because there's
4 a fairly significant amount of distance between those
5 producing wells and the wells along the pool boundary?

6 A Well, I believe the wells in the expan-
7 sion area and Gavilan are so well connected that we'll
8 never see much of a pressure difference.

9 I think we'll see enough difference that
10 we can tell if there's migration but just generally that
11 area is going to be lower pressure than the rest of it.

12 Q Wouldn't those wells show some response
13 as the next plateau was achieved prior to the ones farther
14 west, or do you think --

15 A Do you mean as the gas works through?

16 Q As you achieve the next plateau or the
17 next color in the rainbow?

18 A I don't guess I quite follow your line
19 of questioning.

20 Q Well, if -- if you move -- you've sug-
21 gested that it takes awhile for each of these plateaus to
22 achieve a higher pressure and you demonstrated that by the
23 rainbow map, and it appears to me now that if the bar-
24 rier is either more permeable than is alleged or -- or is
25 not there, that the next response in a pressure plateau

1 would be in that row of sections where those wells that I
2 named exist in --

3 A Okay, under the circumstances where you
4 say it might be more permeable, what I think is going to
5 happen is as the gas works down through it, and it has a
6 higher mobility than the oil, and we're going to see an
7 increase in gas volumes into the expansion area, and then
8 it's just a question of what -- what happens with that gas
9 when it gets over there, whether we produce it or whether
10 it moves on over to Gavilan or what, and right now we've
11 already seen in many of these wells some free gas coming
12 across. So --

13 Q I recall in, I believe, Mr. Elkins'
14 testimony that in the Spraberry deal they injected nitrogen
15 or helium in -- well, I think both, actually, at different
16 injection points and retrieved it at some other point.

17 Have you contemplated doing something
18 like that to test your theory that the barrier doesn't
19 exist?

20 A I certainly hope that we don't have the
21 problem that they had in Spraberry when they saw such
22 gravity movement of gas across the lease lines.

23 The gas cap that we discussed has maybe
24 an 8-to-10 billion cubic feet in it and when we inject gas
25 like, oh, say 5, 5-BCF a year, making 5-million feet a day,

1 that's what's happening here, that might take like 12 years
2 to reach across that township.

3 MR HUMPHRIES: I have no fur-
4 ther questions. Thank you.

5
6 QUESTIONS BY MR. LEMAY:

7 Q Mr. Greer, I think you've testified that
8 because of different engineers using different reservoir
9 fluid density, that you can get bottom hole pressure calcu-
10 lations that will vary roughly 20 - 21 pounds maximum.

11 A I believe around 20, I forget which well
12 had the maximum, but somewhere in that range, maybe 30
13 pounds.

14 Q Uh-huh, well, accepting the 21 pounds
15 figure, and assuming that you have a 20-pound differential
16 across what is now the Gavilan and now the West Puerto
17 Chiquito fields, with high permeability, how would you
18 translate that into oil migration per month, or can you do
19 that?

20 A Well, I think we can, on that famous
21 formula. I'd suggest we use the linear flow formula. We
22 have Q is equal to $1.12 K h \Delta T$.

23 Let's see, we used the simplified form
24 over here. Q is going to be equal to $1.127, K h / \mu$, and
25 (unclear) over F . I presume a one mile wide section and

1 one mile long, and W/L-1, Q then becomes approximately 1 x
2 Kh. If we use Koh, if you'll remember one of the examples
3 I used in the B-29 and B-32 area had about 1.3 darcy feet,
4 so -- so let's take 1.127 times and this is Koh, then 1.3
5 Delta T, so in round numbers that's 1.5 Delta T. If Delta
6 T is 20 pounds that would be 30 barrels a day.

7 Q 30 barrels a day across a one mile area?

8 MR. DOUGLASS: With a 20-pound
9 pressure drop?

10 A That's a 20-pound pressure drop and it's
11 about 1.3 darcy feet per Koh, like I used.

12 MR. DOUGLASS: Could we have
13 what you used for viscosity?

14 A I used -- I just used Koh. That was --

15 MR. DOUGLASS: What's mu?

16 A Let's see, is the sand colored book Two?
17 In our Exhibit Two under Section M we just used the Koh
18 there. Koh there came out to be 1.2 darcy feet and that is
19 -- that's just total Koh, so you don't need the word mu.
20 If we want to go to reservoir barrels and total gas volume,
21 and all that, then you'd need another, another (unclear).

22 MR. DOUGLASS: I thought --
23 didn't I recall that you used 1.3 as the Koh across the
24 barrier?

25 A I just showed them that we had 1.3 was

1 the Koh in that area, to try to be consistent with what
2 we're producing from those wells, but I think any --

3 MR. DOUGLASS: And you -- I
4 just want to make sure --

5 A I might -- if I might, I think Bill
6 Weiss came up with 5, 5 darcy feet on the build-up test,
7 and that would be from our highest capacity well. All the
8 other wells, of course, are substantially less than that.

9 Q Well, proportionately, if you double
10 that differential to 40 pounds differential, you just
11 double the number or does it --

12 A Yes, sir, that's correct.

13 Q So it's in linear feet, basically?

14 A Yes.

15 Q Would that be of concern to the opera-
16 tors, a 20 pound differential across that line, migration
17 of that much fluid?

18 A Well, let's see, what did I come up
19 with, what was that, 20 --

20 Q Well, just using rough figures, 30
21 barrels of oil per day. That's about 7 to 10,000 barrels
22 per month across the field boundary.

23 MR. DOUGLASS: Per mile.

24 Q Well, that's per mile. I'm just taking
25 the miles involved in the boundary, that's what I was

1 looking at.

2 A 30 barrels a day is about 900 barrels
3 per month.

4 Q Times a 30 day period month.

5 A Yes, sir.

6 Q Are we talking about 30 days -- 30 bar-
7 rels per day or 30 barrels per month?

8 A 30 barrels per day or per month?

9 A 30 barrels per day.

10 Q Per day, so 900 barrels per month.

11 A Right.

12 Q Times however you want to -- how many
13 miles do you want to use along that boundary? I was just
14 looking at total migration between the two fields.

15 A Okay. Now, let's take a look at that.
16 There's only a small area that has that kind of capacity
17 and that really not on the boundary, that's our B-32 and
18 B-29 area. I'll point out the rest of it --

19 Q Roughly --

20 A -- there's nothing along the boundary
21 there that has anything near that capacity.

22 Our F-30, F-19, F-18 (inaudible).

23 Q Well, I was looking within the range of
24 predictability, 20 pound differential appears to be about
25 as close as you control that boundary and not something

1 that either side would worry about.

2 A Well, yeah, my concern, I think, would
3 be about the accuracy, can be pretty well taken care of
4 in the methods that I suggested.

5 I think what --

6 Q Just using the difference, relative
7 differences rather than absolute value.

8 A If we do that, we can deal with absolute
9 values if we use the method I suggest, and --

10 Q Well, what do you consider a significant
11 pressure differential that could be a voidage problem?

12 A Well, 20 pounds would be significant.

13 Q 25, anything over 25 should be avoided,
14 that there's significant drainage going one way or the
15 other.

16 A Yes, sir, and of course that's going to
17 depend on the authorization level it has.

18 Q Right, yes. Just one other question,
19 it's brought up some questions I had concerning your expansion
20 area well, the B-29. I think you used that example
21 in this book here under Tab M, I believe, to show the support
22 that well was receiving, pressure support, it was
23 receiving from what you considered the pressure maintenance
24 area.

25 A Well, I just -- what I was showing there

1 was what I felt was consistent with what we observed in the
2 field.

3 Q And that, I think you mentioned, was
4 just a C Zone producer?

5 A Yes, sir, these are --

6 Q Assuming the barrier is there, it
7 wouldn't have to extend into all three zones, would it, A,
8 B and C?

9 A I suspect it could be -- would be in
10 varying -- in different amounts, unless it's just an abso-
11 lute fault. It's unlikely it's going to be the same in all
12 zones.

13 Q It's very difficult, I take it, in order
14 to separate the relative production attributable to each
15 zone. I know Mr. Bush tried to do that earlier and said
16 many wells, it's just -- you can just say that there's some
17 contribution. Initially I thought West Puerto Chiquito was
18 characterized as being predominantly C; Gavilan, predom-
19 antly A and B, and is that still your contention with the
20 pressure information you see?

21 A Well, it seems to me like it's still
22 pretty much that way. Just by happenstance our -- our best
23 C Zone wells now seem to be right up to the Gavilan bound-
24 ary and stop. There just doesn't appear to be -- there
25 appears to be some C Zone production in Gavilan but cer-

1 tainly nothing like we've got in the Unit, and why that is,
2 Lord only knows.

3 Q Could that also account for the fact
4 that generally I think you're showing the expansion wells
5 at lower GOR?

6 A Yes, sir, I think --

7 Q That it could be more C Zone?

8 A The C Zone with the gravity drainage and
9 pressure maintenance is why those wells are flowing so much
10 different from the others.

11 Q Could it also be because of the Bear
12 Canyon and possibly support from the south that these pres-
13 sures remain fairly constant due to migration into the,
14 say, the expansion area or the pressure maintenance area
15 from the north and south, or the northwest to the south?

16 A There is no doubt -- I say no doubt, I
17 feel like -- like Bear Canyon area is probably A and B. I
18 just can't believe that core on their analysis. We could
19 be getting some help from the north.

20 Q Thank you.

21 MR. LEMAY: I have no further
22 questions.

23 Additional questions?

24 MR. CARR: Just a couple on
25 redirect.

1 MR. LEMAY: Mr. Chavez, do you
2 have a question?

3 MR. CHAVEZ: One.

4
5 QUESTIONS BY MR. CHAVEZ:

6 Q Mr. Greer, I just want to clear up a
7 misunderstanding that may have occurred on how you're
8 measuring your injection gas.

9 A Okay.

10 Q Is the injection gas measured to pres-
11 sure record it on the (unclear) of the choke or by daily
12 instantaneous recordings by an operator?

13 A The injected gas --

14 Q Yes.

15 A -- as opposed to gas lift gas.

16 Q I'm sorry, the gas lift gas.

17 A Oh, the gas lift gas. The gas lift gas
18 we measure with -- through chokes and gas, injected gas we
19 measure through the meters and the total gas from the well
20 we measure (inaudible).

21 Q Is the gas lift gas measured, up stream
22 pressures recorded on a daily basis?

23 A Yes, sir.

24 MR. CHAVEZ: That's all.

25

1 REDIRECT EXAMINATION

2 BY MR. CARR:

3 Q Now, Mr. Greer, you testified there was
4 over-injection in the project area.

5 A Yes, sir.

6 Q Could the pressure gradient have moved
7 to the east from that injection?

8 A I'm sorry, say again?

9 Q From that over-injection could there
10 have been a pressure gradient moving to the east because of
11 that injection?12 A There could be no pressure gradient
13 from west to east from the over-injection.

14 Q And why is that?

15 A Because that's just excess pressure with
16 no relevant injection.17 Q Could it have gone to the north or the
18 south?19 A Oh, no way it could go north or south
20 because you've got virgin pressures up there and so there's
21 just no place for it to go.22 Q And did it go to the west, in your opin-
23 ion?24 A I think that there's no doubt that some
25 of it did.

1 Q And do you have a reason for that?

2 A Simply that there's not enough restric-
3 tion to stop it.

4 Q And the fact that you and Dr. Lee may
5 have reached some different figures on the gas injection,
6 does that cause you to reach a different conclusion from
7 Dr. Lee that the migration is in fact going from the in-
8 jection area into what's being called the expansion area?

9 A Oh, no, he was working on a different
10 kind of analysis than I was and his (unclear) don't have
11 any bearing on what I did.

12 Q In the F-20 Well, has that well been
13 perforated in the Mancos interval?

14 A No, sir.

15 Q It would not be possible, therefor, to
16 frac that zone, would it?

17 A Not in the Mancos Zone.

18 Q If you're called upon because of
19 increased withdrawals from Gavilan to increase withdrawals
20 from the wells in the west portion of this unit, what ef-
21 fect will that have on your overall pressure maintenance
22 project?

23 A Well, I feel that it will hurt it. I
24 just hope we wouldn't have to produce at higher rates.

25 MR. CARR: That's all I have.

1 MR. LEMAY: Thank you. Addi-
2 tional questions?

3
4 RECROSS EXAMINATION

5 BY MR. DOUGLASS:

6 Q Mr. Greer, on Mr. -- on Dr. Lee's study
7 what -- what millidarcy feet did he use between the 8-mile
8 area where you join the Tank 2 and Tank 3?

9 A Well, I'd have to look and see his mark
10 there. Looks like he's got 5 and 3.

11 Q Is that 5 darcy feet or 5 millidarcy
12 feet?

13 A That's 5 darcy feet.

14 Q 5 darcy feet.

15 A That's the numbers we were talking about
16 awhile ago in the B-32.

17 Q And when you ran the D-17 you got 55
18 darcy feet in that well, didn't you? Do I recall
19 correctly?

20 A Say again.

21 Q I said when you did the interference
22 test in the D-17 and you had a circle around all these
23 wells, you had 55 darcy feet, if I recall your testimony.

24 A That 55 darcy feet was Kh/u. The trans-
25 missibility we showed -- that's in our Exhibit Two under

1 Section C, when you come to the yellow sheets, at the top
2 of the page it says Kh/u -- 55. Then if you go a couple of
3 pages further over you find the green sheet and if you'll
4 look at the 1009 volume and for gas/oil ration of
5 1000-to-1, you'll have 16 darcy feet. Now that would be
6 like the B-29 and B-32. You've got 4 and 8000 cubic feet
7 per barrel, we're in the range of 2 to 4 darcy feet, which
8 is what would be along the boundary. So what we've been
9 talking about in the Koh in the range of 1 to 5 darcy feet
10 is about what the interference test shows, about what Bill
11 Weiss' test shows, pretty reasonable.

12 Q I think you said Mr. Weiss used 5 darcy
13 feet?

14 A He used 5 for the best well in the area.

15 Q Let me ask you, if the Commission should
16 adopt a production plan that permitted, say, 1200 barrels a
17 day to move from the -- that's 1200 barrels of stock tank
18 oil -- to move a day across into the Gavilan area, would
19 that be a plan that you would endorse?

20 A Well, we would hope for a plan in which
21 there would be essentially no migration. And the judgment,
22 Mr. Chairman, if the judgement, that we believe was left
23 strictly to the Aztec Office of the OCD, and I believe
24 they're capable of being able to tell whether they're get-
25 ting information, whether they can rely on it, or if there

1 is a problem, if they think there's a problem, we could
2 come back to the Commission and show you that something
3 else needed to be done.

4 Q Thank you.

5 MR. LEMAY: Additional ques-
6 tions?

7 Let's take a fifteen minute
8 recess.

9
10 (Thereupon a recess was taken.)
11

12 MR. LEMAY: This is a schedule
13 of how we're going to close out this thing.

14 The Commissioners are going to
15 ask some questions of specific witnesses, calling them back
16 without the opportunity for examination by lawyers or cross
17 examination. We just want to, because we've heard all the
18 testimony, want to zero in on those things that we don't
19 have a clear picture of, or we want some clarification for.

20 Beyond that we'll close. Each
21 side will have forty-five minutes to -- for closing argu-
22 ments.

23 We'll take the case under
24 advisement and we'll ask -- we'll leave the record open for
25 a week. I think there were some exhibits that were wanted

1 -- they wanted to add to with some written comment, I think
2 maybe concerning fractured fields that might produce with
3 pressure maintenance.

4 Is there any comment on that
5 procedure, any -- yes, sir, Mr. Douglass.

6 MR. DOUGLASS: Might I suggest
7 that since I think some of us are making comments, why
8 don't we just close it down, and I don't think whether we
9 hear about fractured fields somewhere else is going to be
10 important now. I hope it wouldn't be significant to one
11 side or the other as far as what we want.

12 MR. LEMAY: I have no problem.
13 I thought there was a desire on the part of someone to
14 submit that.

15 MR. DOUGLASS: I'll put it in
16 a motion for rehearing.

17 MR. LEMAY: You got a problem
18 with that, Mr. Kellahin?

19 MR. KELLAHIN: Our preference
20 is to accommodate the Commission. If you want that infor-
21 mation we will provide it, but I'm like Mr. Douglass,
22 there's perhaps more than we can all understand and maybe
23 you've had enough.

24 MR. LEMAY: You're testing me,
25

1 Mr. Kellahin. That's an understatement. We have lots and
2 lots, according to Mr. Weiss' testimony, to digest.

3 No, I think if it's important
4 to us, that research, we can go on on it, so if there is a
5 quick answer to that by one of the experts I would have
6 liked to hear it but it's not a probing question that's
7 going to decide the case. So I'll accommodate that. I
8 think we can close the record at the end of the closing
9 statements.

10 So does that sound like a good
11 schedule?

12 Let's continue, then, with I
13 think Mr. Hueni. Commissioner Humphries would like to ask
14 you some questions, Greg, if you don't mind.

15
16 GREGORY B. HUENI,
17 being recalled and remaining under oath, testified as fol-
18 lows, to-wit:

19
20 QUESTIONS BY MR. HUMPHRIES:

21 Q Mr. Hueni, yesterday or day before yes-
22 terday, I asked Mr. Roe about some conditions in the Gavi-
23 lan Mancos Pool as it's recognized today, and they had to
24 do with what I called the superstars and I don't think I'm
25 the creator of that term, but my question was that there

1 seemed to be an indication that that contribution to those
2 so-called superstars was poolwide and not discussing at
3 this point the expansion area, you've studied the Gavilan
4 Mancos a great deal and it strikes me that regardless of
5 whether it's Gavilan Mancos or some other field or some
6 other pool, there are from time to time going to be wells
7 that are better than other wells.

8 Is it your opinion that the contribution
9 to the very good wells is poolwide or is it unknown, due to
10 sort of a jagged lightning pattern macrofracture or what-
11 ever you call it, fractures?

12 A Mr. Humphries, I -- I believe that it's
13 largely unknown. We've testified before that while we
14 could use, for example, pressure production history to
15 determine oil in place for a field as a whole, that we
16 really have no very good method of carrying that back to
17 individual areas of the field.

18 The factors that influence the amount of
19 oil within any given area have to do with frequency of
20 fracturing, the spacing, the amount of matrix that's being
21 contacted by the fractures, the width of the fractures, as
22 well as whether you have A and B production, A, B, maybe
23 some C, maybe just A production. There are so many vari-
24 ables in there that we really don't think that there is
25 a method of saying that -- well, we don't think it's cor-

1 rect to say each spacing unit has the same amount of oil
2 under it and should be given the same -- same recovery.

3 We can make the case just as easily
4 that wells that have high deliverability must have favor-
5 able reservoir characteristics underneath that particular
6 portion of the pool, so that its -- that its rate is a
7 demonstration of its -- its -- what's underneath it, as
8 well.

9 But there's no denying there is commun-
10 ication between wells within the pool and, as such, for
11 example, when you go to a restricted rate scenario, then in
12 particular in our opinion what we've seen is that there
13 have been certain beneficiaries and certain people that
14 have been highly hurt by that restricted rate.

15 We see in particular the pressure pro-
16 posed expansion area as being a particular beneficiary of
17 the restricted rates and, obviously, other wells, particu-
18 larly in the Gavilan Mancos Pool proper have hurt.

19 But basically we have no method of going
20 to back to specific tracts and saying that -- saying exact-
21 ly what's underneath each of those tracts.

22 Q I interpret the second part of the ques-
23 tion that was that if, again minus the expansion area that
24 we've discussed, it strikes me that there is a fundamental
25 question there about the correlative rights of the people

1 who own the superstars as well, and there seems in your
2 recommendations about allowables, et cetera, you didn't
3 address that, and yet some of the body of the testimony led
4 me to believe that perhaps we're talking about just equal-
5 izing its production over the entire Gavilan Mancos Pool,
6 yet I clearly believe that there could be good wells as
7 well as bad wells within the pool, and I don't want to see
8 the people who have off production units or spacing leases
9 be damaged but on the other hand I'd hate to see the people
10 who have the good wells get (not clearly understood) the
11 source be punished for having good wells.

12 Is there, in your opinion, a way to
13 determine that, because I think that's becoming sort of a
14 secondary issue in my mind, is what's happening within the
15 -- especially Gavilan Mancos?

16 A Well, you know, I don't believe that's
17 there any way that you're going to do it with pressures,
18 and for example, pressure -- pressure comparisons across
19 this boundary. There's just too much flow rate that can
20 occur as a result of small pressure differences, even the
21 20 psi pressure differential that Mr. Greer talks about as
22 being ascribable just to different assumptions with respect
23 to the density difference of the fluid.

24 There -- there have got to be signifi-
25 cant differences in the quality of the reservoir under the

1 area. We go to the southern part of the Gavilan Mancos
2 Pool and we have wells down there that will produce 2 or 3
3 or 4 barrels a day and there's just no way that the reser-
4 voir quality is the same as the wells that are up in a
5 highly fractured area in the vicinity of, for example,
6 Mallon wells.

7 As a consequence, and I don't know
8 whether it's even appropriate, we obviously are not pre-
9 senting rebuttal testimony, but we did prepare an exhibit
10 that showed, for example, on Mallon's wells, we've talked
11 all along about barrels per psi rock that has occurred,
12 changes that have occurred during the field, and for exam-
13 ple, we have plotted for Mallon's wells under initial con-
14 ditions, a number of barrels that they were making per psi
15 drop, and I believe that was around 1200 barrels per psi.

16 The initial rate restriction went into
17 effect and they decreased then down to 450 barrels per psi
18 drop.

19 The normal rate testing period came back
20 into effect and they went up to 850 barrels per psi drop.

21 The restricted rates came back in effect
22 at the end of the start -- well, the middle of November,
23 and their barrels per psi is now down to 150 and they would
24 appear to have less than I would say 50,000 barrels of oil
25 remaining to be assigned to them under the existing

1 restricted allowable conditions.

2 So obviously there is a commonality of
3 the reservoir. There are good wells and there are poor
4 wells and I guess in my own mind I would make the assump-
5 tion that the good wells probably have better reservoir
6 quality associated with them, more fractures, more inten-
7 sive fractures, maybe wider fractures, maybe they contact
8 more matrix, and -- and therefor they -- they should have a
9 chance to -- or be given -- well, all the wells should be
10 given the same opportunity to produce and I think it's our
11 recommendation that from a reservoir standpoint to maximize
12 production, that opportunity to produce should be at least
13 the statewide allowables and preferably in terms of the
14 ultimate recovery standpoint a capacity type rate.

15 Q I would ask, I asked you once and I want
16 to just clarify again, and I've asked a couple of other
17 people, in your theory of this interspersed matrix and your
18 perception of the structures of producing rock, you'll have
19 to humor me a minute, because I had to finally tell Bill
20 Lemay, or the Chairman, excuse me, that I at least can see
21 the three dimensional part. The best thing I can do is to
22 give on analogy. I remember one time when I was a pretty
23 young kid and we had marbles that we called cat eyes, they
24 were clear marbles with some kind of stuff in the middle of
25 them, I don't know what it was, and I -- I decided I was

1 going to find out what this stuff was in the middle of them
2 and I learned two things. I went and got a big hammer and
3 I was going to break that marble to see what this stuff in
4 the middle of it was. The first thing I did was knock my
5 thumb nail off and the second thing I did was split that
6 and it didn't break open, it just shattered in every dif-
7 ferent direction and those weren't linear, they weren't
8 right angle, they were -- I remember they bent and twisted
9 and they went back and forth through this colored stuff in
10 the middle of them.

11 And that's the way I foresee the
12 fracture system going through your matrix. Is that a fair
13 assumption?

14 A Well, I think that's a fair assumption.
15 Certainly some of the geologic witnesses that we've had,
16 and past exhibits, are better qualified to tell you. Mr.
17 Elkins indicated that in his experience fractures are, this
18 perfect model that we have, is a three dimensional model, a
19 constant width, a constant frequency, that they vary in
20 many different aspects and I think you're right in assuming
21 that if this network is not just an equally spaced network,
22 it is probably a very broken up and irregular shaped solid
23 bodies of rock that are encased in basically these high
24 capacity fractures, such that if you inject anything,
25 whether it's oil or whatever you inject, you wouldn't in-

1 ject oil, but whether you inject gas or you inject water
2 the tendency is not going to be for the fluid to flush
3 through that very hard rock, but it is going to be basic-
4 ally to -- to pass around that rock. The only thing that
5 can work to get the oil out from inside that rock is going
6 to be some sort of imbibition process where it will suck
7 in, for example, maybe water and displace out oil, but that,
8 once again, has been proven to not be particularly effective
9 in this very, very (not clearly understood).

10 I'm afraid that I didn't really answer
11 your question.

12 Q Well, you're saying that that three
13 dimensional pattern is obviously not linear or small, it
14 has all kinds of widths and diameters, down to very barely
15 measurable and you have a lot of formulas for calculating
16 those kinds of things.

17 But if that matrix exists and those
18 fractures, micro-fractures, macro-fractures, or whatever
19 they are, go back and forth through it.

20 The one thing that's hard for me to
21 visualize is that in that if you're able to put some kind
22 of pressure behind, that just going back and forth in
23 there, that you may be able to move stuff through that even
24 with the imbibition theory, and it's hard for me to disregard
25 that completely, also, although I understand that your

1 differential concept, it strikes me that if you pass
2 through this matrix, it has multiple directions and mul-
3 tiple dimensions and widths, that you may have the oppor-
4 tunity by the fracture going through the matrix or the more
5 porous area, to move stuff between the micro-fractures or
6 macro-fractures that is in the matrix. I see the differ-
7 ence that you drew and I understand the concept between
8 pressure differentials. It's hard for me to imagine with
9 the fractures going every way, multiple dimensions and
10 shapes, that you couldn't move between fractures if you
11 have some kind of --

12 A Let me try again, then. What we're
13 looking at is a piece of matrix rock surrounded in a three
14 dimensional sense or somewhat by this high capacity frac-
15 ture system.

16 When you inject gas into that high capa-
17 city fracture system and you, say, pressure that gas up to
18 2000 psi, that 2000 psi gas pressure exists on both sides
19 of the matrix, so it can't really push anything through the
20 matrix. It's a pressure on both sides. There is no pres-
21 sure difference to push through the matrix itself.

22 So the only way that you get fluid out
23 of the matrix is for the matrix to be, let's say, at 3000
24 psi and then through its natural process of flow out of the
25 matrix have a lower pressure in the fracture than you have

1 in the rock itself. But if you try to inject gas and push
2 it out of the matrix, basically that gas pressure is going
3 to be the same on both sides of that matrix rock and
4 there's no way you're going to be able to push gas or any
5 other type of fluid through that matrix rock because the
6 gas will not want to go through -- through the matrix rock
7 itself. It will want to go strictly down the fractures,
8 fracture system.

9 Q And that's -- that slow give up or slow
10 rise to original production you believe to be the amount of
11 time it takes to drop the pressure or to make the pressure
12 differential between the fractures and the matrix or porous
13 --

14 A Yes, we -- we do not believe, in fact I
15 think you've seen a number of exhibits presented by various
16 parties here today where they've shown build-ups that
17 occurred over a period of time in the past. I think even
18 the 1965 pressure interference test that Mr. Greer showed,
19 showed that after 72 hours pressures were not anywhere
20 close to build-up in his wells. They were still building.
21 And this analysis that you do, that compares a barrel of
22 oil to a psi pressure drop, if it's done on a well by well
23 basis, and those pressures are not fully built up, then the
24 analysis is totally distorted by the lack of getting up to
25 a reservoir pressure in -- during that build-up period, and

1 that is why -- that is why we don't see these build-ups oc-
2 ccurring, because it's a very slow feed in from the matrix
3 into the fracture system that's going to occur over an
4 extended period of time. Mr. Elkins referred to, I think
5 in the West Edmond Field, build-up that was still going up
6 after, I think, 2 or 400 days of shut-in, but they were
7 still seeing increases in pressure.

8 So it's a very slow feed in that occurs
9 from the matrix system into the fracture and it means that
10 if you take a pressure of 72 hours, regardless of how well
11 intentioned you are, you probably are not, particularly
12 after a high rate of production, you are probably not going
13 to get anywhere close to an initial reservoir -- or to the
14 true reservoir pressure.

15 Q Is that slow recovery time what you ex-
16 pected production to be -- have been from -- in addition to
17 the -- assuming that there was no matrix contribution or
18 that that was only part of it, could that have been merely
19 a function of how far it had to come down the fracture sys-
20 tem?

21 A That's right. It's -- that, I think, is
22 the other part of this problem that is particularly a prob-
23 lem with analyzing production for psi pressure drop on a
24 well by well basis, because you have within the Gavilan
25 Mancos Pool and the proposed expansion area, you're going

1 to have a number -- you're going to have the fluids rear-
2 ranging themselves in the reservoir in response to these
3 restricted rates, normal rates, restricted rates. It's
4 going to change back and forth, and as a consequence,
5 that's right, there is -- there is -- I don't know if you
6 want to call it influx or efflux (sic) that will occur
7 within the given drainage area of any given well, and as a
8 consequence of that, the amount of production that you
9 achieve per psi pressure drop on an individual well in this
10 particular area, because of the -- some -- the large degree
11 of commonality of reservoir pressure, is -- is going to
12 also measure the influx/efflux between the different wells
13 in the -- in this Gavilan Mancos proposed expansion area
14 pool, and it can reflect influx or efflux from other areas
15 outside the pool to the north, to the south, to the east
16 and west.

17 Q Thank you. I have nothing else. I
18 appreciate it.

19 MR. LEMAY: Bill Weiss, you
20 want to educate us a little bit?

21
22 BILL WEISS,
23 being recalled to the witness stand and remaining under
24 oath, testified as follows, to-wit:
25

1
2
3 QUESTIONS BY MR. LEMAY:

4 Q I just want to concentrate on termin-
5 ology, barrier, permeability restriction. Let's assume
6 that we have some restriction there between the expansion
7 area and the pressure area project, but that thinking of it
8 in terms of maybe a -- I'll use the term semi-permeable
9 membrane, whatever that can conjure up, but the idea that
10 something can get through there, because very few things
11 are completely, at least within a porous formation, are
12 just like cement. Isn't it -- can't that be a function of
13 pressure differential on both sides as to what might pass
14 that thing and then what might not?

15 A Yeah, I think we've heard it this week,
16 many different things could be called a barrier. There's a
17 no flow barrier which is a fault or this igneous dike that
18 was mentioned, water leg, something of that nature. No,
19 not a water leg but a dike is certainly a good example of a
20 no flow barrier.

21 Then we have things mobility cages. You
22 see the -- and this is in homogeneous rock; in a water-
23 flood, maybe you'd see the -- the oil bank, that would --
24 might look like a barrier and a pressure test.

25 And then, of course, that's just a

1 change of mobility. Mobility that is permeability divided
2 by viscosity, so there's two factors in there, and I don't
3 think it's there.

4 Q You've been listening to all this testi-
5 mony all week. Have you changed any of your ideas initial-
6 ly?

7 A No.

8 Q What about the fact that we've got this
9 permeability restriction, then? You're building up pres-
10 sure on one side. Is there a tendency for that gas to
11 break through that restriction, first to the oil to follow,
12 do you expect some of those wells to gas out now?

13 A Yes.

14 Q As soon as that gas front gets close
15 you're going to start -- you anticipate breakthrough?

16 A Yes. That would be -- well, I don't
17 know as that would be definitive, either, unless you have a
18 feeling of that.

19 Q Yeah, right. Yeah, you wouldn't know
20 because you're also getting higher GOR's and so you're
21 trying to find a point in time and you may not have that
22 particular pause at the time.

23 A Yes, that could be a problem.

24 Q We're just trying to focus in things
25 like barrier and rates and what -- what would be your im-

1 pression if we did go to high rates and that was a barrier
2 that was a permeability restriction. It was -- there would
3 always be a pressure differential across that restriction
4 but some of the gas would be coming through, by reducing
5 the voidage both in the expansion area and to those sec-
6 tions adjoining it in the Gavilan Field, by having with-
7 drawals there, would that -- that would cause a greater
8 pressure differential, I guess, and quicker breakthrough,
9 would you say?

10 A Yes. You could very possibly suffer
11 from gas fingering, then. That -- in that fractional flow
12 equation I had before, I had what was called the critical
13 rate. You could use that approach for pushing down dip.
14 If you go too fast, the gas fingers. If you stay just
15 right, it doesn't finger. But you have to know the perme-
16 ability to do that.

17 Q The rates themselves being more effi-
18 cient, have you come to grips with the idea of how can you
19 have more efficient rates and higher production but still
20 on the barrels per pound pressure jump have a reverse rela-
21 tionship?

22 A Well, we did go ahead and check the --
23 on the column I had on Table IV. We converted those, added
24 the gas in terms of reservoir barrels and all we did was
25 get more barrels; we didn't change anything; the ratios

1 were still 5-to-1 in favor of more barrels produced per psi
2 pressure drop than during the high rate.

3 But -- so we didn't change anything
4 there.

5 The more I listen to it, I'm sorry, I
6 think in terms of fluid migration in terms of what's been
7 expressed here earlier, but I've not had time to go back
8 and look and see how that affects the build-ups with time,
9 that type of thing. For instance, these build-ups that --
10 there's a number of them that the engineering committee has
11 collected and I don't know what the effect would be with
12 time. You'd think if it was fluid migration it wouldn't be
13 as evident when the pressure is high as it is at the end,
14 where in the last group the pressures were down around 900
15 pounds, and there you can certainly see that, in many of
16 the curves, see that the tail end of the build-up would go
17 up, which I was -- in the B-37 interpreted it as a natur-
18 ally fractured reservoir. It might have been influx. It
19 might have been a barrier. I did look at that. The bar-
20 rier is either 300 or 2500 feet away, depending on what you
21 use for what you plug into the equation.

22
23 QUESTIONS BY MR. HUMPHRIES:

24 Q Did the idea now -- I can't remember who
25 advanced it, that there might be an opportunity to go with

1 high rate production for a little longer periods of time
2 than one or two days and I think that would be the idea, to
3 overcome the lag time to get the liquid into production.
4 If we went with that kind of operational procedure and got
5 your production back up to the highest or more desirable
6 levels, highest production, and then shut it back in, if
7 that imbibition period was there, it strikes me that when
8 you're shutting it in you still would have that; you might,
9 in fact, exacerbate it.

10 A Well, imbibition is a tough one and
11 these experts here can tell that. I did get a textbook and
12 I found that it was proportional to the size of the block,
13 which there are lots of guesses to. So during this shut-in
14 period, where you could have, in fact, gravity segregation
15 in a big block, which would overcome the capillary forces
16 and maybe you'd get some oil out of it along with some
17 shut-in.

18 This problem of rate sensitivity is --
19 is a real problem and I happen to like the idea of a sec-
20 ondary gas cap forming. That one suited me the best.

21 But there are valid reasons for wanting
22 to produce at a high rate. As well as whether to produce
23 at a high rate per month and then shut the field in for a
24 year, I don't know. I don't know how that -- I think
25 that's your problem.

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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 Propo-
nent 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

1 a jury trial, that's it, the plaintiffs get to open and
2 they get to close.

3 MR. LEMAY: Uh-huh, well you
4 certainly get to close but in which order to you want it?

5 MR. DOUGLASS: Well, I think
6 I'd rather close, if I just get one, if I've got any
7 choice, then I'd like to close.

8 MR. LEMAY: Well, normally
9 what we do, were you thinking of closing, then having their
10 close and then you're closing again?

11 MR. DOUGLASS: Yes, to rebut
12 what they said.

13 MR. LEMAY: Generally we
14 haven't done it that way.

15 MR. DOUGLASS: Well, I can
16 play around or through. You tell me what the rules are and
17 I'll abide by them.

18 MR. LEMAY: Okay, generally we
19 just have closing once but it's your choice, whichever, if
20 you want to close at the end or close at the beginning?

21 MR. DOUGLASS: If I've got a
22 choice, I want to go last.

23 MR. LEMAY: Fine.

24 MR. KELLAHIN: We'll give Mr.
25 Douglass that choice.

1 MR. LEMAY: I appreciate that.

2 MR. KELLAHIN: Gentlemen, I'll
3 be the first to tell you there is lots I don't know about
4 this case. There are some things I did learn, however. I
5 learned some things about how the Railroad Commission of
6 Texas operates and functions from Mr. Powell.

7 I was pleased to learn how
8 that in Texas in these tight fractured reservoirs that they
9 do, in fact, have pressure maintenance projects for primary
10 production in only parts of the reservoir.

11 I was pleased to hear from him
12 in Texas that they do allow those pressure maintenance
13 operators to reinject their gas into that reservoir in or-
14 der to replace reservoir voidage and they get a credit for
15 that.

16 I don't want to tell you that
17 I know a lot about reservoir engineering, but there are
18 some things which I do know.

19 I know that in New Mexico the
20 rule of capture is not the rule in this state, where this
21 Commission has been a pioneer among states in the southwest
22 and in the United States in protecting correlative rights
23 and preventing waste.

24 I don't think you have to take
25 advise from Texas or any other state about how you run this

1 Commission.

2 You have the comfort and con-
3 fidence to act as a Commission knowing that in some fifty
4 years of operation this Commission has been reversed by our
5 judicial system only once or twice, but there are some sig-
6 nificant cases in Commission orders for which I do know.

7 I know that if the rule of
8 capture were in place, then these superstar wells that
9 we've talked about of the Gavilan Mancos could produce at
10 capacity and drain the other wells in Gavilan and drain the
11 other pools in the immediate area and there would be no
12 need for this Commission to exist and we would not be here
13 today.

14 I know that the statutes of
15 New Mexico and the rules of the Oil Conservation Commission
16 are there to keep order in the Gavilan Mancos Pool and to
17 create balance in this pool where the operators cannot do
18 it for themselves.

19 I know from the Continental
20 Oil case of 1962 the Commission can use a pure acreage for-
21 mula among the spacing units for each of these wells and
22 allocate that share of production based upon acreage; in
23 the absence of convincing data, that you can determine the
24 total portion of the pool reserves underlying each spacing
25 unit.

1 I know that from the Contin-
2 ental Oil case, from the Viking Petroleum case, from the
3 Faskin case, from Duke City Lumber, the Trujillo case, that
4 the Commission must in its deliberations review the whole
5 record of this proceedings and consider the entire record,
6 both the evidence for a decision and against that decision,
7 whatever that decision is you must consider the evidence on
8 both sides of that issue. You cannot simply look at that
9 evidence that supports the conclusion that you believe you
10 want to reach.

11 I also know from reviewing
12 those cases and practicing before this Commission that the
13 order itself that you write must be clear in giving us
14 specific findings that disclose the reasons of this Commis-
15 sion in reaching its ultimate conclusions and in doing so
16 you must explain yourself.

17 In writing that order I know
18 that you can reject the competence of Mr. Hueni's dual
19 porosity computer modeling because I know there is an al-
20 ternative explanation from Dr. Lee, because Dr. Lee can
21 take that model with observed reservoir performance and
22 factors and he can match with his model both historical
23 facts without using the dual porosity hypothesis, and with-
24 out having a barrier hypothesized into the model.

25 I know that you can reject Mr.

1 Hueni's concept of the inverse rate sensitivity conditions
2 because Mr. Roe has told us that all that is occurring in
3 this reservoir is not dual porosity operations, it's simply
4 the migration of fluids in the reservoir. We have wells
5 competing against one another, and that's the explanation
6 he sees for the inverse rate sensitivity.

7 I know that you can reject Mr.
8 Hueni's dual porosity hypothesis and explain that rejection
9 very clearly and convincingly in the order that you write
10 based upon the fact that no other well but the Mobil
11 Lindrith B-37 Well has a build-up curve that has a shape
12 that can be attributed to dual porosity.

13 I know that you can reject Dr.
14 Kohlhaas' testimony in support of a barrier, about not
15 seeing that interference between the B-52, the B-32, and
16 the C-34 Well and explain that with conviction because Mr.
17 Greer has told us that Dr. Kohlhaas has used the wrong
18 plots and he didn't see it. He didn't see it because it
19 wasn't there. He simply used the wrong plot.

20 I know that you can reject
21 that barrier hypothesis because of the observations of the
22 situation that your own witness, Mr. Bill Weiss, has found
23 from the project area into the expansion area, and he is
24 the only witness that's been before you in the entire pro-
25 ceedings that is not -- has not been paid by either side by

1 being here for his testimony.

2 I know that you can adopt an
3 order that rejects Mr. Hueni's conclusion that the high
4 rate is more effective for Gavilan Mancos because you know
5 from his own Exhibit Number Twenty-two, for which Mr. Roe
6 had calculated that there are 6,089 more reservoir barrels
7 per pound of pressure loss recovered at the lower rate than
8 at the high rate from Mr. Hueni's own work.

9 We have a significant contrast
10 in styles here between the opponents and the proponents. I
11 thought Mr. Douglass and Mr. Kohlhaas had a wonderfully
12 nice style when they took that display and they showed the
13 interference test on both sides and they had the red lines
14 across the hypothesized barrier and Mr. Douglass had that
15 wonderful opportunity to rip off the tape every time Mr.
16 Kohlhaas told him to take it off. That was great style,
17 but that style does not remove the fact that Mr. Greer has
18 measured the interference across that barrier, so-called
19 barrier, lease. Removing that tape from that exhibit does
20 not remove the fact that Mr. Weiss finds that there is
21 pressure response in the expansion area directly attribu-
22 table to the project area. It's in his report; he commit-
23 ted it to writing; he committed it in a preliminary report
24 and in the final report and he did not change it.

25 Let me direct my attention for

1 a moment to some of the comments that Mr. Lund made earlier
2 today. It's unfortunate that he could not stay for the
3 rest of the day with us, but let's address ourselves for a
4 moment to some of this comments.

5 How would you adopt a position
6 that Mr. Lund urges you to adopt and explain away the fact
7 that his own witness tells us that the initial pressures in
8 the Bear Canyon Unit are lower than Amoco expected to find
9 when they drilled the discovery well?

10 How do you explain the fact
11 that Betsy Lough had forgotten Mr. Roe's testimony from the
12 day before when he said he had examined the results from
13 the Amoco core and it did not bleed?

14 Mr. Lund drew a comment to Dr.
15 Lee providing a correction in the number of barrels of oil
16 to be recovered in Gavilan Mancos in the absence of pres-
17 sure maintenance. On Monday Dr. Lee gave us one number;
18 the following Wednesday, I believe it was, when he testi-
19 fied, he had another number on that portion of his exhibit.
20 Isn't it interesting that Mr. Lund did not remind us of the
21 basic conclusion of Dr. Lee that regardless of what that
22 number was, the 5-million barrels of oil under primary re-
23 covery in Gavilan or the 7-million, the fact of the matter
24 is Dr. Lee tells us under pressure maintenance we're going
25 to get 10-million. The basic conclusion was the same.

1 And isn't it refreshing when
2 witnesses of the caliber of Dr. Lee and John Roe and Al
3 Greer get before you and run the risk of letting the oppo-
4 sition argue that they have changed a calculation. They
5 take that risk just so they can give you the most accurate
6 number upon which you then can rely to make your judgments.

7 How do you explain with confi-
8 dence if you go to a higher allowable rate in the Gavilan
9 Mancos and rely upon the dual porosity reservoir hypothesis
10 when you are shown only 1 well out of 87 wells in the study
11 area, a well that is isolated in the western portion of
12 Gavilan that has that shape on the build-up curve? How do
13 you rely with confidence on the Mobil well core in the
14 southwest corner of this reservoir? Is it not easier to
15 explain that simply related to the situation an anomalous
16 example that you can reject?

17 How do you explain with confi-
18 dence to Mr. Greer that the barrier does not leak when he
19 has shown you the interference across that barrier?

20 How do you explain to Dr. Lee
21 with confidence that you have a dual porosity reservoir
22 when he knows that the better engineering explanation for
23 the shape of those multiple build-up plots is one where we
24 have phase redistribution in the wellbore?

25 And how do you explain with

1 confidence to Mr. Roe that you have matrix contributing in
2 the Gavilan Mancos when Mr. Roe has looked at the informa-
3 tion from the Mallon Davis core and under visual observa-
4 tions, that core shows no oil?

5 How do you explain with con-
6 fidence to Dr. Lee that the matrix is contributing, when in
7 his six section sponge that he gave you in his report, with
8 the eight wells, that we squeeze that sponge as hard as we
9 can under those conditions and we do not improve recovery
10 in those eight wells?

11 How do you explain to Mr. Roe
12 that you have increased the allowables to the higher rate
13 when he knows at the higher rate it recovered only a third
14 of the oil per pound of pressure loss in Gavilan Mancos
15 that the lower rates did?

16 And how do you explain to the
17 operators of the 23 wells during the high test rate that
18 had decreased oil recoveries, that you're going to increase
19 the allowables for the benefit of those operators of the 15
20 wells that are going to benefit? How are you going to
21 resolve that?

22 How do you explain to the
23 operators of the 43 wells that had their productivity re-
24 duced by the high rates that it's okay because we need to
25 help the 15 better wells?

1 How do you explain to Mr.
2 Greer that his pressure maintenance project is not a suc-
3 cess and not entitled to an injection gas credit when he
4 knows he's recovered 15 percent more of the original oil in
5 place in his unit compared to Gavilan Mancos and its 6 and
6 8 percent recovery?

7 How do you explain the fact
8 that Mr. Powell finds that the pressure is constant in the
9 unit between June 30th, 1987, and February 29, 1988, when
10 we know there is over-injection in the unit and as a re-
11 sult of that injection Mr. Weiss sees pressures being
12 supported across the barrier into the expansion area on
13 those three wells that he's put in his report?

14 How do you find an effective
15 barrier and explain away the fact that the pressure main-
16 tenance area was providing pressure support to the D-17
17 Well and the B-29 Well in the expansion area?

18 And how do you explain away
19 the conclusion Mr. Greer gave you, that at the higher rate
20 of withdrawals in Gavilan the pressure maintenance project
21 cannot keep up with the withdrawal rates in Gavilan and
22 there will be a pressure sink, where at a lower rate, the
23 rate of injection of gas in the main project area is
24 allowed to come across the permeability restriction area
25 and recharge the expansion area and recharge Gavilan?

1 The simply basic conclusion is
2 that without the pressure support from the project area
3 across this assumed barrier, the pressure and the produc-
4 tion in the expansion area and in Gavilan will sink like a
5 rock.

6 How do you adopt a higher
7 allowable rate in Gavilan Mancos based upon the credibil-
8 ity of Mr. Hueni as an expert when you have before you his
9 conclusions of the August, 1986 hearing; the conclusions of
10 the March '87 hearing; the conclusions of the hearing this
11 week, each of which contain at least one fundamental,
12 basic, essential conclusion that is different each time he
13 testified?

14 How do you explain to Mr.
15 Greer why you have decided to put at risk a lifetime work
16 of effort to maximize recovery in the Canada Ojito Unit in
17 order to satisfy and receive an erroneous assumption that
18 higher rates for certain high capacity wells is in the best
19 interest of all parties?

20 Mr. Lund earlier today gave
21 you some definitions about correlative rights. Correla-
22 tive rights is written in your rule book, it's in your
23 statutes, and it says simply this: Correlative rights is
24 an opportunity to produce your fair share of the reserves
25 underlying your spacing unit. It is not an opportunity to

1 take advantage of the adjoining spacing units and produce
2 their share of the oil with your superstars. Capacity
3 allowables in Gavilan Mancos will take us back 50 years to
4 the worst days under the rules of capture.

5 I told you on Monday that we
6 had a solution to this case. I did not tell you until
7 Thursday when Mr. Roe testified what we proposed with Mr.
8 Roe as a solution to the allowable rates in Gavilan; how-
9 ever by Tuesday afternoon Commissioner Lemay had already
10 found that solution in his questioning of Mr. Hueni con-
11 cerning how to handle the liability of the flexibility of
12 producing rates for the superwells.

13 I think that fact can be re-
14 solved by proposing a flexible rule for the producing rates
15 of Gavilan Mancos that we discussed with Mr. Roe; that we
16 reconfirmed with Mr. Greer; and I have taken the time to
17 write out what I think is the solution to your problem. If
18 I might have a moment, I will pass those out.

19 Gentlemen, I appreciate the
20 opportunity to appear and practice before this Commission.
21 It's always a privilege and honor. I have enjoyed that
22 privilege this week. I have enjoyed meeting and partici-
23 pating against Mr. Douglass and the other attorneys on the
24 other side. I thank you for your time.

25 MR. LEMAY: Thank you, Mr.

1 Kellahin.

2 MR. CARR: May it please the
3 Commission, this is the time in these proceedings where the
4 incompetents get to finally take over. This is the last
5 opportunity that anyone in this group is going to have to
6 address you in the context of this hearing. For those
7 people who want to maintain the current allowable rates in
8 the Gavilan Mancos Area and after I sit down you're going
9 to hear a great deal from Mr. Douglass and others. You're
10 going to hear about the barrier, and about the porosity and
11 interference and whether or not it's there or not. You may
12 get to look at some more exhibits, and you're probably
13 going to even get to hear something about Mr. Greer.

14 The reason that they go last,
15 they get the last say, is because they have the burden of
16 proving that change is really warranted and they have to
17 meet that burden, and I'm convinced that when you stop and
18 deliberate on the (not understood) they've made after 17
19 days of hearing and review this with your staffs, that you
20 will conclude that they have failed to meet that burden.

21 Now the incompetent lawyers, I
22 think, in our own defense it's fair to say, have tried to
23 keep lawyer damage in this proceeding to a minimum and I
24 think I can speak for both sides in saying we have stepped
25 back and we have let the competent experts come forward to

1 lead you through the wilderness and they took the same data
2 and they ran in opposite directions, and so now we tender
3 to you what has got to be a difficult decision and as you
4 retire to reach your final decision in this case, there are
5 two people who have appeared before you who I believe stand
6 in unique positions.

7 The first one of those is
8 obviously Al Greer. He's different from all the rest.
9 Long before there was Gavilan, long before there was imbi-
10 bition, Mr. Greer with his slide rule walked out into
11 northwest New Mexico and he found a reservoir that I think
12 one thing we all agree on is if it isn't unique, it's
13 complicated. I think that fact is underscored by even Mr.
14 Hueni's testimony. One time we see Mr. Hueni, he talks
15 about the existence of a barrier and how effective it is.
16 The next time something else; the next time imbibition, and
17 I'm not saying those are wrong but I'm saying it under-
18 scores the fact that this is a complicated and a difficult
19 question.

20 Mr. Greer went out and he took
21 the data as it has been developed over the years. He has
22 interpreted it. He has found tight blocks in a reservoir
23 connected by an extension fracture system, gravity drain-
24 age, and all of those things you've heard about, and he has
25 instituted in this Canada Ojitos Unit a pressure mainte-

1 nance project. This has not been something Mr. Greer has
2 done alone.

3 If you go back through the
4 records of this Commission, there aren't 17 days of hearing
5 there are many times that, for as he has developed the area
6 he has done it in close association with the regulatory
7 authorities of this state.

8 Now the concepts that were
9 developed by Mr. Greer, I think it is important, and I've
10 told you this before, the concepts that were developed by
11 Mr. Greer are, unlike so many of the concepts you've had
12 presented to you, they were not developed for the purpose
13 of the hearing. They were not developed to produce the
14 reserves that are in the Gavilan Mancos area. They were
15 developed to produce oil and as we have through these
16 hearings seen experts come forward one after another, we
17 believe that Mr. Greer's theories still stand before you
18 and they stand before you basically unrefuted.

19 Mr. Elkins comes before you
20 and we believe he in fact confirms you use the EI approach
21 and that you interpret the interference tests as Mr. Greer
22 has done.

23 We saw Dr. Kohlhaas come
24 before you and I don't want to suggest that we were having
25 engineering games played but we -- I do submit to you that

1 the analyses of the interference test that he made were
2 incorrect; his results were wrong.

3 Mr. Greer, on the other hand,
4 has come before you and explained how you read those graphs
5 and what they really show. He has shown you why the inter-
6 ference tests look like they do and he's shown you that
7 they show there's interference in the area of the boundary
8 -- of the barrier. There's communication and we submit
9 that we can couple this with the normal pressure gradients
10 that you see across the reservoir with the evidence of
11 pressure support in the expansion area during very recent
12 test periods, that you must conclude the barrier was in
13 fact there -- that you must conclude that the barrier is in
14 fact not there.

15 I think when you look at the
16 evidence you're going to find that pressure maintenance is
17 working, that it must be, and that it is only a clever
18 trick to move the boundary of the Gavilan into our unit and
19 then claim the down dip production and say that the unit,
20 Mr. Greer's unit is dying and the Gavilan is continuing to
21 produce at a more effective rate.

22 So the bottom line, I think,
23 is that we believe what we have told you over the years
24 remains true, and it remains true today, and I ask you when
25 you retire to consider this evidence, that you think about

1 what the two parties have come before you to propose. On
2 one side, we want to produce it all; we want to do it now.
3 On the other hand we want to do it slowly. We want to do
4 it right, and we have come before you and we have shown you
5 how we offer to continue to work with you to monitor that
6 migration across the boundary both ways, to assure that
7 correlative rights are protected and that people are not
8 harmed.

9 I can tell you I'm proud to
10 stand up with Mr. Greer. I'm convinced I stand before you
11 with one of the most respected men in this industry and he
12 has come before you to tell you what he believes; to tell
13 you what he knows, and he knows it because it's been con-
14 firmed by 26 years of experience, 26 years of actual field
15 information.

16 Mr. Kellahin pointed out that
17 we didn't have, perhaps, the razzle-dazzle of the other
18 side, and I'm not willing necessarily to concede that, but
19 we are convinced that however we presented it, what we told
20 you was right. We're asking you not to destroy a pressure
21 maintenance project that benefits the interest owners in
22 the unit, that benefits the State of New Mexico, and will
23 continue to benefit the people of this state and the
24 interest owners in this unit for years to come, and we're
25 asking you to do that instead of just returning a quick

1 buck to somebody else.

2 Now the second person who I
3 think stands before you in a very unique posture is a per-
4 son that you turned to for advice, the man that you asked
5 to come in and help you understand the very complicated
6 matter, give you some neutral opinions and some independent
7 counsel on the engineering side of this case. In this room
8 full of experts there is probably only one who's not being
9 paid one penny extra for being here and that is, of course,
10 Bill Weiss.

11 Now I can tell you that we
12 don't agree with him on some things. He took the informa-
13 tion from one core. He finds this to be evidence of dual
14 porosity, and in fact we don't disagree with that statement
15 so much but with the implications that can be drawn from it
16 but we still contend that the evidence on dual porosity
17 looks a heck of a lot more like an anomaly than a reservoir
18 wide characteristic.

19 But there are areas where we
20 also agree with Mr. Weiss. He finds absolutely no barrier
21 and we think that is obviously the situation in this reser-
22 voir.

23 He finds that the reservoir is
24 rate sensitive and we agree with that.

25 I can tell you too that I was

1 surprised last month to see you release his report when you
2 did. With this kind of help I don't think Mr. Weiss would
3 have written anything at all that could not have been
4 seriously attacked by one side or the other. I will tell
5 you that after five days of hearing this week I think his
6 report stands before you in a pretty good position and it
7 still stands as an honest, competent, professional job and
8 it should be given, when you consider this case, substan-
9 tial weight, and that's lots.

10 Now, if we look at the case,
11 there are some things here that are easy to dispose of.
12 Those can be gotten out of the way quickly. Separating the
13 C Zone one time may have sounded like a great idea but I
14 just don't think in this record it really poses a sure
15 thing.

16 Moving the boundary, further-
17 more, accomplishes nothing; it's a political boundary. We
18 can move from one political boundary to another political
19 boundary, but that doesn't accomplish anything, when the
20 boundary that counts is the unit boundary. It's a
21 creature that has been blessed from time to time by this
22 Commission, but it is a creature of private contract. It's
23 an approved Federal unit and the unit boundary is going to
24 remain. I think those questions are out of the case.

25 The harder question is for you

1 and that's what do you do to make sense out of all that's
2 been presented to you. You're doing today what Mr. Greer
3 tried to do 26 years ago. You're trying to take the infor-
4 mation available and decide what is right to efficiently
5 produce the reservoir.

6 We submit it need not be, how-
7 ever, as difficult as it may appear, for we have attempted
8 to show you how it can be done, expand the pressure main-
9 tenance project, obtain reasonable rates, monitor the flow
10 across this boundary both ways and we're ready to work with
11 you in doing that to assure that no one gains an advantage
12 and no one's rights are impaired.

13 We think that you should
14 permit production at whatever rates are necessary for short
15 periods of time, if it is necessary to get the oil out of
16 that reservoir and to do it in an efficient fashion if this
17 is what needs to be done, and when you do this, we are con-
18 vinced that you will have acted to prevent waste, your pri-
19 mary statutory responsibility, and you will have acted to
20 protect correlative rights and you will have met all of
21 your duties as members of this Commission.

22 Thank you very much.

23 MR. LEMAY: Thank you, Mr.
24 Carr.

25 Mr. Douglass?

1 MR. DOUGLASS: First of all,
2 let me thank you gentlemen for letting me participate here.
3 This is a very serious case. I'm not going to cast asper-
4 sions on co-opposing counsel for being against my position
5 here. That's not my style. I do not play games with
6 clients, opposing counsel, juries, judges, or administra-
7 tive bodies.

8 My client's rights and pro-
9 perty have been severely and adversely affected by what's
10 taken place previously. Production of my client's wells
11 under the normal allowable is 1000 barrels of oil per day,
12 and it's been reduced to 50 barrels a day, still going down
13 as a result of strict allowables.

14 Let's put an exhibit on here
15 to show you how Mallon was going to benefit from restora-
16 tion of the normal allowable rates. All I can say is that
17 that's the best exhibit I know to show you what these re-
18 strictive rates have done to my client, because only by
19 producing normal rates will he get his fair share from this
20 field.

21 He's not just by himself and I
22 think this shows exactly what that -- how and why that re-
23 stricted rate was designed. It was designed to affect only
24 Mallon and only next to the expansion area because the ex-
25 pansion area had not gotten their wells (unclear), had not

1 gotten their numbers in, and according to Mr. Greer would
2 be (unclear).

3 Others are impacted. You've
4 seen the list of them. Those that have stood up and are
5 going to stand up with Mallon, because Mallon does not
6 stand alone. He does not ask to us to do what's right by
7 himself, although I think he's entitled to do so. All of
8 these parties agreed to a detailed study. Their position
9 has been the same as a result of that study. And the
10 question that you now have to decide are the issues and I
11 think it's clear from your questions that you know what the
12 issues are in these cases and you don't need me or anyone
13 else to tell you what they are. You've seen them, you've
14 asked the questions (not clearly understood>)

15 Let me say that it's obvious
16 that everything doesn't fit, and I think we know the reason
17 why. It's Mother Nature. If she let everything fit what
18 good would be on this earth? How would we think? How
19 would we find? How would we expand, if every question had
20 a finite solution?

21 Administrative bodies such as
22 yours have two functions. You're the judge and you're the
23 jury; quasi judicial is what these sessions are, what it is
24 here. That's what it is in almost every state that has
25 judicial authority.

1 Now there's no dispute about
2 the law. I don't think there's any question about the
3 rules. I'll accept them. Mr. Kellahin's definition of
4 what correlative rights are, Mr. Roe's. In every state
5 I've been to it is essentially identical, even a backward
6 state like Texas it is essentially the same. Fair share
7 has been used in our Supreme Court opinions for years and
8 years and years. And let me suggest to you that in order
9 to get a fair share you don't restrict a field down to 40
10 (unclear). That's clear, I think, in New Mexico or any-
11 where else. That's not the standard. That's not what's
12 going to cause oil and gas to be produced. That's not
13 what's going to cause outside capital to come into New
14 Mexico to drill and produce wells, is to set the standard
15 at the lowest level, and you haven't done that. You have
16 set fieldwide yardstick allowables and that's what was in
17 effect in this field before and that's what brought about
18 drilling of these 80-something wells that were out here.

19 The operators had an opportu-
20 nity to produce.

21 And let me suggest something
22 else; competition is not bad. Our country has been built
23 on it. Obviously there are some opportunities when you
24 have freedom, when you have equality. Obviously a lot of
25 times that is an efficient way but it has to be economical-

1 ly feasible, economically practical, for that to happen.

2 My suggestion to you gentle-
3 men is that the best way to decide that is the ones who are
4 spending the money. I think you have the duty to make sure
5 that waste does not occur, and I think that that's why this
6 original restriction was put in because that Commission had
7 a question about whether waste would be caused by contin-
8 uing to produce oil at normal rates and I think the evi-
9 dence since that date and you can see it now and the result
10 of your test shows without question that producing at nor-
11 mal rates (unclear) producing at normal rates caused low
12 GOR and low GOR is more efficient. Every witness has tes-
13 tified and ascribed to that. That has been a uniform and
14 tested theory through every witness that has been here.

15 Since there is no dispute on
16 the law, then your function has obviously got to be to
17 decide the facts and then the remedy; oftentimes juries do
18 that; and they do it, I think, in the same manner that you
19 will be called upon, and that is with the preponderance of
20 the evidence. It's not the great weight of the preponder-
21 ance of the evidence. It's not beyond a reasonable doubt.
22 Let me say, if it was beyond a reasonable doubt, and if I
23 was a barrier, I would be convicted, because the evidence
24 is beyond a reasonable doubt that it exists.

25 Upon a preponderance solely

1 it's a scale. The evidence appears to tip the scale one
2 way and that's the way the facts should be decided and
3 unless there is enough evidence, even though there may be
4 some evidence, unless there's enough evidence to tip the
5 scale the other way, the preponderance of evidence rules.

6 In this case I think you could
7 even go to a great preponderance of evidence. I think
8 there are some things that are even beyond a reasonable
9 doubt on the preponderance side. Let me say that the Pro-
10 ponents did not create this barrier. This barrier was re-
11 cognized by Mr. Al Greer twenty years ago. He knew that he
12 found something that stopped flow down dip from where he
13 was located and that's obviously the reason that he didn't
14 go develop one of the nicest, biggest, substantial oil re-
15 servoirs that you've probably got in New Mexico. If he
16 didn't think there was a barrier down dip, then why didn't
17 he go develop it.

18 I think Mr. Al Greer is a
19 smart operator. I think you've seen him enough on the
20 stand to realize exactly how smart he is and I think that
21 the situation that we have here is, Mr. Weiss says that he
22 has to have a geological barrier in there before he thinks
23 it's one that stops the flow. I think that the more
24 reasonable situation would be that obviously there's at
25 least one barrier in that reservoir or this oil and gas

1 wouldn't have stayed there. This formation, as I under-
2 stand it, outcrops on top of the ground, so obviously
3 there's a permeability barrier in this reservoir that you
4 cannot find geologically, that stops the flow of oil and
5 gas, and I suggest to you there are at least two. A bar-
6 rier is shown by our Exhibit Twenty. Mr. Greer has been in
7 the business for 26 years and I think he's an excellent
8 petroleum engineer, and we've run an interference test
9 that's almost as long as the 26 years in this reservoir and
10 nobody yet has told us how these two reservoirs can be in
11 effective pressure communication when you start out with
12 the pressure down here, continue the pressure all the way
13 across, have pressures in between that fall at or near this
14 line, and you have another reservoir that comes in at least
15 350 or more pounds above, it will come down, and we're now
16 at a 5-to-825 pounds versus 1400 -- we're now 525 pounds
17 pressure below and we're 350 pounds or more above, gentle-
18 men, that is not effective (unclear). You gentlemen recog-
19 nized it in your order as the result of the March, 1987,
20 hearing. You had a serious question at that time. You
21 wanted test data and information, and that test data and
22 information has shown communication as far as the wells on
23 the west of the boundary are concerned. It has shown
24 communication as far as the wells east of the boundary are
25 concerned. But it has shown no communication across the

1 barrier.

2 They chastise Mr. Hueni about
3 being inconsistent. I think not. I think that Mr. Hueni
4 is an excellent petroleum engineer and I think he's given
5 forthright opinions that he's had, and I believe that as
6 far as this case is concerned that they found no error by
7 Mr. Hueni.

8 I think Dr. Kohlhaas, when he
9 put on his case, showed clearly that there were no frac-
10 ture responses in the four wells that Mr. Greer said there
11 were, and as I understand it, Mr. Greer has to do a differ-
12 ent type of analysis to show that data, and I suggest to
13 you gentlemen that all you need to do is to look at the
14 tests themselves in the same scales and these four tests
15 show fracture response and we offer it in this case, it
16 ought to be in communication, these four tests -- he sub-
17 mitted another one to you just on the stand that shows
18 another pressure response in the B-32 Well and you saw what
19 type of response. These fracture tests were across the
20 barrier and they do not show any response.

21 Dr. Lee's model in order to
22 create pressure across the boundary use erroneous data and
23 information. He showed a pressure that both Mr. Roe and
24 Mr. Greer say is not correct, and then they just sort of
25 fluff off for that reservoir.

1 John Lee is not that bad an
2 engineer. He is a good, smart engineer. He has done some
3 oil in place calculations and he has compared those oil in
4 place calculations with what's taking place in the reser-
5 voir. They're consistent with the data and information
6 that's available. I'm not saying that they're completely
7 correct, I don't think that Dr. Lee would say they were,
8 but they are something that you can certainly look at and
9 see whether the fair share is being produced here; what's
10 happening in the reservoir.

11 I think that the evidence on
12 the barrier is clear, it exists. There is no data, there
13 is no interference test across the barrier. This barrier
14 was so easy to show it wasn't there, why didn't they show
15 an interference test pressure. Mr. Greer's rainbow map
16 shows pressure differential across that map. Let me see,
17 got one? Incidentally, my able assistant here is Mr. Mal-
18 lon's son, so we're -- this shows, even using Mr. Greer's
19 Greer's pressure, the way he measures pressure, he says
20 surface is better than bottom hole. I don't know about
21 that. I've always heard the other way around, but even
22 taking his, you see that they're consistent with the bar-
23 rier being in place where it is, and also the explanation
24 for the higher pressures in the gas wells in this tight
25 area that exist, the over-injection. Let me tell you about

1 that over-injection. That over-injection that took place
2 then went exactly the same place that it did for the 10
3 years that he over-injected and he couldn't keep up with
4 the pressure. That's what the evidence shows as far as
5 that's concerned.

6 I suggest to you that the
7 barrier does exist. It's an effective barrier to effective
8 communication across there and that's the first step. When
9 you take that step, then you can analyze what's going on in
10 this reservoir, once you get that problem out of the way.

11 The efficient rate of produc-
12 tion is one that I think we could show without question.
13 All of the data, you remember I started with Mr. Roe in
14 January of '87 at a time when they said there weren't any
15 problems involved when we were at the low rate. Every
16 month increased oil production, low GORs, lower GORs;
17 lower oil production, increased gas/oil ratios. It is true
18 each and every month during the higher rates production,
19 during the lower rates production that occurred. During
20 the normal rates and during the restricted rates that
21 happened, and that's inefficiency. It's inefficient to
22 produce this reservoir at high gas/oil ratios. You con-
23 serve energy, you prevent waste, no one has told you that
24 you do not prevent waste by producing at lower gas/oil
25 ratios and as Mr. Powell says, that's getting it, and it's

1 an opportunity that you have to prevent waste in the
2 future.

3 400,000 barrels in the past,
4 600,000 barrels in the future, 602,000. If you're going to
5 take this scheme that's been proposed of four months and
6 one month, shut it in for the next three months, the
7 problem with that is that that means 3/4ths of the waste
8 that we say is going to occur, is going to occur because
9 you're still only producing those wells at one quarter of
10 the rate. Waste is going to occur if you continue re-
11 stricted production here. The loss to the State has been
12 \$4-million already; it's going to be more. The loss to
13 these operators is \$22-million and that is significant as
14 far as these operators are concerned. That's the kind of
15 thing -- if you go to Sun's proposal and put it down to 94
16 MCF, you can't even pay out a well. When you get down to
17 the rates that we are now with the gas/oil ratios, you
18 can't pay out a new well. You don't have any new wells
19 being drilled when you produce at the rates that are being
20 submitted in this reservoir.

21 If you will recall with
22 reference to the production rate, the effect, I've shown
23 under any test of correlative rights, you'll recall that --
24 that if you take March's production, that they are produc-
25 ing 5.35 in the expansion area, 5.35 barrels per acre while

1 we're producing only 1.22 under the restricted rates, and
2 accepting Mr. Kellahin's definition as set forth in the
3 Continental case, that you can use acreage unless you can
4 determine or detect the reserves that are in each tract and
5 I haven't heard anybody say that they can't determine re-
6 serves in each tract, and if you're applying acreage,
7 that's not what's happening here. You're not using acre-
8 age allocation when you permit 1.22 barrels per acre over
9 in the Gavilan and 5.25 -- now that's using Mr. Roe's
10 Gavilan. That's using the Gavilan that has really been
11 hurt by these restrictions that are there. That's not an
12 opportunity to produce a fair share.

13 If you go to oil in place, and
14 using their figures, you understand this calculation up
15 here is using their figures as far as they acreage, but if
16 you go to the -- using their oil in place figures that they
17 have submitted to you, the percents that they put their
18 wells on, they have recovered 8.4 percent of the oil in
19 place under their tracts while Gavilan has only produced
20 5.5 percent. That is a 52.79 percent.

21 Maybe Mr. Greer is entitled to
22 be (unclear) for his pressure maintenance project. I'm
23 certainly not going to say that you shouldn't encourage
24 people to put in a pressure maintenance project, if they
25 want to put in a pressure maintenance project. Certainly

1 that is sufficient reward. He has already received a
2 substantial advantage that's occurred and you should not
3 continue an allowable system that substantially restricts
4 my client's wells and others in order to reward Mr. Greer.

5 I've got no quick bucks in-
6 volved here. I've got no razzle-dazzle. I got no great
7 style, but I do have one thing that the other side doesn't
8 have. I've got great facts.

9 Thank you.

10 MR. LEMAY: Thank you, Mr.
11 Douglass.

12 Mr. Pearce.

13 MR. PEARCE: Thank you, Mr.
14 Chairman.

15 May it please the Commission,
16 I am not in a comfortable position. It's late in the week
17 and it's late in the day and I am following some gifted
18 rhetorical gentlemen.

19 We began just a little while
20 ago with the Commission being told that you can do certain
21 things. I understand that. I've practiced before the Com-
22 mission and on behalf of the Commission for a number of
23 years and I understand that you can do a lot of things with
24 this case. After the number of years I've been doing this
25 I am willing to be presumptuous because I propose to tell

1 you what I think you should do.

2 I read the Oil and Gas Act; I
3 read your rules and regulations; I deal with them a lot and
4 I for one have an opinion on what you should do.

5 Mobil is one of 11 companies,
6 both majors and independents, who have spent two years
7 studying the Gavilan Mancos Pool. We've also studied the
8 expansion area. Mobil has done this because it, as well as
9 other operators, desire to utilize their geological, en-
10 gineering, and financial resources to recover as much oil
11 as they can. That's why Mobil's here. Mobil seeks the op-
12 portunity to produce a fair share of reserves under its
13 acreage and use a fair share of the reservoir's energy.

14 If the Gavilan Pool is allowed
15 to produce as the Proponents of the study, members of the
16 study committee have indicated is the most efficient, which
17 is allowing those Gavilan wells to produce whatever they
18 can, the maximum amount of oil will be produced from that
19 reservoir and that reservoir is the present Gavilan and the
20 expansion area, and if what we're about is trying to
21 prevent waste and get as much oil out of that reservoir as
22 we can, we're going to let those wells go.

23 Now, there was an exhibit
24 blown up which Mr. Douglass showed to you earlier which
25 dealt with percentages to be recovered. I want to assure

1 you that my client is not in the business of raising its
2 relative percentage of a smaller number. Those numbers may
3 be true. Our share of a daily production number may go
4 down but if the oil we recover is higher, that's fine with
5 us, because we're going to get more ultimate recovery and
6 in that sense our aim in this process is exactly the same
7 as yours is. We're both here to try to recover more oil.
8 And Mobil will pay a smaller percentage of a bigger number
9 but we want the oil.

10 Now I'm not going to restate
11 Mr. Douglass' argument summarizing the evidence about a
12 barrier between the proposed expansion area and the pres-
13 sure maintenance project. That barrier is there. Mobil
14 has spent two years studying the question. Mobil is con-
15 vinced. We think this record is clear. Yeah, two years
16 ago we started a 90-day study in the Gavilan reservoir. I
17 calculate we've studied it about 690 days now. My client's
18 position has not changed. We indicated to the Commission
19 at that time that this reservoir be turned loose so we
20 could recover more oil. That is still our position.

21 I'm not going to restate Mr.
22 Douglass' summary of the high rate/low GOR data. That data
23 shows that producing this reservoir at higher rates is more
24 efficient.

25 With regards to the possibi-

1 lity of gas injection, Mr. Elkins has presented conclusions
2 resulting from the two year or, if you will excuse me, 690
3 days, of money spent in studying, and I want to recall for
4 you what those conclusions are.

5 He concluded that the bulk of
6 Gavilan oil is in the matrix.

7 He concluded that injecting
8 gas into this fractured system will not recover more oil.
9 We wish it would; we'd inject gas; but it won't.

10 He concluded that oil will be
11 lost unless you maintain the highest pressure differen-
12 tial between the fractures and these tight blocks.

13 If there is a single individ-
14 ual who can help the Commission with the problems before
15 it, dealing with fractured reservoirs, it's Linc Elkins.
16 Mr. Elkins has got 47 years of hard core engineering
17 (unclear) of secondary recovery projects in fractured re-
18 servoirs. He's got practical experience and he's got
19 theoretical writings and everybody relies on his theoreti-
20 cal writings.

21 And he is a world renowned
22 expert in petroleum engineering. He's discussed for you
23 several analogous projects and he said I think you ought to
24 know that gas injection won't help you, and he named the
25 places where it had been tried and there was immediate

1 breakthrough and immediate project failure and it didn't
2 help anybody, it just cost everybody money, which causes
3 premature abandonment and wastes more oil, and that's all
4 you get for gas injection out here.

5 I wish that weren't so, but
6 the experts tell us it is.

7 All the parties agree that the
8 Gavilan and the expansion area are relatively flat. They
9 are in relatively good communication. There is not a
10 poolwide gas cap. If you inject gas in that pool you're
11 going to get fast breakthrough. It's happened over and
12 over and over again and the people have related those
13 stories to you, and nobody's come up with a gas injection
14 project in a fractured reservoir. The people who have been
15 studying this all their professional lives haven't done it.

16 And we believe it's signifi-
17 cant that Dr. Lee has come to this hearing and has aban-
18 doned the model he used before. We're not surprised. We
19 think it's interesting, we're not surprised. We thought
20 that model was flawed; we still think it was flawed. We're
21 not surprised he didn't use it.

22 Mr. Elkins also confirmed that
23 the Gavilan and the expansion area are a dual porosity sys-
24 tem. By applying measured reservoir parameters and recog-
25 nized calculations, Mr. Elkins has concluded that the

1 matrix will produce oil. As I said, Mr. Elkins has 47
2 years of practical and theoretical expertise and, you know,
3 he's been proven absolutely correct.

4 In this hearing you have heard
5 evidence which proves that that conclusion about dual poro-
6 sity is correct.

7 Mr. Mallon, regretably maybe,
8 I'm sure for him, drilled the Davis Federal Well. Every-
9 body agrees that that well is in one of what Mr. Greer
10 calls tight blocks and that well produces oil. It doesn't
11 produce enough to make the man who paid for the well happy,
12 but it produces oil and if the tight blocks weren't giving
13 up oil, that well couldn't produce. That well is proof of
14 a dual porosity system. He can't see anything else. We've
15 got dual porosity. We've got dual porosity which needs to
16 have the pressure differential between the tight blocks and
17 the fracture reduced as much as possible so the oil can get
18 out of the tight blocks. That's what we're talking about
19 here.

20 If we don't maximize that
21 pressure differential we will waste more oil.

22 Mobil believes that allowing
23 an injection credit to wells in the expansion area is
24 unfair. Those wells are not receiving pressure support
25 from that pressure injection area. That pressure injection

1 area was at a different pressure first below and then above
2 for 26 years. They're not in pressure communication.

3 I hope the Commission will
4 review, I don't want to be insulting, but I do want to
5 remind you of something.

6 When I started today I hadn't
7 planned to do this until a few minutes ago, but I want to
8 remind you that drilling and having a good well is not a
9 punishable offense. What we're talking about here is
10 taking an operator who goes out and drills a good well to
11 produce oil being punished. We're going to reward some-
12 body who drills a well that's not good in order to punish
13 somebody who drills a well that is good.

14 You've heard Mr. Hueni comment
15 that he's convinced that the better wells are in better
16 parts of the reservoir.

17 Allowing a better well to pro-
18 duce more oil is fair. Punishing somebody for coming into
19 New Mexico or spending money in New Mexico to drill a good
20 well-- I'm sorry, it just doesn't make sense to me. I
21 don't think that's what we're supposed to be about and I'm
22 talking about the Commission and all the lawyers who prac-
23 tice before the Commission and all the companies who bring
24 cases before the Commission. We all want more oil and to
25 punish somebody for having a good well doesn't make good

1 sense.

2 In summary, Mobil joins other
3 proponents in asking the Commission to avoid waste and to
4 protect the parties correlative rights by setting the
5 allowables equal to whatever those wells will produce so
6 that we can recover the maximum amount of oil; by including
7 the expansion area in the Gavilan Pool, in which it is
8 in pressure -- with which it is in pressure communication;
9 and by determining that it is unreasonable to cause further
10 waste by holding down production rates in frankly a false
11 hopes that the parties will get together, form a unit, and
12 come up with some better way to produce this reservoir.

13 The best way to produce this
14 reservoir is to let wells go. My client is in the business
15 of producing oil. We're not in the business of wasting it
16 and we're not in the business of figuring out what relative
17 percentages are, how those percentages change. We're in
18 the business of producing oil.

19 The way to get the most oil
20 out of this reservoir, to distribute that production most
21 correctly and to get the most benefit for the operators,
22 is to let this reservoir go, and we ask you to do that.

23 Thank you.

24 MR. LEMAY: Thank you, Mr.
25 Pearce.

1 Mr. Lopez.

2 MR. LOPEZ: I'm sorry that Mr.
3 Lund is not here so I could explain why I use this script.
4 Some of my friends and clients are afraid to turn me loose
5 without one.

6 Mr. Chairman, and members of
7 the Commission, I'm making this statement on behalf of Mesa
8 Grande.

9 As I mentioned in my opening,
10 hopefully we've come to the last bend in the road. We are
11 now at the moment of truth. It's been a great fight and
12 personally, and on behalf of my client, and surely for the
13 Proponents and Opponents alike, I want to thank the Commis-
14 sion, its staff and Mr. Weiss, for the dedicated attention
15 and the time and energy you have given, and in allowing us
16 to come before you in an open forum to debate and contest
17 the issues that will affect the ultimate recovery of
18 thousands of barrels of oil and millions of dollars in lost
19 revenues to the operators, mineral owners, and the State of
20 New Mexico. That this is a very important case and I know
21 that both the Opponents and Proponents are in agreement on
22 this issue.

23 This is obviously a case where
24 reasonable men disagree and I know for certain that both
25 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.

1 Actually, this is where we
2 incompetent lawyers come into the picture. And incompetent
3 we are perceived because, as my father, who happens to be
4 an engineer, has told me more than once, noting offends him
5 more than to pay the damned lawyers their ungodly hourly
6 rates trying to educate them about things they're incap-
7 able of comprehending.

8 Be that as it may, our demo-
9 cratic form of government has provided laws and a judicial
10 process where the interpretation and enforcement of those
11 laws take place and that is the lawyer's game.

12 That is also why our dispute
13 is before you three gentlemen who are empowered and whose
14 duty it is to prevent waste and protect correlative rights.
15 So you all must do your best.

16 Where do we begin? Section 70-2-3 of
17 the New Mexico statutes states that the term underground
18 waste embraces: "the inefficient, excessive or improper use
19 or dissipation of the reservoir energy, including gas
20 energy and water drive, of any pool, and the locating,
21 spacing, drilling, equipping, operating or producing, of
22 any well or wells in a manner to reduce or tend to reduce
23 the total quantity of crude petroleum oil or natural gas
24 ultimately recovered from the pool..."

25 The Oil Conservation Commission Rules

1 and Regulations define correlative rights to mean: "the
2 opportunity afforded as far as practicable to do so, to the
3 owner of each property in a pool to produce without waste
4 his just and equitable share of the oil or gas, or both, in
5 the pool, being an amount, so far as can be practically
6 determined, and so far as can be practically obtained,
7 without waste, substantially in the proportion that the
8 quantity of recoverable oil or gas, or both, under such
9 property bears to the total recoverable oil or gas, or
10 both, in the pool, and for such purpose to use his just and
11 equitable share of the reservoir energy."

12 In a word, correlative rights
13 means the opportunity to drill and compete with for the
14 hydrocarbons available without causing waste.

15 Your task is to now examine
16 the evidence and apply the law. As Mr. Greer stated, there
17 are some things that we agree on.

18 We agree that the Gavilan Pool
19 is in direct communication with the expansion area. We
20 strongly disagree, however, that the expansion area is in
21 effective communication with the West Puerto Chiquito Pres-
22 sure Maintenance Project.

23 We also agree, or at least Dr.
24 Lee testified, that if the Gavilan Mancos is solely a solu-
25 tion gas drove reservoir, it is then not rate sensitive,

1 and that if Gavilan has matrix, that matrix contribution
2 might be an explanation for observing lower gas/oil ratios
3 at higher producing oil rates.

4 We both disagree on the signi-
5 ficance of matrix contribution, however, and its contribu-
6 tion to ultimate recovery. The Proponents believe that the
7 matrix is a significant contributor of oil production to
8 the fracture systems and the most efficient way to produce
9 the matrix is to produce the wells at capacity, creating as
10 large a pressure differential as possible between the
11 fractures and the matrix system. This minimizes the imbi-
12 bition effects in the reservoir, which at restricted pro-
13 ducing rates, causes waste. As John Roe said yesterday,
14 "once you get the oil moving, you better keep it moving."
15 And we totally agree with that testimony.

16 I might again divert from my
17 script, but imbibition is a new thought for me but I know
18 it's not for my wife, because she's accused me on more than
19 one occasion when we're at a cocktail party that I seem to
20 suck up everything in sight like a sponge and I know it's
21 harder than hell to get me to expel it.

22 There may be disagreement, but
23 there is no denying on any account, that during the test
24 periods performed at the Commission's direction since July
25 of 1987, when the reservoir was produced at normal allow-

1 ables and then restricted allowables, that oil was produced
2 more efficiently at normal allowables as witnessed by the
3 observed lower gas/oil ratios in the pool.

4 Another area of disagreement
5 is whether there exists an effective permeability barrier
6 separating the two pools and whether it lies two sections
7 east of the present Gavilan boundary.

8 Our evidence has indeed shown
9 that there exists an effective barrier separating the ex-
10 pansion area and the pressure maintenance project. The
11 Proponents have strong evidence to support their position.

12 First, we have the 25 year
13 interference test, Exhibit Twenty, that Mr. Douglass refer-
14 red to, which shows that Gavilan on first discovery came
15 in at virgin pressures, although West Puerto Chiquito had
16 been producing by then for 20 years and had experienced a
17 pressure decline that did not affect Gavilan.

18 Conversely, the substantial
19 Gavilan and expansion area production over the past six
20 years has not affected the production from the West Puerto
21 Chiquito Pressure Maintenance Area.

22 Also the Commission ordered
23 interference tests have provided additional proof that no
24 effective pressure communication exists across the barrier.
25 Actually, as Dr. Kohlhaas explained, the correct Horner

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1 Mesa Grande believes that the
2 pool boundary should be moved to reflect the true boundary
3 separating the two pools because again by Commission
4 definition, "pool means any underground reservoir contain-
5 ing a common accumulation of crude petroleum oil or natural
6 gas or both... pool is synonymous with common source of
7 supply." Under any circumstance, the expansion area must
8 be treated identically as the rest of the Gavilan under the
9 rules adopted by the Commission.

10 Turning to the second matter
11 the Commission must address, namely the protection of cor-
12 relative rights, there again should be no disagreement on
13 what it means, but there is sharp disagreement on who is
14 doing what to whom.

15 It has been inferred by the
16 Opponents that Mallon superstar wells have a formidable
17 advantage over other wells in the area. However, the facts
18 of the matter are the first five highest ranked superstar
19 wells are operated by BMG in the expansion area and BMG and
20 Sun operate 11 of the 18 superstar wells compared to
21 Mallon's 3. If drainage is occurring, then it is clear
22 that the expansion area is draining the heart of Gavilan.
23 Restricted rates substantially benefit expansion area
24 wells, a clear violation of correlative rights, which will
25 be clearly exacerbated if injection credits are allowed.

1 One thing is clear, however,
2 and that is that the issue of correlative rights disap-
3 pears if the expansion area is included or treated the same
4 as Gavilan and if capacity allowables are instituted, or at
5 least allowables no less than the statewide allowables.

6 The Commission should bear in
7 mind that there are many pools in the state that enjoy
8 allowables much higher than the statewide rules call for,
9 but we know of none except Gavilan that suffer from re-
10 stricted allowables.

11 Finally, I come to the last
12 item on which there is very strong disagreement, and that
13 is the issue of unitization. The opposition has supported
14 unitization since day one and still does. Mr. Kellahin
15 said in his opening comments that unitization is the appro-
16 priate solution. Mesa Grande strongly disagrees, and why?

17 Mesa Grande believes the only
18 reason that makes sense for forming a unit is to provide a
19 mechanism for efficiently and economically recovering more
20 oil from secondary recovery operations as required by State
21 law.

22 As I have stated, because we
23 are convinced that Gavilan together with the expansion area
24 is a fractured, dual porosity, solution gas driven
25 reservoir we have concluded that gas injection for pressure

1 maintenance won't work but, in fact, will inhibit ultimate
2 recoveries from the pool from primary operations.

3 Moreover, as both Mr. Elkins
4 and Mr. Powell testified, comparable fractured reservoirs
5 have proved to be very poor candidates for secondary re-
6 covery operations whether through gas injection or water-
7 flood operations.

8 I fervently hope the Commis-
9 sion will see these cases the way the Proponents do and
10 find, as Mr. Hueni stated, "We're not wrong." I believe
11 the evidence is overwhelmingly in our favor and that the ad
12 hoc committee composed of the Gavilan proponents by their
13 present unanimity, sees it the way it is. Please don't let
14 the 243 barrel per day tail continue to wag the dog that
15 can produce 6,000 barrels per day.

16 As I stated in my opening,
17 these hearings will have an irreparable and irreversible
18 effect on Gavilan's future.

19 These cases also have repre-
20 sented one of my very best professional experiences and
21 have for the most part been a great deal of fun since my
22 oil and money are not at risk, and I thank all concerned.

23 MR. LEMAY: Thank you, Mr.
24 Lopez.

25

1 MR. BUETTNER: Thank you. I
2 had eight minutes, I've cut out about half.

3 Mr. Chairman, members of the
4 Commission, distinguished Professor Elkins, ladies and
5 gentlemen.

6 I'm Bob Buettner. I'm General
7 Counsel and Secretary of Koch Exploration Company.

8 Koch, as you know, is a wholly
9 owned subsidiary of Koch Industries of Wichita, Kansas.
10 Koch Industries is the largest privately owned oil company
11 in the United States. If we were publicly owned, we'd rank
12 between 15 and 18 on the Fortune 500 with revenues in the
13 range of \$17-billion annually.

14 We have available to us, thus,
15 huge capital resources and fairly large experience in the
16 oil business generally. We've invested, perhaps, \$100-
17 million in feasible enhanced recovery projects, both con-
18 ventional and exotic, in the last few years.

19 I can't begin to improve on
20 the summaries of the Proponents' overwhelming evidence that
21 Mr. Pearce has made for Mobil; that Mr. Lund has made for
22 Amoco; that Mr. Lopez has made for Mesa Grande; further,
23 that Mr. Douglass has made for all of us.

24 I know at this stage that
25 promises of brevity are laughable, but I'll make a comment

1 on regulatory policy and I'm going to try to take one more
2 stab at an analogy on the part of the physical process that
3 -- that's been difficult for me to grasp and I am still not
4 sure that Mr. Humphries is comfortable with it, as I am
5 not.

6 The idea that you can't cure
7 this problem of reimbibition by injecting gas into a frac-
8 tured reservoir, the best analogy I could think of that
9 the engineers would agree was correct was if I blow into a
10 balloon hard enough to blow out a candle, I'll push out the
11 sides of the balloon because the air can't go anywhere
12 else, but if I hold that balloon out in a wind that's
13 strong enough to blow out a bonfire, I won't inflate the
14 balloon, and that's because the wind just whistles right on
15 around it, takes the path of least resistance.

16 The original gas in the matrix
17 or the hairline fractures or whatever, the smaller, tighter
18 spaces, can go no place but out to the big fractures and
19 that pushed oil ahead of it.

20 The injected gas just whistles
21 like the wind through the fractures and around the matrix.
22 The actual results received from the physical processes in
23 the reservoir, we're seeing 300 barrel a day wells that are
24 plummeting to 3 barrel a day abandonment levels and all
25 the oil is being sucked back into the rock forever.

1 These rates are not only
2 killing this field and the smaller businesses that live by
3 it, but if they're continued, they're going to kill the
4 confidence of responsible operators in New Mexico regula-
5 tory policies.

6 Finally, a word on history and
7 regulatory policies, the industry learned the hard way 30
8 to 40 years ago that gas injection into fractured reser-
9 voirs is a disastrous mistake.

10 Chairman Lemay asked if it
11 worked anywhere in the world. With an auditorium full of
12 experts on fractured reservoirs, the closest we could come
13 is Mr. Greer's (unclear) example, which is a nonfractured
14 limestone with a water drive and any number of other non-
15 analogous conditions.

16 It doesn't work and the people
17 who have to pay for it know better than to try and that's
18 why you can't find examples.

19 Now, 25 years ago the prede-
20 cessors to this Commission allowed Mr. Greer to try to
21 disprove that lesson for the noble purposes of conserva-
22 tion. For 20 years the experiment continued without
23 affecting others in the industry.

24 Since the early eighties this
25 Commission and its predecessors have continue to protect

1 the experiment to the concern and later to the injury of
2 others and to the state itself, but again in the name of a
3 noble cause.

4 Now it seems some want to hold
5 primary recovery hostage until the Proponents agree to try
6 the experiment again.

7 It's time to end the indul-
8 gence, declare the experiment was noble, but declare
9 enough. Gas injection in fractured reservoirs was waste in
10 1950, it is waste today, and it will be waste tomorrow.

11 High rates will maximize the
12 ultimate recovery; low rates jeopardize it. This Commis-
13 sion should not risk primary recovery in the vain hope of
14 forcing another doomed experiment.

15 Those who do not learn from
16 history are condemned to repeat it. That thought is attri-
17 buted to the philosopher Santana. That name sounds New
18 Mexican. I think that thought certainly should be.

19 Thank you.

20 MR. LEMAY: Thank you, Mr.
21 Buettner.

22 Additional comments in the
23 case?

24 Statements?

25 I want to thank everyone for

1 the professional manner in which this week has been con-
2 ducted, including the lawyers and the expert witnesses.
3 It's been a fun week.

4 We'll take this case under
5 advisement. Thank you.

6
7 (Hearing concluded.)
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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