NEW MEXICO OIL CONSERVATION DIVISION

STATE LAND OFFICE BUILDING

STATE OF NEW MEXICO

CASE NO. 10462

IN THE MATTER OF:

The Application of Marathon Oil Company for termination of oil prorationing in the Vacuum-Glorieta Pool, Lea County, New Mexico.

BEFORE:

DAVID R. CATANACH

Hearing Examiner

State Land Office Building

April 2, 1992

REPORTED BY:

DEBBIE VESTAL
Certified Shorthand Reporter
for the State of New Mexico

ORIGINAL

NEW MEXICO OIL CONSERVATION COMMISSION

EXAMINER HEARING

SANTA FE, NEW MEXICO

Hearing Date APRIL 2, 1992 Time: 8:15 A.M.

NAME	REPRESENTING	LOCATION
W. Perry Pearce	Montgomery & Andrews P.A.	Santa Fe
William F. Carr	Campbell, Carr, Berge & Sheridan	Santa Fe
Thomas C. Lowry	Marathon Oil	Midland
Joan J. Chapman Kyle	Marathon Oil	Midland
John Nelson	Marathon Oil Co	Roswell
Rod Schumacher	Marathon Oil Co	Roswell
Paul Tanaka	Marathon Oil Co	Midland
Al Rector	Blackwood & Nichols	Durango Colo
Bill Duncan	Exxon Corp.	Midland, TX
Ernest L. Carroll	Losee Carson Haas & Carroll	Artesia NM
DAVE BONEAU	YATES PETROLEUM	ARTESIA, NM
Brent May	Yates Pet	Artesia
Bill Mueller	Ex Phillips	Odessa
Tim Bussell	Yates Pet.	Artesia
Larry Halleck	Phillips Pet.	Odessa
Keith Maberry	Phillips Pet	Odessa
Robert Bullock	YATES Pet.	Artesia
DAN BURNHAM	Mobil	Midland.

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NAME	REPRESENTING	LOCATION
Curt McKinney	Blackwood & Nichols LP	SANTA FE
HAI NGUYEN	MOBIL EXP PROD US INC	MIDLAND
James Bruce	Hinkle Law Firm	ABQ
Mike Hunt	Bright & Co	San Antonio
Bruce Gates	Bright & Co	San Antonio
STEVE SALZMAN	BUREAU OF LAND MGMT	SANTA FE

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I N D E X

E X H I B I T S

EXXON CORPORATION:

MOBIL E&P U.S.:

EXAMINER CATANACH: I guess we're all ready. We'll go ahead and call the hearing back to order and call Case 10462.

MR. STOVALL: Application of Marathon Oil Company for termination of oil prorationing in the Vacuum-Glorieta Pool, Lea County, New Mexico.

EXAMINER CATANACH: Are there appearances in this case?

MR. SCHUMACHER: Yes, Rod Schumacher and John Nelson, from the Atwood and Malone law firm in Roswell, appearing on behalf of Marathon. We'll call two witnesses.

MR. BRUCE: Mr. Examiner, Jim Bruce from the Hinkle law firm in Albuquerque. I'm representing Phillips Petroleum Company and Exxon Corporation, each of whom will present one witness.

MR. PEARCE: Mr. Examiner, W. Perry Pearce, Santa Fe office of Montgomery & Andrews, appearing on behalf of Mobil Exploration & Producing U.S. I will call two witnesses.

EXAMINER CATANACH: Other appearances? Can I get all the witnesses to stand and be sworn in at this time.

[The witnesses were duly sworn.]

MR. SCHUMACHER: Shall we call the first witness?

EXAMINER CATANACH: You may proceed, yes.

MR. SCHUMACHER: Marathon will call as it's first witness Mr. Paul Tauscher, T-a-u-s-c-h-e-r.

PAUL TAUSCHER

Having been duly sworn upon his oath, was examined and testified as follows:

EXAMINATION

BY SCHUMACHER:

Q. Mr. Tauscher, you're an employee of Marathon Oil in its Midland office; is that correct?

A. Yes.

Q. And you have previously testified at Commission hearings in Wyoming and Oklahoma but not in New Mexico?

A. That is correct.

Q. Would you tell the Examiner, please, a little bit about your educational background and experience?

A. I graduated from the Montana College of

Mineral Science and Technology in 1979 with a Bachelor's of Science Degree in petroleum engineering. Since that time I have worked for Marathon in various capacities, with the last eleven years being as a reservoir engineer and advanced reservoir engineer.

I'm currently licensed as a Professional Engineer in the state of Wyoming.

Q. Will your proposed testimony today be consistent with your training and education?

A. Yes.

MR. SCHUMACHER: Do you have any questions about the gentleman's qualifications?

EXAMINER CATANACH: No, I do not. The witness is qualified.

MR. SCHUMACHER: Thank you.

Q. (BY MR. SCHUMACHER) Mr. Tauscher, how long have you been involved or how long have you been familiar with the Vacuum-Glorieta Pool that is the subject of this proceeding today?

A. I started becoming involved with the Vacuum-Glorieta Pool in August of 1990. And since that time I have been Marathon's representative on the technical committees for the Vacuum-Glorieta Pool as well as the working interest owners' committee.

Q. In what connection with, what, unitization efforts in that pool?

A. Yes.

Q. Could you give us just briefly a history of the Vacuum-Glorieta Pool, its location and that sort of thing?

A. Okay, the Vacuum-Glorieta Pool was discovered in January of 1963. It was developed fairly quickly on 40-acre spacing with 174 proration units. During the initial completion, most of the wells were top allowable, with the current allowable being 107 barrels of oil per day.

The Glorieta Pool includes both the Glorieta and Paddock formations, with a top of the Paddock at approximately 5800 feet -- or excuse me, the top of the Glorieta at 5800 feet and the bottom of the Paddock at about 6200 feet.

Q. All right. Let me turn your attention to your Exhibit No. 1. And we have furnished copies of some 13 exhibits to the parties involved in this proceeding. Let me ask you generally, with the exception of Exhibits 5 and

6, did you prepare each of these exhibits, or were they at least prepared at your direction?

A. Yes.

Q. And that includes Exhibit No. 1?

A. Yes, it does.

Q. And it's correct, is it not, that Exhibits 5 and 6 were extracted from the information compiled and prepared by the technical committee during the unitization process?

A. Yes.

Q. And you have independently examined and verified the accuracy of those Exhibits 5 and 6?

A. Right. I have looked at the data contained on those exhibits and, from an independent investigation, the data appears accurate.

Q. All right. Would you explain Exhibit No. 1 for us, please.

A. Exhibit 1 is simply a base map of the Vacuum-Glorieta Pool showing the wells that have produced from the Glorieta. It also has the current top allowable wells shown by having a well symbol enclosed in a circle.

In the southwest quarter of Section 28,

there are two wells shown enclosed with a circle with a dashed line in between. This is an indication that the two wells are on one proration unit with a shared allowable. Between the two wells they are capable of top allowable production.

Q. You're familiar with the application that is on file herein that was prepared and filed on behalf of Marathon?

A. Yes.

Q. Could you briefly describe the objectives of the relief that is being sought by Marathon in this proceeding?

A. Okay. Marathon's request is that the allowables be set at the current capacity of the wells, or in the case of where two or more wells share a proration unit, we would like the allowables set at the current 107 barrels of oil per day or the capacity of any single well on the proration unit, whichever is higher.

Q. And could you point out to us again on Exhibit No. 1 the wells that are at issue?

A. Okay. The wells that are currently producing top allowable, Marathon has two wells in the north half of Section 33; Exxon has one well in the far northeast corner of Section 32 and two proration units in the south half of Section 28.

Q. And would it be your testimony that these objectives of Marathon in this proceeding will help guard against waste, protect correlative rights, and assist in necessary data collection for the unitization process?

A. Yes.

Q. Could you describe for us that aspect of this proceeding that will, in accordance with your testimony at least, help guard against waste in this pool?

A. Currently the production from the Vacuum-Glorieta Pool is relatively erratic, and there are a majority of the wells producing at fairly low rates. Approximately 50 or actually 55 of the 121 active wells in the pool are producing at less than 10 barrels of oil a day. At the same time there are the four wells and one proration unit with two wells that are producing at top allowable.

The significance of this is that there are higher voidage rates from wells offsetting the top allowable well that are making use of the reservoir energy and depleting the reservoir energy while the top allowable wells are still restricted because of the allowable.

As a result, it is my opinion that there will be a relatively high oil saturation remaining around the top allowable wells that will not be recovered because of the depletion of the reservoir energy.

Q. Let me turn your attention to your Exhibit No. 2. You prepared Exhibit No. 2?

A. Yes, I did.

Q. Would you explain the purpose of Exhibit No. 2 and what principle is illustrated by that exhibit?

A. In reviewing the production around the top allowable wells, I started looking at the reservoir voidage rates. And Exhibit 2 shows the reservoir voidage rates for each one of the active wells in the Vacuum-Glorieta Pool.

It includes, as the top number shown next to the wells, the barrels of oil per day in reservoir barrels. The bottom number is the total voidage rate, which is a combination of the oil volume, gas volume, and water volume that is produced as daily barrels per day for that particular well.

The voidage rate was calculated from the November in 1991 production and static reservoir pressures estimated from the reservoir pressure map included in the Vacuum-Glorieta technical report that was approved by the working interest owners approximately a year ago.

In the case of Marathon's two wells in the north half of Section 33, the top two allowable wells there, the static reservoir pressure used for estimating the voidage rates was taken from some testing that Marathon performed early on in March of this year.

And the pressures at that time compared favorably to the technical committee report and its estimated pressures from 1986. There was approximately a 50 PSI decrease in the pressures since 1986.

Q. What can you tell us about the comparative voidage rates of the Marathon wells as opposed to the wells that are north of there?

A. Okay. The voidage rates on Marathon's wells, the Warn State Account 3 No. 6 Well is producing 232 barrels of reservoir voidage per day, while the No. 7 Well is producing 190 barrels per day.

Due north of the No. 6 Well on the Santa Fe lease, there is a proration unit with two wells producing just short of 500 barrels of reservoir voidage per day. Just west of that on the P State lease, there is a well producing 291 barrels per day, and further west is a 792-barrel-a-day well, indicating that the offsets to the top allowable wells are producing at substantially higher reservoir voidage rates.

Q. What effect does that have on the available reservoir energy?

A. The amount of reservoir energy used by any given well is a function of that voidage rate. The voidage rate represents the total volume pulled from the reservoir that the reservoir needs to make up through expansion of gas, the oil, and the water.

If you look at the average voidage rate for the field, which currently averages 367 barrels per day reservoir voidage, now the average for the top allowable wells and the two wells shown on Exhibit 2 enclosed by square boxes, which represent wells that I believe can be made top allowable with increasing drawdown through larger pumping equipment, those wells average 275 barrels reservoir voidage per day. The field average is 33 percent higher than the top allowable wells.

Q. If that situation is allowed to persist unabated, that is, if Marathon is not allowed to increase the allowables from these wells, what will be the effect of that depletion of reservoir energy on the Marathon wells?

A. Eventually the reservoir pressure will drop down to near zero or to a very low producing pressure as the reservoir energy is depleted. This will result in ever-decreasing rates and finally abandonment of the wells with a significant oil saturation remaining around the wells.

The decrease in pressure from the loss of energy would also result in an increased viscosity further complicating the recovery of that oil.

Q. Now, your Exhibit 3 actually furnishes a comparison of the voidage rates for the active wells in the field. If I could invite your attention to that for a moment.

A. Okay. Exhibit 3 is simply a plot of

the individual voidage rates for each well in the field. And this is sorted by increasing voidage rate. Shown on the plot are the voidage rates for the four current top allowable single wells.

And as it appears on this plot, you can see that the voidage rate for these wells is substantially below most of the voidage rates in the field. There are currently 57 of the 121 producers that are producing voidage rates higher than the average of the top allowable wells.

I've taken this one step further. If you would draw your attention to Exhibit 4.

Q. You also prepared Exhibit 4; is that correct?

A. That is correct. Exhibit 4 shows the same data; however, it is sorted by the proposed unit areas, as well as by estimate of the performance areas for the Vacuum east unit. The west unit is supported primarily from a solution gas drive and appears to be separated in its performance characteristic from the east end of the field.

Q. Let me stop you just for a second. I want to go back now to Exhibit No. 1 and ask you simply to point out the line of demarkation that separates the east unit and the west unit.

A. Okay. On Exhibit 1 the boundary to the east unit shows up in the very eastern -- or near the eastern edge of Section 30 and 31 in Township 17 South, Range 35 East. At the bottom of Section 31, it jogs slightly to the east to continue on to the south at the east edge of Section 6.

Q. You said the eastern edge of Section 30; wouldn't it be the western edge?

A. Excuse me. Yes, the western edge of Section 30.

Q. All right. Thank you. Going back then to Exhibit No. 4, would you finish your explanation of that, please?

A. Okay. The center peak, if you wish to describe it as that, on this exhibit shows the producing wells in the west half of the east unit. And this area of the field performs very much similar to the west unit with the main pressure support coming from the solution gas drive.

Finally, to the far left-hand side of this exhibit is the actual east half of the east unit, which includes the current top allowable wells. And this area of the reservoir is influenced by the encroachment of water to the far eastern end of the field.

And as a result, the wells in this east half of the east unit are a better comparison to the top allowable wells in the remainder of the field. Even in the smaller area, these wells are producing at higher voidage rates than the top allowable wells.

It's not as noticeable in the east half of the east unit, with the average being 288 barrels per day. Or 13 barrels per day above the top allowable well average. However, this includes the impact of low rate wells located in low productivity areas of the reservoir.

Referring back to Exhibit 2, if you look to the far north and far south areas offsetting the top allowable wells, you can see an indication in some of the wells very low voidage rates, which we feel is a representation of lower reservoir quality, lower permeability, and so forth.

The average of 288 includes these wells. I have also looked at the 12 direct offsets to the top allowable wells that have similar producing characteristics. Those 12 wells average 450 barrels per day of reservoir voidage. This is over 60 percent above the top allowable well rates.

Q. Going back to Exhibit No. 4, if this application is approved, what impact would you expect to see in terms of this exhibit or what would you expect this exhibit to look like?

A. Okay. Including the two wells that potentially could be top allowable with increased drawdown, I'm anticipating a total voidage rate average for the six top allowable wells at that time of 456 reservoir barrels per day, which compares very well with the offset production at this time.

Q. I know your Exhibit No. 5 illustrates the reservoir pressure. If we could turn to that just for a moment. Now, Exhibit No. 5 was taken from the reports and research conducted by the technical committee for the unitization?

A. That is correct.

Q. And have you independently examined this exhibit and tried to verify some of the information contained therein?

A. Yes. I have looked at our wells where we do have current static pressures, and they generally support the numbers that appear on this map in spite of the six-year difference in time frame. Also, the producing GORs primarily in the east half of the east unit appear to correspond to the associated pressures at that point.

Q. And is this reservoir pressure map identified as Exhibit 5 typical of the kinds of reservoir pressure maps you use in your business?

A. Yes.

Q. And has it been useful to you in forming the opinions about which you're testifying here today?

A. Yes, it has been very useful.

Q. Can you illustrate for us or explain to us what the prospects are for any continued or increasing influx of water based on this reservoir pressure map?

A. Okay. The reservoir pressure map, if you look to the far right-hand side along the east edge of the pool, you can see pressures in the 1100 PSI range. The original reservoir pressure in this area was 2,260 PSI, indicating that the aquifer is providing very little pressure support. However, because you can see that the pressures there are higher than the main portion of the reservoir, it is very limited.

Also, if you look at the closeness of the contours on the east edge of the reservoir, it appears that the water influx there is encountering a fairly steep pressure transition, again, indicating very slow movement of the water into the main portion of the reservoir.

Q. If you could, please, point out for us the areas of significant areas of water influx. If it's not clearly illustrated, by this exhibit, feel free to refer to another.

A. Okay. The main exhibit that I have that indicates the water influx is my Exhibit No. 6. Again, this is -- this particular exhibit is a current water cut map as of 1989.

Q. Is this one that you've prepared?

A. No. This was extracted, again, from the technical committee report.

Q. All right. Have you independently examined this information or analyzed it in any way?

A. Yes. It appears to correspond quite well to the current water cuts throughout the field.

Q. And a water cut map such as this is something that is typically employed by those in your profession?

A. Yes.

Q. And it forms part of the basis for the opinions you'll express here today?

A. Yes, it does.

Q. Okay. What does this Exhibit 6 illustrate about the influx of the water, for example, the rapidity with which water influxes from east to west?

A. Okay. If you look at the east side of the reservoir, I've highlighted in red the contour at 100 percent water cut. The water-oil contact was approximately at the very east edge of the outlined area initially.

The red outline shows how the water has moved very slowly into the reservoir after 27 -- or actually at this point, after 25 years of production, it has only moved in approximately one mile where it has truly watered out the producing wells.

If you continue to follow the contours in, you can see how the water continues to move in a westerly direction. And then there's an indication it's starting to move south from it after it reaches Section 28.

Q. From an engineering perspective, can you characterize this reservoir as either heterogeneous or homogeneous?

A. Based on the production performance, it is a very heterogeneous reservoir.

Q. Is that in any way illustrated by the comparative water production from the various wells?

A. Yes, it is. You'll see throughout this map, various circular contours located throughout the field, again indicating that there are localized areas of either lower or higher water production and water cut.

Q. Do we have any assurance that an increase in the allowable production from the Marathon wells will not have any significant impact on the influx of water?

A. I have prepared a separate exhibit, Exhibit No. 7, that somewhat illustrates this. But before I leave Exhibit 6, there's a line starting at the east edge that's marked A and finally A prime at the very south edge. This line follows the approximate process or the approximate path that we expect water, if it does reach our wells, to migrate to those wells.

Exhibit 7 is a simple cross-section along that line. And on Exhibit 7 --

Q. You prepared Exhibit 7?

A. Yes, I did.

Q. Okay.

A. And on Exhibit 7, for each one of the proration units that that path travels through, is the current oil rate, gas rate, water rate, and total reservoir voidage rate. And starting from the right-hand side of Exhibit 7, you can see the first three wells are inactive at this time. This corresponds quite well to the previous water cut map indicating that these wells have watered out.

Then as you proceed to the left further, you encounter a well producing 227 reservoir barrels per day, then one at 475 reservoir barrels per day. Then we come to the New Mexico K State lease where there are two wells on the proration unit with combined production of 560 barrels of reservoir voidage.

Q. Can you identify the location of those wells for us, please?

A. Okay. On Exhibit 6 those two wells are in the central and southwest or southeast corner of Section 28. The cross-section goes through the No. 21 well. And the No. 35 well is not shown on this map, but it is slightly to the northwest of the No. 21 well. If you refer back to Exhibit 1, it does show up on that exhibit.

Okay. Now, continuing on the discussion of Exhibit 7, the next proration unit is the Santa Fe 95 and 132. And on the map these two wells are just south of the New Mexico K State wells. Here, again, there are two wells on the proration unit producing 468 reservoir barrels per day.

Then, finally, is the Warn State Account 3 No. 6 Well of Marathon, a current top allowable, with a voidage rate of 232 barrels per day. At the far left-hand side of this exhibit is the State T No. 10 Well, which again is moving into the area of limited production capacity with a reservoir voidage rate of 52 barrels per day.

Q. All right. If there's to be any influx of water as a result of increasing the allowable from the Marathon wells, that water would have to travel along the line that you've identified as A-A prime?

A. That's correct.

Q. Should there be any concern about that possibility?

A. I don't believe that there should be any major concern about that primarily because the water migration along that path is going to be controlled more by the initial wells in that path, the wells with the higher voidage rates.

Q. Identify those wells again, please?

A. They would be the State 427 No. 10, the two New Mexico K State wells, and finally the Santa Fe wells.

Q. All right. Is there any underlying water or coning problems associated with this reservoir that you're aware of?

A. At this point I am not aware of any coning problems or other bottom-water drive in this reservoir. And in our lease, on the Warn State Account 3 lease with the No. 6 and No. 7 wells, the current water cut is less than 2 percent after producing top allowable for approximately 27 years.

Q. All right. I want to turn your

attention now to Exhibits 8, 9, and 10, which I believe you also prepared.

A. Yes, I did. In trying to either verify or contradict the previous information I obtained, I looked at the performance of the south half of Section 28. And primarily the reason I looked at this area was in early 1989 two infill wells which shared allowables and one replacement well were drilled. This --

Q. Where were those drilled?

A. Okay. Referring back to the Exhibit 1, the two wells in the center of the south half of Section 28, the No. 34 and 35 wells, the one is circled and then in the far southwest corner of the south half of Section 28 is the No. 36 well, that was the replacement well.

Q. Those were in 89?

A. Yes, early 1989. Exhibit 8 was prepared showing the actual production performance from the original wells in that south half of that section. The dark line shows the original wells' production. The light solid line shows my extrapolation of that production before the drilling of the infill wells. Finally, the dashed line shows the production from the infill wells.

Q. Is there any indication here that the production decline has increased in any way as a result of the increased production from that area in general?

A. No, there is not.

Q. All right. Let's turn to Exhibit No. 9.

A. Exhibit 9 was prepared using the same group of wells; however, this time the plot is of the water-oil ratio, again, in an effort to verify whether the increased drawdown and the increased voidage rate from these new wells was increasing the rate of water influx.

Again, the original wells' water-oil ratio is shown by the solid line. The light line shows my projection using the pre-1989 historical. And, finally, the dashed line is the infill wells.

Now, there is a decrease in the water-oil ratio evident in early 1989. And this is a result of reduced production on the two original wells on the proration unit with the infill wells.

In early 1990, these two wells had

their production increased as the original wells lost production and they no longer needed to -- or they no longer needed to reduce the production to maintain the allowable. The increase in early 1990 also included the installation of larger pumping units on a couple of the wells in this area.

Even with the changes that you see here and with the addition of larger pumping equipment, it appears that the water-oil ratio trend is on the same trend before and after the infill drilling, indicating limited, if any, increase in the water influx in this area.

Q. So, if you had an increase in water influx as a result of increased voidage rates, you would see expect to see some increase or sharper than expected upward slope in the water-oil ratio graph?

A. Yes. You would expect to see a change in that slope.

Q. There's no such change illustrated by Exhibit 9?

A. No.

Q. All right. Exhibit No. 10, then, is a water production exhibit; correct --

A. Yes.

Q. -- which you have prepared?

A. Yes. This is the same basic data. In this case I'm plotting only the daily water production from these wells. Again, the extrapolation shows that the current water production is basically on trend with the water production prior to the infill drilling.

Q. Again, I assume that if you were increasing the water influx with increased voidage, you would expect to see a sharper than normal rise in the water production?

A. Yes, you would.

Q. We've talked about the fact that unitization efforts are underway in this pool, both in the west half and the east half. What is the importance of this application with respect to that unitization effort?

A. Okay. This application, in my opinion, will have no impact on the unitization or pending unitization of the west half of the pool. The Vacuum-Glorieta west unit is currently preparing to present the unitization to the state for approval. They have negotiated a participation formula and are proceeding ahead.

The nearest top allowable well to the west unit is approximately two miles away. With the low pressures between and the difference in the reservoir producing characteristics of the two sides of the reservoir, I do not feel that there will be any direct impact from the increased allowables.

Currently there are no wells in the west unit that are at or near top allowable that our request would influence.

Q. What about in the east half?

A. In the east half of the unit, efforts have been underway since the early 80s at unitization. And currently it has been sent back from the working interest owners committee to the technical committee to reevaluate the remaining primary reserves as a parameter for unitization.

And the main question concerning the remaining primary reserves centers around the estimation of remaining primary reserves for the top allowable wells.

Q. In your opinion does Marathon at present have sufficient data to arrive at those figures?

A. No, we do not. Currently any estimates we make of the remaining primary reserves for top allowable wells are open to a lot of dispute, and there's some questions involved around it because we cannot in any way evaluate the current performance of these wells. They have been on top allowable for some time. There is no decline established with which we can estimate the remaining primary reserves.

Q. How will this application assist you in that effort?

A. This will allow the top allowable wells to go on a visible decline where we can watch and monitor the decline in production and use that data to extrapolate what the remaining primary reserves are.

Q. Now, you have prepared Exhibit No. 11, which I gather reflects some effort on your part to calculate remaining reserves --

A. Yes, I did.

Q. -- on different methodologies. Could you explain that, please?

A. Okay. Exhibit No. 11 was prepared after I did a decline analysis of all of the non-top allowable wells in the east unit area. This was done in an effort to be prepared to return to the technical committee and to discuss the remaining primary reserves for the unit. And, again, with the top allowable wells, there was no method of directly estimating the remaining reserves.

What I did do was I looked at the wells of similar producing characteristics around the top allowable wells. These are wells that have produced at top allowable and that recently went off top allowable but have established a stable decline since that time. The average decline for these wells was 10.84 percent.

Applying this decline to the four current top allowable wells left remaining primary reserves of 2 million barrels. As a more pessimistic approach, I looked at the five highest declines, the rate of decline in the east unit area, and this averaged 15.3 percent.

Applying this exponential decline to the five top allowable wells left reserves of 1.4 million barrels. Even being kind of a worst-case scenario, I looked at the highest decline in the wells in the east unit area, which was 25 percent. This left remaining reserves of 900,000 barrels.

The technical committee report, after reducing the remaining primary for current production, left remaining reserves for these four wells of 1.2 million barrels. This exhibit indicates the magnitude of the difference that these remaining reserves can be estimated, again, using reasonable numbers. However, it's strongly influenced by how optimistic or pessimistic the engineer or whoever is looking at the remaining reserves wishes to be.

Q. And I take it, then, without the increased production from the Marathon wells or without the approval of this application, then, you won't have sufficient baseline of data to accurately calculate the remaining reserves?

A. That is correct.

Q. How were the calculations made by the technical committee resulting in the figure of 1.2 million barrels?

A. Okay. The technical committee estimated the remaining primary reserves for top allowable wells by doing a water-oil ratio extrapolation on the New Mexico K State lease using the combined production from all top allowable and non-top allowable wells on that lease.

After estimating the total remaining reserves from the water-oil extrapolation, they then subtracted out the total remaining primary reserves for the non-top allowable wells. The remaining reserves they divided by the number of top allowable wells to allocate to the individual wells.

Unfortunately, this analysis does not take into account the fact that all of the top allowable wells are not capable of the same production. The top allowable wells, just like the non-top allowable wells, have different producing characteristics. They have different capacities at the current point in time that this method does not account for.

Q. All right. Let me turn your attention then to Exhibit No. 12, which, as I understand it, is an effort on your part to project the well capacities of the various wells?

A. That is correct.

Q. Can you describe the methodology that you used in making this analysis?

A. Okay. This is a plot of the projected daily oil rate as a function of the producing well pressure. The analysis method I used was a Vogal analysis of the productivity index of the individual top allowable and potentially top allowable wells.

Q. And the curves that appear on this graph were made consistent with that Vogal analysis?

A. Yes.

Q. What sort of a production increase do you expect could be obtained as illustrated by this exhibit?

A. If you add up the rates that are shown to the left of each one of these curves and then subtract out the top allowable production, the estimated production increase will be 470 barrels of oil per day.

Now, calculating for each individual well the increased voidage rate that this will bring with it comes up with a total voidage rate of 1,085 barrels of oil per day. This is the increase over the voidage rates under the current allowables.

Now, comparing these increases to the combined total for the pool, this is a 15 percent increase in the oil rate from the field with only a 2 percent increase in the total voidage rate, indicating a very efficient use of the remaining reservoir energy under the top allowable leases.

Q. With only a 2 percent increase in the total voidage rate from the field, then, would you expect to see any reservoir damage resulting from the increased voidage?

A. No, I do not expect any reservoir damage from the increased withdrawals for two reasons: First of all, the current reservoir pressures are so low in the top allowable wells that the increased drawdown should not significantly impact the near wellbore. There's not going to be excessive pressure drawdowns around the wellbore.

And also the 2 percent increase in reservoir voidage will have a very limited impact on the rate of water encroachment because of its limited significance. Also, the top allowable wells have significantly lower pressures than other wells in the field, indicating that the possible drawdown for these wells, again, is going to be limited, further reducing the impact on the water encroachment.

Q. All right. Now, the incremental

increases that you've discussed in oil recovery compared to total voidage rate, are those illustrated in your Exhibit No. 13 that you've prepared?

A. Yes, they are.

Q. And Exhibit No. 13 is what?

A. Exhibit 13 is a pertinent data summary. I just tried to summarize most of the numbers that I've presented in an effort to, I guess, bring to recollection what I'm trying -- the rates that I'm throwing out.

If you look at about halfway down, the current and projected rates for the top allowable wells, currently they're producing 620 barrels a day, barrels of oil per day, with a predicted increase to 1,088 barrels of oil per day, 468 barrels per day increase. Again, comparing this to the reservoir total, that's a 15 percent increase.

You can also, if you go to the next row of numbers down, looking at the current and predicted rates as percent of current field total, you can see that we are estimating to increase oil again by 15 percent, gas production by only 3 percent, water production by 1 percent for a total reservoir voidage rate increase of 2 percent.

MR. SCHUMACHER: Mr. Examiner, at this time Marathon will move admission of its Exhibits 1 through 13 and will pass the witness.

EXAMINER CATANACH: Exhibits 1 through 13 will be admitted as evidence. Mr. Pearce.

MR. PEARCE: Let's let Mr. Bruce.

EXAMINER CATANACH: Mr. Bruce, I'm sorry.

MR. STOVALL: Why don't we establish an order here if you want. We can do Mr. Bruce and anybody else and then Mr. Pearce; is that the way we'll do it?

MR. BRUCE: Anybody else before Mr. Pearce.

MR. STOVALL: Anybody else before Mr. Bruce?

EXAMINATION

BY MR. BRUCE:

Q. You mentioned you took some pressure tests in March?

A. That is correct.

Q. What were those numbers?

A. I do not have the exact numbers with

me, but they were approximately 200 PSI bottom-hole static pressure in both wells.

Q. In both wells?

A. Yes.

MR. STOVALL: Mr. Bruce, just so I make sure I know where you're going, should we get into any extensive stuff, your clients are basically in support of the application with some limitations; is that correct?

MR. BRUCE: That's correct. And I've only got about two or three questions. I wasn't clear from his answer the first time.

MR. STOVALL: Sometimes when we don't know where you're going on cross, it's hard to figure out where you're going.

Q. (BY MR. BRUCE) And you did test both wells; right?

A. That is correct, yes.

Q. This is just a general question. You mentioned the unitization. Is Marathon committed to unitizing its interest?

A. Marathon realizes the necessity for the unitization out here, and we have no intention of standing in the way. However, our participation depends on negotiation of a fair and equitable participation formula. And right now that is one position where we are uncomfortable because of the discrepancies that we can see in the remaining primary reserves.

MR. BRUCE: Just a second. Let me get a question from Mr. Duncan here.

Nothing further, Mr. Examiner.

EXAMINER CATANACH: Thank you, Mr. Bruce. Mr. Pearce?

MR. PEARCE: Thank you.

EXAMINATION

BY MR. PEARCE:

Q. Mr. Tauscher, I'm Perry Pearce. I'm here representing Mobil this afternoon. And as I assume you're aware, we're opposed --

A. Yes.

Q. -- to what you're seeking?

MR. STOVALL: Thank you, Mr. Pierce.

MR. PEARCE: Yes.

Q. I'd like to walk back through a few of these exhibits with you, if you'd be so kind. Looking at Exhibit No. 1, at least I had that in front of me, when you mentioned during your direct testimony that, I think your words were, most of the wells in the Vacuum-Glorieta were

initially top allowable wells; is that correct?
A. That is correct.
Q. Have you gone back on those initially top allowable wells and calculated an average decline?
A. The ones that are not -- no longer producing at top allowable that have established a decline. I have done that on the east unit. I have not looked at the west unit.
Q. Okay. I'm going to get a little deeper into that in a minute. But I was confused about which wells went into that decline analysis, whether it was the, I believe you said, 12 offset, non-top allowable wells, or did you use all of the top, formerly top allowables wells, in the --
A. In my 13.2 percent -- or 13. -- I'll have to find that exhibit. In the 10.84 percent --
Q. I'm sorry. Can you reference me to an exhibit number, please?
A. Exhibit No. 11.
Q. Thank you.
A. The 10.84 percent included nine wells in the immediate area around the current top

allowable wells, wells that had come off top allowable in about the last five or six years. I did not use the decline for wells that had gone off top allowable ten or fifteen years ago as I was trying to compare it to the performance characteristic of the wells performing very similar to the current top allowable wells.

Then the average of the five highest declines, which was 15 percent, 15.32, used the five highest declines in the east unit.

Q. I'm sorry. Again I'm not following, and I apologize. I'm just slow.

A. Okay.

Q. The five highest declines that you used, were they the five highest of the nine offsets?

A. No. Of the wells in the east unit area.

Q. Okay. So do I gather from that, then, you did in fact look at the declines of wells other than these nine offsets?

A. Yes. I looked at all wells, all active wells in the east unit area.

Q. Okay. And what was the average of all of those declines, not just the nine referenced as 10.84?

A. I'm trying to think if I have that number available. I did not bring that number with me. It would be somewhere between the 10.8 and 15.3 percent.

Q. During the prefatory part of your direct testimony, you indicated it was your opinion that oil would be left around the wellbores of the currently top allowable wells in the absence of granting your application because it would cause depletion of reservoir energy?

A. That is correct.

Q. And explain to me again, if you would please, sir, what's your understanding of the reservoir energy we're working with here?

A. My understanding, for a majority of the reservoir, it's a solution gas drive.

Q. Okay. And let's just make sure we're thinking the same thing. Majority of the reservoir, you're talking about the Vacuum-Glorieta Reservoir?

A. Yes.

Q. All right. Let's focus that analysis on the part that would be included within the proposed Vacuum-Glorieta east unit, and let's go back and ask the same question. What's your opinion of the drive mechanism of the proposed east unit area?

MR. SCHUMACHER: So that I understand the question, you're not making any distinction between the west half and the east half of the eastern unit?

MR. PEARCE: Not yet.

MR. SCHUMACHER: You're talking about the entire eastern?

MR. PEARCE: At this time it's addressed to the entire eastern unit.

A. In the eastern unit I feel that the majority of the reservoir energy is coming from the solution gas drive also.

Q. All right. Let's look at the acreage that Marathon, I believe, is primarily concerned with, which is the acreage in Section 33. What's your opinion of the reservoir energy mechanism at work in that section?

A. Based on the current reservoir pressures, I feel that the main energy in this area is also the solution gas drive. I feel that in this area we're receiving very little additional energy from the water encroachment to the far east.

Q. If you would open for me, please, your Exhibit No. 2, which was your reservoir voidage map, and what I'm hoping is that you can provide me some background information on a few of these data points.

With regard to the Marathon acreage, and I believe it's the well numbered 6, which is one of the top allowables of wells?

A. That is correct.

Q. And that shows 146 barrels of oil capability. In your opinion is that what the top number means?

A. The top number is the average production for November of 1991 after adjusting it for reservoir conditions.

Q. I'm sorry. Could you explain to me what that adjustment is?

A. That adjustment is taking into account the formation volume factor of that oil when you add in the solution gas from that oil.

Q. Okay. What was the actual oil rate?

A. For November, on that particular well and on the No. 7 well, we inadvertently overproduced as a result of a breakdown in communication between our crude oil purchaser and our field personnel.

They changed the method in which they were purchasing the oil, and our field people failed to be notified that they no longer were shutting in the lack units when the allowable was produced during the month. And we are currently making up that overproduction.

Q. And what were the actual rates in November for each of those wells, please?

A. 127 barrels of oil per day.

Q. Each?

A. Yes.

Q. All right. Now, let's focus on the bottom number, which in the case of the No. 6 well was 232.

A. Yes.

Q. Could you explain that number again to me, please?

A. Okay. That number, again, is the volume of the oil produced with the addition of its solution gas. It's also the additional volume from any gas above the solution GOR at the reservoir pressure after adjusting that gas for its reservoir volume and then adding in the water production, again, adjusting for its reservoir volume.

Q. Okay. And what was the water volume in November of 1991 for the No. 6 well, please?

A. Two barrels of oil per day.

Q. Two barrels of --

A. Or water per day. Excuse me.

Q. How about the No. 7 well?

A. Two barrels of water also.

Q. All right. Let's look at the well northwest of those wells, which is numbered 4 on the Texaco acreage. Do you see the well I'm talking about?

A. Yes.

Q. Okay. Once again, the 104 number shown for that well, that's a November 1991?

A. It is.

Q. And is that similarly adjusted?

A. Yes. All of the numbers are adjusted in the same manner accounting for the gas and water volumes in reservoir conditions.

Q. Okay. What was the actual oil production for that well?

A. The average, as reported to the state and published in the production books, was 91 barrels of oil per day, 44 Mcf per day, and 7 barrels of water per day.

Q. I'm sorry. That's on the Texaco?

MR. SCHUMACHER: I'm just going to say, I might point out, Mr. Pearce, you'll see these numbers in one of our later exhibits with our next witness. So it should become clearer at that time.

MR. PEARCE: Okay. Let me pursue --

MR. SCHUMACHER: I don't want to shortchange you. Go ahead.

Q. (BY MR. PEARCE) On the Texaco No. 4 well --

A. Yeah.

Q. -- you told me it was showing 91 barrels of oil, 44 Mcf of gas, and 7 barrels of water?

A. That's correct.

Q. And that when you run your calculation, that brings to you to the 792 oil voidage number?

A. That is correct.

Q. Okay. Let's do the same thing for the No. 3 well for me, if you would, please, sir.

A. No. 3 well was producing 64 barrels of oil per day, 23 Mcf per day, and 64 barrels of water per day.

Q. Okay. There is a well, I believe, it's numbered 32 on the Phillips' acreage, a little misdrawn line, I think, but it shows 75 and 273?

A. That's the 132 well.

Q. The 132 well. That's the problem. I apologize. Can you give me those numbers on that well, please?

A. 64 barrels of oil per day, 11 Mcf per day, and 196 barrels of water per day.

Q. Okay. Just to the north of that, looks like the Exxon 21, showing 19 and 285 for reference?

A. Okay. The New Mexico K State 21 I show as producing 16 barrels of oil per day, 6 Mcf per day, and 252 barrels of water per day.

Q. And I believe you indicated that the dashed line between that well and the No. 35 well indicates that they're on a common proration unit; is that --

A. That is correct.

Q. -- what I understood? And can you give the numbers for the 35 well, please?

A. The 35 well was producing 48 barrels of oil per day, 15 Mcf per day, and 203 barrels of water per day.

Q. All right. Let's do a couple more, please, sir. I've got a circle. The other two wells that are sharing the proration unit, it appears on my map to be 34 and maybe 31, but I can't tell.

A. 34 and 31, yes.

Q. Can you give me the numbers on those, please?

A. 31 was producing 15 barrels of oil per day, 40 Mcf per day, and 79 barrels of water per day.

Q. Okay. And the 34?

A. 94 barrels of oil per day, 8 Mcf per day, and 18 barrels of water per day.

Q. All right. During your testimony you indicated something about the average field voidage rate?

A. That is correct.

Q. I need you to go back and explain to me the information that you gave us with regard to that again, because I didn't understand it, please, and I may be able to draw that out with some questions.

You said that the field average voidage

rate, I believe you said, was 33 percent above the two Marathon wells; is that what you were saying?

A. No. It's 33 percent above the six wells that are top allowable or could be top allowable with increased drawdown.

Q. And when you said the field average, is that reservoir as a whole all of the Vacuum-Glorieta?

A. Yes.

Q. Have you looked at the average voidage rates for the wells in the eastern part of the proposed east Vacuum area? And I'm speaking about the wells in Section 28, 33, 27, and a few wells in 34. Have you looked at those average voidage rates?

A. Yes.

Q. And what was that rate?

A. Using the east half of the east unit, which for my numbers --

Q. Yes.

A. -- included the eastern quarter of Section 29 and the eastern quarter of Section 32 and all wells further to the east, the average was 288 reservoir barrels per day.

Q. Okay. So there's a row of wells in the east half of Section 29 and 32 and I assume the one well down in Section 5 which you included within that average?

A. That is correct. However, the well in Section 5 is inactive, so it was not included in the numbers.

MR. PEARCE: All right. Thank you.

MR. SCHUMACHER: So your record will be clear, Mr. Pearce, you said the eastern half --

MR. PEARCE: Eastern quarter. I apologize. Yes.

Q. (BY MR. PEARCE) Let's just run through those. There's a well 106, which shows 145 barrels rich, Well No. 3, south of that, which shows 585, a Well No. 4, continuing south, it shows 613, a well number -- I can't tell -- 28 maybe?

A. Yes.

Q. It shows 311. Continuing down, 954 for the well numbered 24; is that correct?

A. That is correct.

Q. Is that the biggest well in the proposed eastern unit? Is that the largest voidage well?

A. No. If you move further to the west in the northwest quarter of Section 32, there's a well producing 1205 reservoir barrels a day.

Q. I see that. Thank you. Continuing south, the No. 18 well, 609?

A. That is correct.

Q. I don't think I asked you before, but can I ask you to pull out your back-up data again and give me the information on that No. 24 well that shows 51 barrels of oil.

A. Okay. The No. 24 well produced 45 barrels of oil per day, 38 Mcf per day, and 1 barrel of water per day.

Q. What was that last number? 38?

A. 38.

Q. All right. Looking at the Texaco No. 4 well --

A. Yes.

Q. -- the numbers, I believe you gave me, were 91 barrels of oil, 44 Mcf of gas, and 7 barrels of water?

A. That is correct.

Q. And looking at the No. 24 well, you gave me 48, 38, and 1?

A. 45, 38, and 1.

Q. And yet the respective voidage numbers are 792 reservoir barrels for the Texaco No. 4 well and 954 for the No. 24 well?

A. That is correct.

Q. Okay. All right, sir, if you would look at Exhibit No. 3 with me, please. As I understand this exhibit, the Shell well south and slightly west of the No. 6 well shows the voidage number of 52. That's somewhere to the left of this scale, just so I understand what I'm talking about, is that what this exhibit shows?

A. That is correct.

Q. Thank you. And, once again, on Exhibit No. 4, when you refer to the east half of the east unit area, you're referring to that line that includes the east quarter of Sections 29 and 32?

A. That is correct.

Q. The same set of data. I believe, during your direct testimony, you indicated to us what you thought the producing rates of the two Marathon wells, top allowable wells, would be if your application were granted?

A. Yes.

Q. Could you give me those numbers again, please?

A. Okay. They are projected to produce at 292 barrels of oil per day with a 40-pound producing bottom-hole pressure.

Q. And they're each projected at 292?

A. That is correct.

Q. And in response to Mr. Bruce's questioning, you indicated that the bottom-hole pressure in each of these wells in March of this year was approximately 200 pounds?

A. That is correct.

Q. How did you take those bottom-hole pressures?

A. They shot static fluid levels after leaving the wells shut-in for over 24 hours. They then extrapolated that to a bottom-hole pressure.

Q. Had those static fluid levels stabilized after 24 hours?

A. The indications we have are, yes, they have.

Q. In your opinion, as an expert in the field of petroleum engineering, are there more accurate ways to measure bottom-hole pressure in those wells?

A. Yes, there is. However, from an economic standpoint at this time, we could not justify pulling the equipment to run the pressure gauges necessary to measure it in a more accurate form.

Q. Okay. You indicated when you projected the 292-barrel-per-day rates for each of these wells that that would be 40-pounds producing bottom-hole pressure; is that the phrase you used?

A. Yes.

Q. You need to help me understand, because I don't have an engineering background, what is the present producing bottom-hole pressure in those two wells?

A. They are approximately, after adjusting to the datum for the field, they're approximately 150 pounds. The No. 7 well is slightly different, but at this time I don't remember the exact magnitude of that difference.

Q. Let's look at your Exhibit No. 5, please, which is the pressure map. A difference in the numbers that you have been discussing with me and those reflected on Exhibit No. 5 are that these are 1986 numbers; am I correct?

A. That is correct.

Q. Do you have any information on whether a similar pressure differential map would be drawn today? Would today's map be reflective of these same kinds of contours?

A. At this point I have no idea since the only current data I have available on static pressures are on the two Marathon wells. However, they compare fairly well to that map.

Q. Okay. And just to clarify, you indicated to me you didn't have any other current pressure information; is that correct?

A. No, I do not.

Q. Thank you. Look now with me, please, at Exhibit No. 6. Looking at the Marathon acreage, it appears that both of the Marathon wells fall on contour lines between 10 and 20 percent water cut; do I read that correctly?

A. Yes, that is what this particular map shows.

Q. What's the cut on those wells now?

A. Approximately 2 percent.

Q. And the red line that you indicated as being 100 percent water cut -- there are a couple of partial contour lines to the east of the red

line; what do those contour lines mean?
A. I was not directly involved in the creation of this map, but I assume that they used an automatic contouring feature in a program that went ahead and contoured above 100 percent.
Q. Am I correct in understanding that the percentage water cuts for all the available wells are put in the machine and it contours?
A. I assume. That's what the indication is.
Q. Okay. Looking, please, sir, at your Exhibit No. 7, the three wells to the east, State 427, State V-5, and looks like Santa Fe 110, those wells are inactive; is that what you said?
A. Yes.
Q. Did they water-out?
A. Based on the water-cut map, I would assume they watered-out. I have not gotten back to those wells and looked at the production history to verify that was the reason they were shut-in.
Q. The fourth well on that display, which is labeled State 427 --
A. Yes.
Q. -- that's the No. 7 well on your

Exhibit No. 2 that shows 5 barrels and 227 barrels were voided.

A. [No audible response.]

Q. Is it not? That wasn't a question. I'm sorry. Isn't it?

A. Yes.

Q. And these are, again, November of 1991 data points?

A. Yes.

Q. Do you have similar data for the State 427 Well No. 7 from November of 1990?

A. No, I have not looked at November of 1990.

Q. Have you looked at any month prior to November of 1991?

A. Not in this particular aspect.

Q. Of the wells reflected on Exhibit No. 7, is there any point in time in the year 1989 or 1990 which you can address water production from those wells in a month's average?

A. No, I have not looked at that point in time.

Q. You do not know what the rate of increase of water production in any of those wells is?

A. No.

Q. Have you looked at any historical production data with regard to water production for any of those wells?

A. Not for the wells for this lease, no.

Q. Do you know if any of those wells reflected on Exhibit No. 7 were initially top allowable wells?

A. I do not have that information directly available; however, a geologist has prepared some exhibits that will show the top allowable wells, various snapshots and points in time.

Q. Thank you, sir. Look with me, if you would, please, sir, at Exhibit No. 13. You talked about some of the data sort of in the middle of your summary there relating to current and projected rates of oil, gas, and water and reservoir voidage. Do you see the set of data I'm talking about?

A. Yes.

Q. The 468-barrel increase in oil production rate, can you tell me which of the wells you expect to get what part of that 468?

A. If you step back one exhibit to No. 12, the Warn State Account 3 No. 7 and No. 6 wells will increase to 292 barrels a day, which is approximately 175. Just a second. I do have a table of that. Excuse me. 185 barrels of oil per day.

Q. That's 185 barrels of increase from those two wells combined?

A. That is correct, yes. The New Mexico K State No. 27 is 24 barrels a day; the No. 28 is 57 barrels of oil per day; the No. 29 is 10 barrels of oil per day; and the No. 36 is 7.

Q. Okay. I misspoke, and I don't think you and I had a meeting of the minds on something. That is 185 barrels each?

A. That is correct.

Q. Okay. And I said combined. You agreed with me quickly. I apologize. Mr. Tauscher, it appears to me that Marathon is lucky to have these wells because they appear to me to be considerably better than any other wells. Looking at your Exhibit No. 12, if I interpret that correctly, you've got to agree with me?

MR. SCHUMACHER: Is that a question?

Q. (BY MR. PEARCE) Do you agree with me?

A. Yes. The producing characteristics appear better than the wells around it.

Q. Do you have an explanation as to what to attribute that benefit? Quality? Why are these wells better?

A. At this point I'm not sure we can quantify why; however, our geologist will discuss a few ideas as to why certain areas in the reservoir perform better than others.

Q. Do you believe -- I'm sorry. Take that back. Let me start again, please.

Do you have an opinion on whether or not water influx is contributing to the drive mechanism in these two wells?

A. Based on the current reservoir pressure, it's my opinion, if at all, it is a very minor portion of the reservoir energy.

MR. SCHUMACHER: For those wells?

THE WITNESS: That is correct, for those wells.

Q. (BY MR. PEARCE) Looking at Exhibit No. 13, sir, the section of the data relating to current and protected rates that we were just discussing, looking at the reservoir voidage, current reservoir voidage you calculate as 1651 reservoir barrels per day. You predict that to be 2736 or 1,000 reservoir barrels per day

increase; do I read that correctly?
A. That is correct.
Q. Okay. Then looking further down on that page at the reservoir voidage averages, field total, that's all of the Vacuum-Glorieta? I'm sorry. Do you understand the question?
A. Yes.
Q. 367 versus 379?
A. That is correct.
Q. That's the total Vacuum-Glorieta?
A. That is correct.
Q. And the east half of the east unit, that difference is 288 increasing to a projected 318; is that correct?
A. That is correct.
Q. And that is for the average 40-acre tract?
A. No. That is per well.
Q. But under your projections, am I not correct that there are only four or five wells that will show any increase in voidage at all, if your application is granted, or do I misunderstand you?
A. I'm projecting six wells that will increase in reservoir voidage, and two of those

wells, I believe, can increase in reservoir voidage without exceeding the current allowable. So there is some additional increase in there that can be obtained without a change in the allowable rules that I have not included in the predicted increase.

Q. Okay. Let's look back, please, at Exhibit No. 2. November of 1991, on the Marathon acreage, for the No. 6 well, you show 232 reservoir barrels per day average reservoir voidage; is that correct?

A. That is correct.

Q. What would that number be if your application were granted?

A. 533.

Q. And the No. 7 well?

A. 436.

Q. Okay. During his questioning of you by Mr. Schumacher, you were asked about whether or not you saw evidence of coning in this reservoir. Do you recall that question?

A. Yes.

Q. Can you tell me again, do you see any evidence of coning in this reservoir?

A. I have not specifically addressed

coning in any of my general work. However, I did not, in looking at these wells, see any indication of coning.

Q. But that is under the condition of these wells being restricted by the 107 barrels of oil per day allowable; is that correct?

A. That is correct.

Q. Do you have an opinion on whether or not increasing the reservoir drainage in the No. 6 well by 300 barrels per day and in the No. 7 well by almost 250 barrels a day might cause coning of water to these wells?

A. Based on the work I've done, it is my opinion that it will not.

Q. Okay. Looking at the Marathon acreage on Exhibit No. 2, although I assume the same wells show up, there is a well labeled No. 5 and No. 9. What's the current status of those wells?

A. Those two wells are -- one of the wells is currently in use in the Diablo unit; the other well is currently shut-in.

Q. Why is that well currently shut-in?

A. It was shut in because of low oil rate.

Q. What was the last month that -- was that the No. 9 well?

A. Yes, the No. 9 well.

Q. What was the last month that well produced?

A. I do not recall.

Q. Do you know what the oil, gas, and water rates at the time that well was shut-in were?

A. No, I do not.

Q. Do you know if the well had historically experienced an increase in water production rate before it was shut-in?

A. No, I have not looked specifically at that well, primarily since it had always been a poor producer from the initial completion.

Q. Same series of questions with regard to the well No. 8, which appears to be northeast of the No. 6 well. Do you see the well I'm talking about?

A. Yes, I do.

Q. Do you know the last month that well produced?

A. No, I don't.

Q. Or its oil, gas, or water producing rates at the time it was shut-in?

A. No.

Q. Do you know if that well increased -- evidenced an increase in water production rate prior to being shut-in?

A. No, I do not.

Q. You made an allusion in response to my questions about coning that it was, I believe you said, that it was your opinion that coning would not result from the increased allowables based on the work you had done to date?

A. That is correct.

Q. Is that a fair representation?

A. [Nodded.]

Q. And did any of the work that you've done to date specifically address that question of whether or not you would draw water into these wells?

A. I looked at the historical performance of these wells, and with the current water rate and the cumulative withdrawals, I felt that if there were any coning possibilities, we would have been seeing increased water rates consistently instead of the current 2 percent oil cut -- or 2 percent water cut. Excuse me.

Q. Okay. Thank you. To refresh my recollection, the wells almost due north of your

No. 6 well, which is the Phillips 35, I believe; is that correct?

A. Due north of the No. 6 well?

Q. Almost due north. North and slightly west.

A. There's a 132.

Q. 132. And what's the well south and east of the 132?

A. 95.

Q. 95, I apologize. What's the water rate on the 95 well?

A. 119 barrels of oil per day -- or barrels of water per day. Excuse me.

Q. 119?

A. Yes.

Q. And then for the 132 well, you told me it was 196; is that correct?

A. 196, yes.

Q. Did you look back at any production records on either of those wells to determine the history of water producing rates from the wells?

A. No, not in this particular analysis.

Q. I'm sorry. I don't know whether that was a restricted answer or not. The concluding part of that was not in this analysis?

A. I had not looked at any other analysis either.

Q. Okay. I just wanted to --

Nothing further at this time. Thank you, Mr. Examiner. Thank you, sir.

EXAMINER CATANACH: Do you have any redirect, Mr. Schumacher?

MR. SCHUMACHER: Yes, sir, two questions, please.

EXAMINER CATANACH: Okay.

FURTHER EXAMINATION

BY MR. SCHUMACHER:

Q. Mr. Tauscher, I'll ask you this question, and if you can give us a generic explanation, that's fine; if you need to use some examples, that's fine. On your Exhibit No. 2, we obviously have two sets of numbers by each well, I'll say a top number and a bottom number. So far so good?

A. Yes.

Q. The top number, as I understand it, is the oil rate; right?

A. It is the oil rate after correcting it for reservoir conditions.

Q. All right. And the bottom number is

the total voidage rate?

A. That is correct.

Q. And that includes oil, water, and gas?

A. Yes, it does. And with the low reservoir pressures shown in the map in figure 5, 1 Mcf of gas has a very high reservoir volume. At some of the lower pressures, it was as high as 10 barrels of reservoir volume per Mcf of gas. So any gas over the solution GOR at the reservoir pressure took up a tremendous amount of volume in the reservoir.

Q. Is that the reason that, as we went through those numbers, or as you went through them with Mr. Pearce, is that the reason that the amounts or percentages, if you will, of the adjustment were not uniform from one well to the next?

A. That is correct.

Q. On the plotting of the contours in your water cut exhibit, which I believe was Exhibit No. 6, recognizing that that was prepared by the technical committee with probably a commercial contouring feature, if I may use a simple example, am I understanding that correctly, if you have actual data that establishes points 2, 4, and 6, for example, then the plotting function will arbitrarily plot a point 8?

A. That is correct. On the area outside of the 100 percent water cut contour, there would be no input data points. So the plotting package would interpret and carry the contour interval previously used and draw these additional contours out.

Q. All right. But, as far as you know, the 100 percent contour line that is shown was based on actual data?

A. Yes.

MR. SCHUMACHER: That's all.

EXAMINER CATANACH: Mr. Bruce.

MR. BRUCE: Yes, I've got a couple of questions, Mr. Tauscher.

FURTHER EXAMINATION

BY MR. BRUCE:

Q. Exxon has two wells that are simultaneously dedicated; right?

A. If you mean on the same proration unit, yes.

Q. Yes. And now, as I understand it, you've proposed that these two Exxon wells be allowed to produce the highest rate of the two

rather than the sum of the two?
A. That is correct.
MR. NELSON: Or 107 barrels of current allowables.
Q. (BY MR. BRUCE) Why?
A. The reason that we approached the request in that manner was to refrain from having operators drill additional wells out there, producing both wells wide open, and potentially doubling the production from the field prior to unitization.
Q. But in its application Marathon just requested unrestricted allowables; isn't that correct?
MR. SCHUMACHER: We perhaps should address that.
MR. NELSON: That is what it says. And I suppose at the time that, yes, at the time the application was written, the concept had not been communicated to me, and that's why it's not in the application.
MR. STOVALL: Mr. Bruce, perhaps if I can shed some light on some thinking that might go on in that context, is that the Division's memorandum with respect to infill drilling in

unprorated gas pools simply prohibits the producing of more than one well in that particular proration unit at a particular time. And that might be the type of approach that --

MR. BRUCE: Well, I guess from Exxon's standpoint, the application requested -- the application requested unrestricted allowables, and now there's a restricted allowable basically being put on the simultaneously --

MR. NELSON: Of course, it was indicated in the prehearing as well. You have seen it.

MR. BRUCE: I saw it about 20 minutes ago.

Well, just to the Commission -- or to the Division, I think that could be better addressed during -- and it will come out in our testimony -- restricting this testing period to a nine-month period. I think it could be better handled by preventing any infill wells during that period rather than restricting it to Exxon's wells.

MR. STOVALL: Yeah. I just want to make you aware, because some of you may not be aware, that memorandum doesn't apply of course to oil because there is no such thing as an unprorated oil pool. So it never addressed oil, but that is how infill drilling is treated in gas as a matter of Division policy and has been implemented in numerous decisions that in the situation of infill or simultaneous dedication that only one well could be produced at a time.

MR. PEARCE: If I may make an off-the-record comment, if Mr. Bruce wants to switch over to my side, that would be okay.

MR. BRUCE: I didn't hear that, Perry.

MR. STOVALL: That's all right. It's in the transcript.

MR. BRUCE: Strike all of Mr. Pearce's comments.

EXAMINER CATANACH: Okay.

MR. PEARCE: May I get back in for just a minute?

EXAMINER CATANACH: Yes.

MR. PEARCE: Or I'll be happy to go in after you.

EXAMINER CATANACH: Go ahead, Mr. Pearce.

FURTHER EXAMINATION

BY MR. PEARCE:

Q. Mr. Tauscher, going back to my favorite Exhibit No. 2, please, the well No. 132, the Phillips well that produced 196 barrels of water per day average in November of 1991 that we've discussed before; that's correct, isn't it?

A. Yes.

Q. We've referred to this as reservoir voidage. Do you have an opinion on whether or not that 196 barrels of water was replaced? How was the space filled?

A. At this point I have no way of knowing whether it was filled with gas, with water, with oil or anything else. But there was some expansion somewhere in the reservoir that filled that space.

Q. Same sort of question. I'm not sure an engineer would ask these questions. But let me ask you, with regard to your well No. 6, the 232 barrels of reservoir voidage per day average for November of 1991, how has that voidage been filled?

A. Based on the decline in pressure from the numbers prepared in 1986, it's my opinion that that voidage is being replaced by a drop in pressure and expansion of the fluids in the reservoir.

Q. I'm sorry. I thought you indicated to me when we were looking at the pressure exhibit that you thought the pressure was about the same now as it was in 1986?

A. I indicated that the pressure was in general agreement. It has actually dropped on that particular well 30 to 50 pounds, somewhere in that range.

Q. But you don't have any information on pressure on any of the other wells; is that what you told me?

A. That is correct. I have no current pressures on any of the other wells.

Q. Was there a corresponding pressure drop on the No. 7 well?

A. The No. 7 well indicated a very slight increase.

Q. I'm sorry. A very slight increase in pressure from 1986 to 1992?

A. Right. However, because of the method the fluid levels were shot and the somewhat imprecise calculations that go into a fluid level, our pressure may have been calculated on the high side, the static pressure on that particular well and on the No. 6 well.

Q. The voidage rates that you show for November of 1991, on Exhibit No. 2, have you prepared voidage rates for some previous time frame?

A. No, I have not.

Q. So you don't know if the 190 barrel per day average voidage on the No. 7 rate is reflective of what the voidage rate has been historically?

A. No, I have not. I have looked at cumulative voidage, but I have not looked at a point in time, another point in time.

Q. Okay. Tell me the cumulative voidage investigation you've done. Have you done that with regard to all wells in the pool?

A. No. I looked at a few selected wells.

Q. And which wells did you look at, please, sir?

A. I do not have the exact data with me, so I can't tell you the exact wells. But I did look at some of the top allowable wells.

Q. Do you remember if you looked at all of the top allowable wells as reflected on Exhibit 2?

A. Okay. I looked at it. And the only data I have available is the total for the four current top allowable and the two that I estimate can be made top allowable.

Q. All right. And give me the numbers that you have available on the four top allowable wells, please, sir.

A. I just have a total for the six.

Q. Okay. And what is that six? I see you're looking at Exhibit, I believe, No. 13; is that reflected on that exhibit?

A. Yes, it is at the bottom of Exhibit No. 13. And it is 34 million reservoir barrels, or approximately 6 percent of the total reservoir voidage.

Q. In looking at that original oil-in-place data line, the line immediately below the one you were just discussing with me --

A. Yes.

Q. -- this original oil in place number of 8.6 million stock tank barrels of oil, what is the source of that number?

A. That is from the technical committee report.

Q. You indicated at the beginning of your testimony that you had been involved with the Vacuum-Glorieta pool, I believe, since August of 1990?

A. That is correct.

Q. And had the technical committee issued a report prior to you being involved in this project?

A. I do not have that information, I have not found a previous report in our files.

Q. Okay. The current report was issued after you began working on this project?

A. That is correct.

Q. Did a previous Marathon employee participate in the engineering and geological efforts that led to that report?

A. I know that one was involved in the previous technical committees. I am not positive on whether we had someone that attended the geologic committee meetings.

Q. Do you know if -- well, I guess it happened after you began being involved in this project. Did Marathon approve that report for the Vacuum-Glorieta?

A. Yes.

Q. And did that report contain numbers for

original oil in place for each 40-acre tract?
A. Yes, it did.
MR. PEARCE: That's all. Thank you, Mr. Examiner. Thank you again, Mr. Tauscher.

EXAMINATION

BY EXAMINER CATANACH:
Q. Mr. Tauscher, just for clarification, on the no restriction, you're proposing no restriction on top allowable wells. Tell me again what the proposal is for wells sharing a proration unit.
A. On those wells we would allocate either the 107 barrels of oil per day or the capacity of any single well on that proration unit, whichever is higher. So we would not restrict any well beyond what the current restrictions are.
Q. Okay. Tell me which of the top allowable wells are Marathon operated.
A. The two wells located in Section 33.
Q. The well numbers, can you give me the well numbers?
A. Okay. The Warn State Account 3 No. 6.
Q. Okay.
A. And the Warn State Account 3 No. 7.
Q. Okay. Are those the only two Marathon

wells that are top allowable?

A. Yes.

Q. Okay. The 28 is Exxon?

A. Exxon.

Q. The 31 and the 34 are whom?

A. Those are Exxon also.

Q. 29?

A. Exxon.

Q. The 27 and the 36?

A. Okay. Those are Exxon wells also.

Q. Do you have any idea when the unit is going to be officially formed out here?

A. Okay. The target date that was presented at a meeting for the Vacuum-Glorieta west unit, it was held just a couple weeks ago, they were targeting somewhere around August 1st.

Q. Of this year?

A. Of this year. The Vacuum-Glorieta east unit, at this time I'm not aware of any target date because, like I said, previously in testimony it has been sent back to the technical committee to reevaluate the remaining primary reserves.

Q. Okay. So there's no current target date for the east unit?

A. No.
Q. Have the various allocation -- or the allocation formula for the east unit, has that already been determined --
A. No, it has not.
Q. -- and agreed upon?
A. It has not.
Q. It has not.
A. And that is one of the problems with the unitization is the establishment of a proration or a participation formula.
Q. Is Marathon in disagreement over that issue?
A. At the last working interest owners meeting, the highest agreement of any formula was approximately in the 60 percent range. Marathon supported some formulas; Marathon opposed others, again, in an effort to try to come up with what we feel is an equitable and fair formula.
Q. Is Marathon concerned with the fact that they feel that they're not being allocated enough remaining reserves; that's part of the problem?
A. That is part of the problem in the

unitization. The other concern we have in the unitization is because of some limitations of the data available, we feel the oil-in-place number is underestimated. And as a result of some things that our geologist will mention later, we feel it's not necessarily an equitable parameter. And between the remaining primary and those numbers, there's been quite a bit of discussion on the parameters.

Q. Is there a factor of current production as of some cutoff date in any of the allocation proposals?

A. Yes. There has been cumulative production as of, I believe, for the east unit was 1/1 of 90.

Q. How about current production, is that a factor?

A. It was also 1/1/of 90.

Q. Okay. Explain to me a little bit about the Vogal analysis, I don't remember that particular process, on how you calculated what the capacity of these wells could be.

A. Okay. The Vogal analysis takes a current rate and reservoir pressure -- or producing pressure and it takes the static reservoir pressure, and from that you can estimate what the rate will be at any producing well rate.

There was some work done, I believe, in the early 60s on solution gas drive reservoirs. It also appears to work fairly well in other reservoir drives also. It's more conservative than the straight-line productivity increase, simply drawing a straight line through the static pressure and the producing pressure.

Q. Okay. If you produce these wells at top allowable, how long would it take you to get to establish a decline on these wells?

A. I feel that we would need approximately nine months to establish a reliable decline on these wells. I suspect that because of the change in the operation in the reservoir, the first couple of months you may see what's commonly termed "flush production."

So after the first two or three months, the wells should then start to establish a decline. And after about six months of decline, I feel we would have a fairly reasonable idea of the remaining primary reserves, assuming that the wells do not jump around a lot.

Q. Is it not possible to calculate remaining reserves on any other -- based on any other type of formula, volumetrics, or anything like that?

A. I think if we had better production tests on the top allowable wells, historically over the last five or six years where the wells were produced at capacity for a couple of days, each year or something of that nature, yes, we could. We could extrapolate a decline in capacity.

However, that work was never done. And as a result, with the data currently available, this is the only method that I'm aware of reliably calculating reserves that the companies with and without top allowable wells could come to an agreement on. That is the remaining reserves.

EXAMINER CATANACH: Okay. I believe that's all I have of the witness.

Anything further? This witness may be excused. I guess let's go ahead and take 10 minutes at this point.

[A recess was taken.]

MR. SCHUMACHER: Can we make one

clarification for the record, please?

MR. NELSON: Mr. Catanach, in Mr. Tauscher's testimony he stated that one limitation that we were asking on the increased allowable was that where you have a proration unit with two or more wells, we wanted to limit it to the greater of the current 107 barrels per day or the capacity of any single well.

We want to clarify that to say that in our proposal would not apply to current proration units with infill wells on them, but would apply to future infill wells.

EXAMINER CATANACH: So you, in effect, have no restrictions on proration units that show wells?

MR. NELSON: Currently, there's two, as I understand, two Exxon proration units that have that situation. And our limitation that we propose would not apply to that situation, to either of those two situations. It would apply if the situation arises anew in the future.

EXAMINER CATANACH: Okay.

MR. SCHUMACHER: Shall we proceed?

EXAMINER CATANACH: You may proceed

JOHN CHAPMAN

Having been duly sworn upon his oath, was examined and testified as follows:

EXAMINATION

BY MR. SCHUMACHER:

Q. You are John Chapman; you work for Marathon Oil in its Midland office?

A. That's correct.

Q. You've never testified before this Commission?

A. That's also correct.

Q. Can you give us an idea of your educational background and work experience?

A. I graduated in 1981 from the Colorado School of Mines with a Bachelor of Science Degree in geological engineering. I at that time went to work for TXO Production Corp. I worked for them for nine-and-a-half years. TXO later merged into Marathon, so total, I've essentially worked for Marathon for just shy of eleven years.

Q. You are familiar with the Vacuum-Glorieta Pool that's the subject of this proceeding?

A. I am.

Q. How have you become familiar with that pool?

A. Approximately a month-and-a-half to two months ago, I was asked to come in and take a look at the pool to look at the geological aspects of the pool to see how they agree with the observations that were coming out of our reservoir engineering staff.

MR. SCHUMACHER: Any additional questions about the witness' qualifications?

EXAMINER CATANACH: No.

MR. SCHUMACHER: We would submit his expertise.

EXAMINER CATANACH: He is so qualified.

Q. (BY MR. SCHUMACHER) What were your objectives in conducting a geological study of this reservoir?

A. I wanted to understand how the geology affects the production and producing characteristics of the field.

Q. Did you find any unusual producing characteristics in this field?

A. Yes, I did. I basically took a four-fold approach to the analysis in the field. The first thing I did was go back and look at the production historically to see how it has behaved through time.

I then reviewed the geological portions of the Vacuum-Glorieta committee technical report. I then analyzed logs and cross-sections across the field and finally analyzed three cores of the Vacuum-Glorieta interval from within the field.

Q. Cores you said?

A. Cores, yes.

Q. And in connection with that work, did you have occasion to prepare a series of exhibits that you've brought with you here today?

A. I did.

Q. Those exhibits are numbered 14 through 19. May I turn your attention first to Exhibit 14 and ask you to explain that to us, please?

A. Exhibit 14 is a map I prepared of the average daily oil production rate as of November 1971. The way this map was prepared is I went back and found the production per well for the month of November of that year. I then divided by 30 to come up with an applicable average daily oil production rate.

Q. You heard Mr. Tauscher's earlier testimony, did you not?

A. I did.

Q. He indicated that in his view the pool showed characteristics of being a heterogeneous pool. Have you found any geological findings that would bear that out?

A. Absolutely. And that will -- that is shown in all the maps I plan to show. I would like to note that from the beginning, the first exhibit here, Exhibit No. 14, November of 71 was only approximately eight years after the discovery of the pool, six years, if you will, past the primary development of the pool. It was still early in the life of this pool. And --

Q. It might be good if you explained to us Exhibits 14, 15, and 16 seem to focus on three discrete periods of time. Tell us how you arrived at those periods of time.

A. If I could move to the latter first just for reference briefly, Exhibit 16 is based on the November 1991 production data, which was the most recent available production data I had that was field-wide.

I looked at that data first, and then I stepped back in two ten-year increments, November 1981 and November 1971, to arrive at the three maps I plan on showing just to show how the field has behaved through that period of time.

Q. All right. Why don't you proceed with that explanation, please.

A. Okay. Again, Exhibit No. 14, the average daily oil production per well as of November 1971, this map is contoured on a contour interval of 25 barrels of oil per day per well. We have shaded in those areas of 100 barrels a day or greater. This is oil alone. By so doing we basically have designated those portions of the field which at the time in its history were top allowable capacity.

You can observe on this map that the vast majority of the eastern end of the Glorieta Vacuum-Glorieta Field was capable of top capacity production, top allowable production, with the exception of wells on the margin. But then as you move to the west, the western end of the field, from early in its life has exhibited a different production character. There is only two relatively small areas in that end of the field which are capable of top allowable production.

Q. What changes did you observe over time between November 71 and November of 81?

A. If I move to Exhibit 15, which is the November of 81 map, again utilizing the same methodology, taking the monthly production per well and dividing by 30 to arrive at an average daily production as a representative number, you can see that through time the field naturally is breaking itself down into discrete cells capable of sustaining top allowable production.

At this point in time, November 1981, the west end of the field, there are almost no wells that are still capable of top allowable production rate, while at the east end there are still an appreciable number, though much less than what they were early in the life of the field.

And these areas of top allowable capacity wells basically appear as east-west trending zones, at this point two discrete areas of higher production capacity.

Q. All right. Then let's make that same comparison with Exhibit 16 for November of 1991.

A. Exhibit 16 merely moves ten years further along in the history of the field. It is the most currently available field-wide production data. Same methodology was used again.

You can see by this point in time it has become -- the differences in the wells in their production capacity has become even more extreme. There are no wells in the west end of the field which are capable of top allowable production. There are only three small areas in the east end of the field that are capable of top allowable production.

Those areas are the two Marathon wells in question in Section 33, the Warn State Account 3, 6, and 7, the Exxon K State 28, I believe is the number, in the northeast-northeast of 32, and then the Exxon K State 29 in the northeast-southwest of 28.

What we see is that the field through time and from the beginning has exhibited a very heterogeneous behavior in production characteristics.

Q. On what do you base that opinion?

A. By the discreteness and extreme contrast between the production rates of which the wells are capable and the dispersion of those rates through the field and the high contrast moving from one proration unit to another as far as capability.

Q. Can you give us some examples of that to illustrate your testimony?

A. If you look at the Marathon Warn Account No. 3 No. 7 Well, which is the -- happens to be right under the letter B on this map in Section 33 --

Q. You're still looking at Exhibit 16?

A. Exhibit 16, yes, sir. As you move from that well to the one proration unit to the west, you see the two Phillips' Santa Fe lease wells, 131 and 96. Those two wells are only capable of producing 10 barrels of oil per day combined, while the Warn State Account No. 3 No. 7 was producing at that point at a rate of 127 barrels of oil per day.

Q. What about if you go east of the Warn State wells?

A. The same change. Within Marathon's Warn State Account 3 lease, there are three wells in the easternmost proration unit on that lease, the Warn State Account No. 3, No. 5, 8, and 9. None of those wells are currently capable of production, economic production.

I should note that the No. 5 well has

been converted to an injector in the underlying Abo Vacuum, Abo Field.

Q. And how does that help illustrate the heterogeneous character of the field?

A. Again, merely in the fact that it changes rapidly and drastically as you move across the field. What I'd like to do is compare these maps, these production maps, to the next set of exhibits, which are a fairly standard set of geologic maps, mapping the reservoir.

Q. Are you referring to 17 and 18 or 17 only?

A. 17 and 18. We'll start with 17. I'd like to note that both of these maps, again, are taken from the Vacuum-Glorieta technical committee report, as is noted on the exhibits.

Q. And they're typical of these kinds of maps that form the basis for your opinion?

A. Yes. The first map is the -- Exhibit No. 17 is a structure map on the top of the Paddock, sub-sea depth. If the Vacuum-Glorieta interval was a homogeneous reservoir, homogeneous sponge, you would expect current top allowable capacity wells both now and back through its history to be in some shape or form coincident with structure, whether it be absolute crestal structure or some relatively common point.

There is little or no correlation between those two maps, which points to its basic heterogeneity. That is generally recognized, and I don't believe it is in question, it is a heterogeneous reservoir.

What I would like to do is move on to the next exhibit, Exhibit No. 18. Exhibit No. 18 is also taken from the Vacuum-Glorieta technical committee report.

Q. It's identified as a "net pay." What is meant by this designation?

A. Net pay, as determined by the technical committee, was determined by the committee that the Paddock Formation needed 6 percent or better porosity to be capable of economic production. So a 6 percent porosity cutoff was used as a minimum limit for production capable formation.

What this particular map is is merely -- is merely a map showing how many feet of formation is present in the wellbore on the leases that is equal to or exceeds 6 percent porosity as measured in the logs taken in the wells.

This is, again, one of the first and most basic type of maps used to describe a reservoir. There are other pervasions of this same map that can be made, but they're all based upon the same measurement. They're all based upon a measurement of the porosity in the wellbore.

If I can compare Exhibit No. 18, again, with Exhibit No. 16, you note a distinct lack of coincidence with the areas of high net pay as compared to the areas of high production capability.

Q. What do you mean by that lack of coincidence?

A. Well, you would expect here that the areas of highest or greatest volume of net pay would tend to coincide with the wells which are capable of the highest rates of production.

If you contrast the Marathon Warn State Account 3 Wells No. 6 and 7, which are top allowable capacity wells with the net pay map, you'll see that they are located in what could be considered a median value for the field. The net pay ranges from zero to 120 feet of formation that exceeds 6 percent porosity.

And these Marathon wells fall in an area that is approximately 60 to 70 feet of net pay porosity. So they do not coincide with an area of high net pay, nor, as I attempted to illustrate earlier, do they coincide with an area of crestal position on a structure map.

The same observation can be made for Exxon's top allowable wells in Section 32 and 28. The only well there that approaches coinciding with a high net pay area on the map is Exxon's K State No. 28 Well in the northeast-northeast of 32. The wells in the center of Section 28, again, are in somewhat moderate position on the net pay map.

Q. What is the importance of those findings in terms of expressing the geological basis for estimating the remaining primary reserves?

A. Again, re-stresses the heterogeneity of this reservoir. Beyond simply heterogeneity, as in the presence or absence of porosity, are the nonuniform presence of porosity across the field. It stresses beyond that that there is heterogeneity as to the nature of the porosity, the production capabilities of the rock in the reservoir, and therefore, correspondingly, to the production characteristics of the individual zones within the reservoir.

The reason for that being, normally these two maps, a structure map and a net pay map, would come pretty close to approximating, explaining production characteristics of the reservoir. Unfortunately, in the case of the Vacuum-Glorieta Pool, the field was developed in the early- to mid-60s, and as a result, we are primarily limited to that data, that geologic data which could have been gathered in the early 60s and 70s.

At that time the primary logging tool of choice for measuring porosity was a sonic tool. I'd like to illustrate how that affects the heterogeneity and the understanding of the heterogeneity of the reservoir by moving on to Exhibit 19, if I may.

Q. All right. Identify Exhibit 19 for us.

A. Exhibit 19 is a stratigraphic cross-section B-B prime. I'd like to stop and point out that the cross-section is clearly labeled on the majority of the maps that have been exhibited both by myself and Mr. Tauscher.

Q. This is the same B-B prime line, for example, that we saw earlier on Exhibit No. 1 from Mr. Tauscher?

A. That is correct. It is a stratigraphic cross-section, which means it is hung or datum'd on the top of the Paddock, which is the primary producing interval or horizon in the field. It is an east-west cross-section containing the Marathon Oil State Warn Account No. 3, Wells No. 5, 6, and 7.

The two westernmost wells, the No. 6 and No. 7, are both top allowable wells, as contrasted to the easternmost well, the Marathon No. 5, which is not or was for some period of time a top allowable capacity well.

It can be noted at the base of the log for the Well No. 5, this is the well I previously mentioned that was converted to an auto injector in 1974, June of 74. At that time the daily Glorieta production at abandonment was 37 barrels of oil per day and 35 barrels of water per day. So this well was not a top allowable capacity well.

Q. How many barrels of oil was it?

A. 37 barrels of oil per day and 35 barrels of water per day.

Q. All right.

A. What I would like to illustrate by this cross-section is, again, the heterogeneity of the reservoir and the inability of the available data to accurately or adequately measure and quantify that heterogeneity within the reservoir.

Each of these logs is a gamma ray sonic log, the left-most curve of the gamma ray curve measuring the natural radioactivity of the rocks, its depth. The right-most curve in each log is a measurement of the interval transit time, that being the time it takes an acoustic signal to travel through rock over a given length.

The two top allowable wells exhibit a very spiky acoustic travel time, or interval transit time, contrasted to the non-top allowable well, which shows a relatively smooth log character on the sonic log.

Q. What's the significance of that?

A. The significance of that, and this is widely recognized throughout the industry, is that sonic logs or sonic tools are unable to adequately image vugs and fractures in a wellbore. They are only able to image what is considered the primary porosity, which is the most general porosity distributed through the wellbore.

Whenever it encounters a vug or fracture, it frequently will spike. Spikes are considered an indication of one and/or the other. And that spike is a nonaccurate measurement. It's essentially just a failure of the tool to be able to measure the porosity of that position in the wellbore.

I examined, as I previously mentioned, three cores in the field. They are three of the same four cores of the Vacuum-Glorieta technical committee of the geologic portion they examined when they were trying to characterize the field.

These cores are the Exxon K State 18, 19, and 30. The rock type through the main Paddock, which is the pay in the eastern portion of the field, is predominantly of dolomite with some limestones.

The dolomite is generally a fairly uniform rock in that it is uniform as far as the porosity type. However, you will come to zones in the dolomite which will exhibit vugs, both vugs and fractures. And the quantity and position of these vugs and fractures differs and varies radically from well to well throughout the field.

When I examined those three cores and compared them to the logs, every time you ran into vugs or fractures, coincidentally the sonic tool also responded with a spiky nature.

Again, I just want to stress that what this is pointing out to us is that the reservoir is very heterogeneous in the nature of the porosity. That affects the ways in which the wells -- the production behavior of the wells both -- well, throughout the time. It also, unfortunately, limits our ability to adequately model the field, the reservoir.

Q. In terms of allocating the oil in place?

A. Absolutely. The technical committee made a very good effort, and I feel their maps are accurate for the data that was available, but because of the lack of other porosity and permeability data across the field in general, they were constrained by the limits of the data available, which is that sonic tool which is an inadequate tool.

And as of this point, there is no way we can feasibly or economically go back and gather across the field data that would be adequate to accurately model the reservoir and its production characteristics.

Q. How does this application help address that data situation with the insufficiency of that data?

A. Well, what it affects are some of the parameters or the inability to accurately determine some of the parameters that have previously been mentioned and the desire to unitize this field, those being the original oil in place and the remaining primary reserves.

There just is insufficient data to adequately model and determine those two parameters in existence at this time.

Q. How will the approval of this application give you more data?

A. It will give you the one piece of data which everybody can agree on and find reliable, and that is an accurate decline curve on these top allowable wells, the four current, the six total wells which we have cited show capable of, give you have adequate decline curve so that all parties should be able to come to some agreement of a fairly accurate method of ascertaining what is the original oil in place for those portions of the reservoir and what is the remaining primary reserves for that portion of the reservoir.

Q. And the Marathon wells at issue here have remained top allowable wells throughout the 20-year period that you've analyzed from 71 to 91?

A. That is correct.

Q. From a geologist's perspective, can you address the water encroachment problem that was discussed by Mr. Tauscher during his testimony?

A. I can. It has been noted, both in the committee report and in general descriptions of the Paddock throughout the Permian Basin or the Delaware Basin where the term is applied, that the Paddock was deposited in a shelf-margin position.

It is a fairly linearly-deposited formation as far as the porous sand; thereby, productive portions of the reservoir, rulites, grainstones, packstones which have since been dolomitized. These type of facies show a very linear trend which mimics the edge of that basin margin or shelf margin.

If I could refer to three maps, if I may, referring first to Exhibit No. 16 again. As I previously stated, the production characteristics of the field, as far as what they are capable of producing, tend to mimic these facies patterns you see in the eastern end of the field.

Generally the production characteristics are elongated in an east-west direction which turns on the west end to more of the north-south direction. This again mimics the original depositional facies pattern.

Mr. Tauscher earlier referred to Exhibit No. 6, and I'd like to recall that one also at this point in time, in which it was shown evidence that that water encroachment which has occurred in the field has also occurred in the eastern field, if I may, primarily in an east-west direction, basically the same type of pattern that we were seeing in the production rates, again, mimicking that same depositional pattern.

The reason that Marathon's well would not effectively draw water from the south end of the reservoir, that end of the reservoir or marginal reservoir which is closest, as you go south from the Vacuum-Glorieta Field, you are moving into basinal position, and the facies of rock type changes. As you go basinally, it becomes nonporous and nonpermeable, and basically you cannot communicate water from that direction.

The same thing can be said of the field in general. As you move off to the north end, you again change. As you go in a shelf-ward direction, which would be to the north, you again change rock type facies. And again the rocks in that direction are just basically unable to communicate water.

The only direction in which you can effectively or significantly pool water, if at all, is along the facies depositional pattern, which is from the east.

Q. Is there anything to indicate to you geologically that that will not occur in terms of increasing the production from these Marathon wells?

A. Well, I would cite again the distinction, the difference between the Marathon Warn State Account 3, 6, and 7 wells to the wells which lie immediately to the east of them, which are the Marathon 5, 8, and 9, which are basically nonproductive and nonproducible wells.

If that is the eastward direction, if that's the preferred direction of encroachment, there is no way we can pool it from that direction. Likewise, in the same way that these facies occur in a somewhat parallel sequence or series of higher productivity areas, it is unlikely or improbable that you could draw water from one to the other across normal or perpendicular to that preferred orientation.

Q. Is that because of the lack of communication?

A. It is because of the extreme heterogeneity of the reservoir, which equates to a lack of communication of the reservoir fluids as far as the ability to draw reservoir fluids across the zones.

Q. You mentioned a term, I think you said, "vertical structure." What do you mean by that in terms of this field?

A. I'm not sure when I mentioned that term; therefore, I'm not quite sure what I meant. If I mentioned it when I was referring to Exhibit No. 17, which is the structure map on top of the Paddock, it would -- I would just have been referring to the vertical relief of the reservoir as it goes up-structure and down-structure.

MR. SCHUMACHER: Pass the witness. We'll move the admission of Marathon's Exhibits 14 through 19.

EXAMINER CATANACH: Exhibits 14 through 19 will be admitted as evidence.

MR. BRUCE: I have no questions, Mr. Examiner.

EXAMINER CATANACH: Mr. Pearce.

MR. PEARCE: Thank you.

EXAMINER CATANACH: No questions?

MR. PEARCE: You're not that lucky.

EXAMINATION

BY MR. PEARCE:

Q. Mr. Chapman, looking at your Exhibit No. 19, please.

A. Yes, sir. Okay.

Q. The Warn No. 5 well that has now been

converted to an Abo injector --
A. Yes.
Q. -- that well was producing 37 barrels of oil per day on abandonment?
A. At abandonment in June of 64, yes, sir.
Q. And 35 barrels of water?
A. That's correct.
Q. And can you tell me the same information with regard to the No. 8 and the No. 9 wells?
A. The No. 8 and No. 9 wells did not exist at that point in time. They were both drilled to replace the No. 5.
Q. All right. Can you tell me when the No. 8 well was abandoned?
A. No, I cannot.
Q. Do you know what its producing rates for oil, gas, and water were on abandonment?
A. No, I cannot.
Q. Has that well been plugged and abandoned, or is it just shut-in or temporarily abandoned? Do you know the condition of that wellbore?
A. To the best of my recollection, it has been plugged and abandoned, but I'm not

absolutely sure.

Q. With regard to the No. 9 well, any information on producing rates at abandonment?

A. No. Again, I'm not familiar.

Q. And are you aware of the current status of that wellbore?

A. I also believe that well has been plugged and abandoned.

Q. The problems that you mentioned that you observed with regard to the old sonic logs, particularly referring to the three Marathon logs shown on your Exhibit No. 19, are the majority --

A. Uh-huh.

Q. -- of these, the wells in this pool, about the same vintage? Was it one of those pools that in the late 60s experienced a lot of drilling and there has not been a lot since?

A. Yes, that is true.

Q. Those same limitations, are they applicable to all of the logs in this pool?

A. They're not applicable to all. They're applicable to the vast majority. There have been some recent wells drilled, and in those cases they did use newer vintage porosity tools.

Q. And do those newer vintage porosity

tools provide helpful information that these logs do not?

A. They do. Unfortunately, they're very few and far between. You have the unfortunate aspect, in no case that I know of was the same wellbore logged with an older vintage sonic tool and then with a newer vintage porosity tool so you could directly compare and contrast them.

Q. Would it be possible to re-enter one, for instance, the Marathon wells with some modern-day tool and collect the information you need?

A. No. Since these are case-tolls, you would be unable to adequately and with the precision needed be able to re-log them and gain that additional data.

Q. Okay. Looking at your series of exhibits, 14, 15, and 16, in the course of your study of the geology of this reservoir, did you have occasion to try to construct similar maps with regard to water production rates?

A. I did not do that, no, sir.

Q. Do you know if there is a trend in water producing rates of wells particularly in the east unit area?

A. There was no exhibit specifically prepared to show that. I'm trying to think if that could be derived from any of the exhibits available, and I do not believe that could be adequately done.

Q. I believe Mr. Tauscher indicated earlier that he believed there was what he referred to as a slow influx of water from east to west in this reservoir; do you recall that?

A. Yes, I recall that. That comment was also made in the technical committee report.

Q. And do you agree with that?

A. I do agree.

Q. And that led you to your discussion of the likely, and I don't want to mischaracterize, but I can't quote it either --

A. That's fine.

Q. -- the likelihood that water is more able to move in an east-west direction than a north-south direction?

A. I'm sorry. Would you ask the question again?

Q. Yes. Did I understand your earlier testimony correctly that you believed water is more likely to move from east to west than it is to move from north to south?

A. I believe that both the water-cut maps and just my basic knowledge of the reservoir, as far as what I've been able to ascertain to date, would say that is more likely, but likely is a relative term.

Q. But you do not know or recall at this time what the water production rates for the No. 8 and No. 9 wells on Marathon's acreage was?

A. No, I do not.

Q. Looking at your Exhibit No. 14, Mr. Chapman --

A. Yes.

Q. -- just to the left of the B prime indication --

A. Uh-huh.

Q. -- I see the number 78 in somewhat bolded print.

A. Yes.

Q. What does that 78 refer?

A. That refers to the No. 5 well. In November 1971 that well was producing 78 barrels of oil per day. I'd like to note, to avoid some confusion here, that these three series of maps were drawn on a base map showing all current wellbores in the unit.

Therefore, there are some wells spotted, such as the 8 and 9, the 9 which immediately offsets the 5 where you spotted, they were nonexistent at that time.

Q. Okay. Neither the 8 nor the 9 well shows production rates for 1981 either; is that right?

A. Right. They were not in existence -- or they were not productive at that time.

Q. Okay. Do you have information available as to the cumulative production from the 5, 8, and 9 wells?

A. I do not think that information is contained on any exhibits shown. There would be in the technical committee report a map, which would, I believe, when -- you're referring only to cumulative oil production?

Q. I would ask about others if you told me oil, so --

A. I believe there are maps -- there is a map or maps which may indicate those "cums."

Q. Okay. I'm sorry. If you answered this, I just have to ask you to answer it again, I'm sorry. When were the 5, 8, and 9 wells abandoned?

A. The No. 5 well, as I said previously, was abandoned in June of 74 when it was converted into an Abo injector.

Q. All right.

A. The 8 and 9, I cannot tell you the date. I'm not familiar with those dates. They were drilled in the order -- I can say that much. They were drilled in numerical order, 8 first and then the No. 9.

Q. But they apparently were drilled after 1981?

A. Not necessarily. They were not productive in 1981.

Q. Okay. You indicated during your testimony, Mr. Chapman, that your review of the cores indicated correlation of core data and log data, I believe, with regard to the spikes?

A. It did in that sonic logs tended to react with spikes, basically become nonfunctional when vugs and fractures were encountered.

Q. And you saw those vugs and fractures at the same depths when you reviewed the cores?

A. I saw the vugs and fractures in the cores at the same depth as spikes occurred on the sonic log for that same wellbore.

Q. That was my question. I'm sorry. How long did you spend reviewing those cores, and where are they?

A. The three cores belong to Exxon. They are in their core storage facility, or laboratory, I'm not sure exactly what they call it, in Midland, Texas, at the corner of Marion Field and I believe it's Front Street. I spent an afternoon examining the three cores.

Q. Okay. You indicated in the early portion of your testimony, Mr. Chapman, that you were relatively new to this particular Vacuum-Glorieta project, I think you said a month-and-a-half or two months?

A. That is correct.

Q. Have you worked this pool in any other context previously?

A. The Vacuum-Glorieta Pool itself?

Q. [Nodded.]

A. No, I have not.

MR. PEARCE: I have nothing further at this time, Mr. Examiner.

EXAMINER CATANACH: Any redirect?

MR. SCHUMACHER: No, sir.

EXAMINER CATANACH: I have no questions of the witness. You may be excused.

LARRY D. HALLENBECK

Having been duly sworn upon his oath, was examined and testified as follows:

EXAMINATION

BY MR. BRUCE:

Q. Would you, please, state your name for the record.

A. Larry D. Hallenbeck.

Q. And where do you reside?

A. Midland, Texas.

Q. What is your occupation, and who are you employed by?

A. I'm currently employed with Phillips Petroleum as a reservoir engineering specialist in our exploitation group.

Q. Have you previously testified before the Oil Conservation Division?

A. No.

Q. Would you, please, outline your educational and employment history?

A. I graduated from the University of Kansas in 1979 in chemical engineering, after which I was employed by Phillips Petroleum in

Odessa, Texas. I spent 14 months there and then was transferred to our Norway operations in 1980.

And I spent ten years in Norway in our reservoir engineering department there in three different capacities: well testing, reservoir simulation, and field reservoir engineering. And in June of 1990, I transferred back to West Texas in the Odessa office and became a senior reservoir engineering specialist in our exploitation group.

Q. Does your area of responsibility include southeast New Mexico?

A. Yes, it does.

Q. Are you familiar with the engineering matters related to this pool?

A. Yes. I began reviewing the Vacuum-Glorieta Pool about six months ago.

MR. BRUCE: I tender Mr. Hallenbeck as an expert petroleum engineer.

EXAMINER CATANACH: He is so qualified.

Q. (BY MR. BRUCE) Mr. Hallenbeck, briefly what is Phillips' position in this case?

A. Phillips supports the application of Marathon but requests that the unrestricted allowable be limited to a nine-month period. In addition, Phillips requests that the monthly allowable for the well equal its actual production.

Q. Now, why does Phillips want the allowable to equal production?

A. So that any top allowable well will not gain an advantage by having its previous overproduction canceled.

Q. Now, why does Phillips request the time limitation?

A. Phillips thinks that nine months is sufficient time to gather the data required to allow the unitization process to proceed. In fact, Phillips will be actively pursuing unitization during the requested time period.

Q. Now, referring to Exhibit 1, would you, please, discuss Phillips' unitization proposal?

A. Phillips has proposed a secondary recovery unit covering approximately 4200 acres of state leases in the eastern part of the Vacuum-Glorieta Pool and has met with working interest owners to discuss allocation of unitized production.

Exhibit 1 here is a plat which outlines

the proposed unit area and shows a possible water-flood development plan that might be implemented if such a unit was approved and accepted.

Q. Okay. If the unit is formed, what are Phillips' estimates on capital investment and recovery of secondary reserves?

A. In our proposed development plan, we have estimated a $35 million investment may yield a total of 22 million barrels of EOR recovery.

Q. I think it was mentioned briefly by Marathon's witness, but Phillips is seeking a unitized, and many other operators are too, the eastern part of the pool. What of the western part?

A. Yes. Texaco is pursuing the western part and has proceeded along and has actually gained temporary -- or has gained agreement among their working interest owners on a proposed unit. And I guess they will be presenting that this summer to the committee.

Q. So if both kinds as proposed are approved, the entire pool will be unitized?

A. Right.

Q. Is there an agreed participation formula for the eastern unit?

A. No. But the working interest owners have formed an engineering committee which have discussed certain parameters.

Q. In referring to Exhibit 2, what are those parameters?

A. Well, Exhibit 2 lists some of the key parameters, but not all of them, but some of the key ones. These include 1990 production, volumetric original oil in place, usable wellbores, acreage, and 1/1/91 remaining primary.

All of these parameters, the first four are pretty well set. There's no disagreement among those. But it's the last issue that becomes the sticking point to proceeding along and getting agreement among all the owners.

Q. And there's really no agreed value of that fifth parameter; is that correct?

A. We have agreed and done analysis, but how you use that in the actual formula is what's not be agreed upon.

Q. Okay. So could you summarize more what is the problem?

A. Well, as stated earlier by the Marathon people, the vast majority of the wells in the Vacuum-Glorieta Pool, over 90 percent are on decline. However, certain wells in the pool are still producing at top allowable. And I might mention that a lot of these wells, there are a lot more top allowable wells just a few months ago than there are now. Some of them have been coming on.

Thus, there is no decline curve analysis that you can perform on these top allowable wells, and therefore it's very difficult to assign a remaining primary that everyone may agree to. We believe that if the top allowable wells are allowed to produce temporarily at the unrestricted rate, then we could perform, the engineering committee, could perform the necessary calculations and assign an equitable remaining primary that would be acceptable to all parties.

Q. In short, you hope that this will pave the way for unitization?

A. Right.

Q. Why not wait for the wells to begin their decline naturally?

A. Well, Phillips believes now is the time to unitize the pool. The faster unitization is started the better it will be for all the interest owners in the pool.

Q. And why should unitization proceed now?

A. Well, as stated earlier, there are a number of shut-in wells in the eastern part of the pool due to high-water production or low-oil production or both. In addition, 49 of the 73 active wells in the eastern part of the field are producing less than 20 barrels of oil per day, so there's a significant number of wells that are reaching marginal status.

Second, Phillips operates the East Vacuum Grayburg San Andres Unit, which is located vertically above this Glorieta Pool. And unitizing the eastern part of the Glorieta Pool, we believe, will result in operational efficiencies with the operations of that unit.

Finally, without the unrestricted allowable, it may take years for the top allowable wells to begin their decline. This may have an adverse effect on the marginal operations in the pool on the other wells.

Q. As a result, does Phillips request

prompt approval of this application?

A. Yes. We would like to see action taken as soon as possible.

Q. Now, if the Division grants Marathon's request, does Phillips request that certain test data be obtained from the top allowable wells?

A. Yes.

Q. And what type of data does Phillips request?

A. Phillips has discussed the top allowable wells with Exxon, another operator who has some top allowable wells in the unit, and we came to an agreement, and that will be presented by Exxon later, and basically we want to see 24-hour production tests of fluid volumes to be done at least twice monthly.

We'd like to see monthly pumping fluid levels taken at the time those well tests are taken. We'd also like to see a multi-rate flow test and a shut-in bottom-hole pressure test. These tests, we believe, will provide the data necessary to fully evaluate any decline curve work that may come along.

Q. Are these tests costly?

A. Not at all. And in considering the

increased oil production that the operators with these -- that are fortunate enough to have these wells, there shouldn't be any problem.

Q. Now, a couple of extra things, Mr. Hallenbeck. In your opinion, what is the drive mechanism in this pool?

A. The Vacuum-Glorieta Pool is quite complicated in that you have high GOR wells on one side of the field, very low GOR wells, high water cut on the eastern part of field. From our preliminary work that we have done, it is very obvious to us that solution gas drive cannot be the main -- cannot explain the total driving force of the mechanism in the field. But significant water flux is needed to produce the volumes that have already been produced in the field.

Q. And what direction is the water influx coming from?

A. We have done some studies that have indicated that we need significant pressure support from the north and the east, all -- let's say the northeastern part of the field all the way around to the, almost to the southern part, like that. There's a tremendous volume required to maintain the current production rates that we see today.

Q. So what is your opinion as to the effect of the water influx on the production of this pool?

A. We can't help but feel it's very, very important in explaining some of the situations that exist in the field as far as high recoveries.

Q. And in your opinion will the current fluid withdrawal rates in the pool result in adverse effects to the top allowable wells?

A. It's Phillips' opinion that the Marathon wells are not experiencing abnormal pressure decline. In fact, it was testified earlier that there's hardly been a decline since 1986. And that fact actually supports that these wells are actually being supported by probably water influx or some kind of mechanism like that.

To support this claim is the fact that the producing GOR of the two top allowable Marathon wells is well below solution GOR, even though the reported reservoir pressure is well below the bubble point pressure in the field. In other areas of the field, when pressures have dropped below the bubble point, significant GOR development has occurred and have risen well above the solution GOR.

It is, therefore, our conclusion that the only basis for increasing the allowable is from an information-gathering viewpoint and that Phillips would not support just increasing the allowable because of the claim of lack of -- or losing reservoir energy or something like that.

Q. Now, even if Marathon's assertions are correct, in your opinion will unitization prevent any harm to Marathon?

A. Oh, yeah.

Q. And in your opinion is the granting of Marathon's application for a period of nine months in the interests of conservation and the prevention of waste?

A. Yeah, we believe it is.

Q. Now, was Exhibit 2 prepared by you or under your direction?

A. Yes.

Q. And as to Exhibit 1, did you prepare that?

A. No. But I have reviewed that exhibit

and found it okay.

Q. Was it prepared by your predecessor?

A. Yes.

MR. BRUCE: Mr. Examiner, at this time I move the admission of Phillips' Exhibits 1 and 2.

EXAMINER CATANACH: Phillips' Exhibits 1 and 2 will be admitted as evidence.

MR. STOVALL: I guess, Mr. Nelson, I think you get first shot probably being consistent here.

MR. PEARCE: Mr. Schumacher will be with us in a moment.

EXAMINATION

BY MR. SCHUMACHER:

Q. Just a couple of quick questions, Mr. Hallenbeck. During the meetings regarding the unitization, was any concern expressed by any people in attendance at those meetings about the distribution of the original oil in place?

A. Well, I'm going to have to say that I did not attend the meetings that have been taking place up until this point in the direct unitization talks. I am recently replacing Bill Miller, who is our chairman, who was our chairman of the technical committee, who would have to address that.

Q. All right. And you may give me the same answer --

A. But I -- go ahead.

Q. Go ahead. I don't want to interrupt you.

A. I know there have been lots of discussions on the oil in place.

Q. What's been the nature of those discussions that you can recall?

A. The same concerns that were expressed earlier in that, you know, distribution and using the old logs to come up with a reasonable distribution and also I believe the water saturations have been a source of problem, developing a decent water saturation distribution.

Q. So that results in some imprecision, then, with respect to those estimates?

A. Yes.

Q. If you know, when the technical committee report was accepted, was the nature of that acceptance simply acknowledging that the technical committee had filled its obligation, or was it actual acceptance of each and every finding and each and every set of numbers that was expressed in that report?

A. I can't answer that.

Q. If you don't know, don't guess.

A. No.

MR. SCHUMACHER: That's all.

EXAMINER CATANACH: Mr. Pearce.

MR. PEARCE: Thank you.

EXAMINATION

BY MR. PEARCE:

Q. Mr. Hallenbeck, with regard to your Exhibit No. 2, focus with me for a minute, please, on the item, "Volumetric Original Oil in Place." Do you know if an adjustment was made for top allowable wells to add to the volumetric original oil in place that's calculated because those were top allowable wells?

A. Again, I could confer with Bill Miller, who is in the room.

Q. You don't know?

A. I don't know.

Q. Okay. Is it it a fair characterization of Phillips' position, as you understand it, that you believe this application should be approved so that you can move forward with the unit but that you have no particular quarrel with the information that's available now?

A. We would like to see efforts in resolving the remaining questions that have held up the unitization, if I can rephrase that question back to you.

Q. Do you have an opinion on whether or not gathering this data would get joinder of all parties to the east unit? I mean, is this enough?

A. We are very close to coming up with an acceptable formula. And I believe this last stumbling block would really -- would pave the way. It's really been a problem with, you know, having top allowable wells not being able to actually perform the decline curve analysis. And that's a very accepted method here outside of very exotic methods where we don't have the data to really perform those types of studies.

Q. Is it possible to obtain the data to perform those other tests you're talking about?

A. It would require extensive costs. You know, anything is possible along those regards. If you want to drill new wells just for data collection, but that would just be prohibitively expensive from our viewpoint.

Q. Do you have an opinion on whether the granting of this application will or might cause coning of water into the -- particularly the Marathon acreage?

A. I have not studied their individual wells in detail, so I would have not an opinion on whether coning would be a problem in their wells or not. I primarily stay with the general field study.

Q. As currently proposed, Phillips would be the operator of the east unit and Texaco would operate the west; is that correct?

A. That's how it's been proposed. You know, it's not been accepted, of course.

Q. And before the east-west division, what was proposed? Was there a proposal for unitization of the whole?

A. I couldn't answer that one.

Q. You've indicated some experience with well-testing procedures. And you indicated that bottom-hole pressure data was one of the items that you would want operators to collect if this application were approved. Do you have some information for me about what you think is an appropriate bottom-hole pressure test, how long, and under what conditions?

A. Yes. I define a static bottom-hole pressure as a test in which bottom-hole pressure is building up less than 2 PSI an hour, you know, and -- or in this case, in these obviously top allowable areas that permeability is obviously high, it won't take that long to stabilize, in my opinion.

Q. Do you have any experience from any of the Phillips' wells about how long those tests will be?

A. No, we don't.

MR. PEARCE: I don't think I have anything further, Mr. Examiner. Thank you, Mr. Hallenbeck.

EXAMINER CATANACH: I don't believe I have anything further. The witness may be excused.

WILLIAM THOMAS DUNCAN, JR.

Having been duly sworn upon his oath, was examined and testified as follows:

EXAMINATION

BY MR. BRUCE:

Q. Would you, please, state your name for the record?

A. My name is William Thomas Duncan, Jr.

Q. And where do you reside?

A. I reside at 2304 Wedgewood, Midland, Texas.

Q. Who do you work for and in what capacity?

A. Exxon Corporation as a staff engineer.

Q. Have you previously testified before the Division as an engineer and had your credentials accepted as a matter of record?

A. Yes, I have.

Q. And are you familiar with the Vacuum-Glorieta Pool?

A. Yes, I am.

Q. And does your area of responsibility include southeast New Mexico?

A. Yes, it does.

MR. BRUCE: I tender Mr. Duncan as an expert petroleum engineer.

EXAMINER CATANACH: He is so qualified.

Q. (BY MR. BRUCE) Mr. Duncan, could you reiterate Exxon's position in this case?

A. Exxon is agreeable to the application that Marathon has filed, and we recommend approval of the application with the constraints that Phillips referred to in their testimony. The first of these would be to limit the duration of the order to nine months from the effective date of the order.

And the second would be for operators producing wells in excess of the 107-barrel-a-day top allowable average for each month to acquire and provide certain information for those wells to the Vacuum-Glorieta Unit Engineering Technical Committee.

And Exhibit 1 lists that information. The first item, as Phillips noted, was a minimum 24-hour production test of oil, water, and gas volumes to be performed twice monthly. The next item is monthly pumping fluid levels to coincide with a production test. And third, a multi-rate flow test during the period to enable calculation of the well's productivity index.

And the last item would be a shut-in bottom-hole pressure done either by direct measurement or fluid level for any one well on the lease during the period. This may allow any well, even non-top allowable wells, to give the operator flexibility in acquiring that data.

Q. Is this data acquisition program designed to be reasonable for an operator to perform?

A. Yes, it is. In fact, Phillips originally proposed a data acquisition program, and we checked it for whether or not we would be able to accomplish it since we're going to be the ones doing it on most of the wells involved. We do have more top allowable wells than Marathon, although we have much less excess capability than Marathon does.

Q. And this nine-month period, what's Exxon's reason for that nine-months' period?

A. We believe nine months is an adequate period of time in order to gather information to be used to extrapolate to a better or a good remaining primary number. On the other hand, there is going to be some adjustments that will have to be made to the wells in the first few months of production under this attempt to produce at capacity.

There will be pump adjustments; there will be artificial lift adjustments. And because of that the first couple of months' data probably won't be that meaningful. The latter six months' worth of data is going to give us the indication of what kind of remaining primary there is.

Q. Do you have anything further you'd like to say regarding Exxon's position?

A. Well, we do believe in the approval of this application as it supports unitization. We're not in favor of a permanent lifting of allowables in the pool. We see this as a stepping stone toward unitization.

Q. And was Exhibit 1 prepared by you or understand your direction?

A. Yes, it was.

Q. And in your opinion is the granting of this application, as modified by Exxon's request, in the interests of conservation and the prevention of waste?

A. Yes.

MR. BRUCE: Pass the witness, Mr. Examiner.

EXAMINER CATANACH: Mr. Schumacher?

MR. SCHUMACHER: I don't think we have anything. We don't have anything. Thank you.

EXAMINER CATANACH: Mr. Pearce?

MR. PEARCE: Yes.

EXAMINATION

BY MR. PEARCE:

Q. Mr. Duncan, I want to talk to you about something that's been circulating around the room, and I just don't have enough information to know whether I ought to be worried yet or not. The infill well problem in this pool, how many of the well proration units in this pool are infill drilled?

A. There are two proration units that have additional wells on them.

Q. Two additional?

A. Let me look at this. To my knowledge, the only ones that exist are on Exxon's K State lease in Section 28. There are two wells that have been simultaneously dedicated to a single proration unit in the northwest quarter of the southwest quarter and two wells that have been dedicated to a single proration unit in the southwest quarter of the southeast quarter.

Q. All right. Can you, looking at those two proration units and four wells, can you give me Exxon's opinion on the producing capacity, oil, gas, and water, of each of those wells, please?

A. No, I cannot. I don't have that information in front of me.

Q. Looking at your Exhibit No. 1, item 2, "Operators' Producing Wells in Excess of 107 Barrels of Oil Per Day, Average for Each Month, Will Acquire," I'm trying to figure out with regard to the two proration units that are infill, what happens under this last description of data to be collected, the shut-in bottom-hole pressure?

A. The last item --

Q. A shut-in bottom-hole pressure, yes, on your Exhibit No. 1.

A. My --

Q. What is Exxon going to be required to do? I apologize for interrupting you.

A. My reading of this would be to acquire one bottom-hole pressure in each of the two areas. Actually, I think a strict reading would be one bottom-hole pressure for the lease, and it is a single lease. So that would be a single bottom-hole pressure for Exxon's K State lease.

Q. Okay. Do you have any information available to you on water production rates on Exxon's wells historically?

A. Historical information?

Q. Well, I have information that's been represented to me as being data from November of 1991 that I've discussed with the Marathon witness earlier.

A. I do have information on a few of Exxon's wells for that time period.

Q. Okay. Do you have information for any of Exxon wells for an earlier time period?

A. Not with me, no, I don't. And I don't recall any.

Q. Do you know if water production levels in the wells on Exxon's lease in the south half of Section 28 has increased over time?

A. I have not studied that. I don't have the answer to it.

Q. In your experience in this reservoir, do you have an opinion on whether granting Marathon's application might cause coning of water onto the Marathon acreage?

A. I haven't studied Marathon's particular situation. There are a lot of variables that influence coning.

Q. Would you expect an increase in water production rates and percentage water rates on your leases if production rates from your wells are increased?

A. No, I wouldn't. We don't have a lot of excess capacity. We estimate only possibly an additional 15 percent production capability. We are thinking that probably maybe another 70 barrels a day between all of the top allowable wells is what will be produced. And that additional amount of fluid production is not going to significantly change the producing characteristics.

MR. PEARCE: I don't think I have anything further, Mr. Examiner. Thank you, Mr. Duncan.

MR. BRUCE: Mr. Examiner, could I ask a couple of follow-up questions?

EXAMINER CATANACH: Yes.

FURTHER EXAMINATION

BY MR. BRUCE:

Q. Looking at Marathon's Exhibit 2, Mr. Duncan, currently the Marathon exhibit lists four Exxon top allowable wells, does it not?

A. It indicates four wells that are top allowable, although I think it also indicates that two of those wells share a top allowable.

Q. So, in effect, three top allowable units?

A. Three top allowable oil proration units.

Q. There are two units with infill wells, but only one of those infill units has a top allowable on it; isn't that correct?

A. Only one of those infill units is capable of top allowable between the wells on that unit.

Q. And, Mr. Duncan, you were involved -- the K State 35 Well, which is an unorthodox location, I believe; isn't that correct?

A. Yes, it is.

Q. You were involved in the process of obtaining approval for that at the Division?

A. Yes, I was, and in No. 34.

Q. And were those wells drilled in part to obtain data for unitization?

A. Yes, they were.

MR. BRUCE: Thank you, Mr. Examiner.

EXAMINATION

BY EXAMINER CATANACH:

Q. Mr. Duncan, on the stipulations that you submitted on Exhibit No. 1 about the testing, are those similar or are those the same as the ones proposed by Phillips?

A. They are intended to be the same.

Q. Okay. Do you have sufficient knowledge of this reservoir as to have an opinion whether granting this application on a temporary basis for nine months will cause detrimental harm to the reservoir or decrease ultimate recovery or --

A. I believe that directionally the information that we gain and the enhanced prospects of unitization at an earlier date overall outweigh any possible adverse consequences to a short-term capacity test. So overall I think the granting of the application will certainly be in the best interests of conservation.

As to the specifics of approval of the application and whether -- if unitization does not take place, I am of the opinion that on Exxon's lease, the K State lease, there would not be any adverse consequences to the additional production rate since they are not very large. It's not substantially different than continuing to produce under the current conditions.

MR. PEARCE: Can I get back, Mr.

Examiner?

EXAMINER CATANACH: Sure.

FURTHER EXAMINATION

BY MR. PEARCE:

Q. Mr. Duncan, if you could, get a copy of Exhibit 2 that we were looking at a minute ago.

A. Yes, sir.

Q. Look at the Exxon K State lease, the proration unit that is shared by the 34 and the, I believe, it's the 31 well --

A. Yes, sir.

Q. -- can you tell me why there is the difference in producing capability of the two wells that share that proration unit?

A. The 31 is a much older well. The 34 is an infill well, or a simultaneous dedication well, and has been more recently drilled. I could only speculate really without doing any -- without doing some study, I really could only speculate as to why they have the two different producing rates.

Q. Is it possible that those two wells are completed in different strata of the formation?

A. I have not checked their completion.

Q. If this application were granted and

water influx was accelerated and then unitization did not occur, do you have an opinion on whether or not we have damaged any interest owner in this pool?

A. It's likely that the interests that chose to accelerate their production would see diminished recovery. Does that answer your question?

Q. Diminished recovery as compared to what?

A. What they would have received.

Q. Would have received had unitization occurred? I really don't understand what you're saying. I'm sorry.

A. Maybe we better start over. What question do you want me to answer?

Q. Okay. If Marathon's application is granted, assume that for me, assume that unitization does not occur in the future, the question is: Do you have an opinion on whether or not correlative rights of any interest owner in the pool have been damaged?

A. With the constraints that Exxon is proposing, I don't believe there will be a significant reallocation of reserves or significant reallocation of production. There will be additional data gained, and that data is to be used for unitization.

In an extremely small fashion, there could be some diminished recovery or some reallocation of reserves, but I haven't studied that absent unitization.

MR. PEARCE: Thank you, sir. Nothing further.

EXAMINER CATANACH: I have nothing further. The witness may be excused.

Let's take a short break again here.

[A recess was taken.]

EXAMINER CATANACH: Let's go.

MR. PEARCE: Thank you, Mr. Examiner. At this time Mobil would like to present Mr. Dan Burnham as a witness. Let the record reflect, please, that he has been previously sworn.

DAN E. BURNHAM

Having been duly sworn upon his oath, was examined and testified as follows:

EXAMINATION

BY MR. PEARCE:

Q. Mr. Burnham, where do you reside?

A. Midland, Texas.

Q. By whom are you employed?
A. Mobil Producing Texas and New Mexico, or something like that -- we change our name -- as agent for Mobil E & P U.S., Incorporated.
Q. For ease, I'm going to talk about Mobil.
A. Okay. Mobil.
Q. Have you previously testified before the Division and its Examiners and had your expertise recognized?
A. Yes, I have.
Q. Credentials recognized?
A. Yes, sir.
Q. In what field, sir?
A. In geology, production geology.
Q. And are you familiar with the Vacuum-Glorieta Pool under consideration today?
A. Yes, I am. I'm probably the, with the exception of Mr. Miller in the back, the only remaining person that is associated with the original 1985 work on this subcommittee as a geologic subcommittee and then working as a unitization committee.
Q. And you're familiar with the application filed by Marathon in this case; is

that correct?

A. That's correct.

MR. PEARCE: Mr. Examiner, at this time I would ask that Mr. Burnham be recognized as an expert in the field of petroleum geology.

EXAMINER CATANACH: He is so qualified.

Q. (BY MR. PEARCE) Mr. Burnham, I'd ask you, please, to refer to what we've marked as Exhibit No. 1. You mentioned that you were one of the participants in the Vacuum-Glorieta study committee. Could you identify this document for us?

A. This is just a Xerox copy of the front page of this report, which was previously announced, entered into testimony, I guess. It's a proposed Vacuum-Glorieta Engineering Geologic Technical Committee Report, dated November 1990. That's just the front page of this. Much of the testimony and maps which we are going to supply today are out of, directly out of this report.

Q. All right, sir. What's the second page of this exhibit?

A. Second page is, just states the first sentence there, "On February 12, 1991, the working interest owners of the Vacuum-Glorieta Field approved the Technical Committee Report dated November 1990."

Q. All right, sir. Anything further you'd like to highlight on that document for us?

A. It was my understanding that when we voted on this, on the contents of this report, that we accepted it as being accurate as far as possible with the data that we have and that it was to be used in the unitization process of trying to create parameters to unitize, in this case, to unitize both the separate units. But if it was not split up, it would have been used to unitize the entire field.

So they were accepted and voted on by each of the individual companies. And the best of my recollection, it was a unanimous vote and that it was approved by all operators and working interest owners.

Q. Did that report assign original oil-in-place numbers to each 40-acre tract within the unit?

A. Yes, it did, and it's in the report. I don't have those numbers, but we'll be glad to copy the whole thing. If you want to enter it in as the report, we'll be glad to submit it.

Q. Okay, we'll see. Let's look now, please, at Exhibit No. 2. Could you describe that for us, please?

A. This is a front page of several pages in there that are out of a thesis, which I just concluded last summer, on the Vacuum Depositional Environments and Facies Distribution of the Permian Paddock Member of the Yeso Formation in the Vacuum-Glorieta Field.

This was at the University of Texas, Permian Basin, was chaired by Dan Womashall (phonetic). And I received a degree August 17, 1991, as a master's degree.

Q. During the course of your testimony, will you be referring to certain pages contained in this exhibit?

A. Yes, I will.

Q. Would you like to address any of those now, or should we move on?

A. No. We can address them in order, or sort of order.

Q. I'm sorry. I don't understand. You want to look at some of the pages of 2, or do you want to move on to 3 at this time?

A. No. We need to look at 2.
Q. All right. Referring to what, if anything?
A. First, just as a quick reminder, for those of you, it's been stated, and I'll just do it real quickly. It's hard to talk brief when you've spent three or four years on a thesis.

The Vacuum-Glorieta Field is located in central Lea County. The zone we're talking about is the upper-most Leonardian-Permian section, Middle-Permian. The actual pay zone is the Paddock interval, this Upper Clearfork equivalent. If you go across the border 15 miles, it's called Clearfork, Upper Clearfork.

The Glorieta really is not a producer. You might have 1 percent of the production that's come from the Glorieta; 99 percent is from the Paddock. It was named the Paddock Pool just as a bracket between the Upper San Andres Pool, which produces prolifically in Vacuum and then a lower Blinebry Pool, which produces also in the Vacuum area.

This is the interval we're talking about, equivalent to the Upper Clearfork. Let's see, I don't remember what numbers I've got on here. I'm so mixed up over there.

The type log for the field is the Bridges State No. 95. This is located on the eastern portion of the field right here on the edge.

MR. SCHUMACHER: East or west?

THE WITNESS: Excuse me, western. The western edge of the field, way back over on the very edge of it. This is a core map I'll show you in a minute, and this well is not on the map. It's a twin well that the No. 97 well was drilled as a replacement. It was a quadruple-completion discovery well that actually drilled to granite, about 15,000 feet.

This is the type log that was chosen by the, I guess, the Commission and those who are in the field -- pool at that time, the No. 95. This is the proposed unitized interval. These were prepared actually to help Phillips go ahead and unitize this interval. But I'll just go ahead and use them here.

This is the interval we're talking about. If you'll notice on the displays, a gamma ray log on right-hand side -- left-hand side. On the right-hand side is the sonic log. As you can see, the gamma ray does not have a very clean signature. It's not a big spiky block, which you'd associate with a real clean formation.

And, likewise, you get the same kind of cycles at bed boundaries throughout the reservoir just to indicate that this is a very stratified reservoir. This is not a nice big homogeneous tank that has been testified previously.

In the packet No. 9, page number 9, if you want to look in your packet, is a smaller version of -- sort of version of this map. It's out of my thesis. Page No. 9. It shows the cores that were cut throughout the field. They're indicated on this map with the triangles around them. These are the hole cores -- better qualify that -- that were available for review for this thesis, or for my thesis, and for the rest of the committee that we looked at them as an engineering geologic subcommittee.

The yellow one here is the Mobil acreage, so we're sort of distributed throughout the field. We're not really isolated, mostly on the west, but we do have acreage right up against the west.

If you add up the total cumulative

number of footage in these wells that have core, it's about 1500 feet. And on the next exhibit, on page 2, there's a page 7 in it, in Exhibit 2, indicates the actual intervals that were reviewed for core for this study, approximately 1500 feet.

Also in the study I finished up approximately -- well, approximately 495 thin sections, I counted them one day, thin sections of core and looked at them through the petrographic microscope, making thin sections, photograph micrographs, looking at the minute details of the depositional systems of this reservoir.

It's a very complex reservoir. It's not a -- it's not a layer-caked big tank that we can discuss and look at out there. It is very stratified. And within these stratified intervals, you find zones of very, very low permeability, and you can even have high porosity and low permeability.

But you can have low permeability, go into a three- or four-foot interval that will have 15 percent porosity, have even up to a 100 millidarcies perm, sometimes even more, and then immediately below that is a very tight interval again. So you have these layer-caked intervals that I'll talk a little about more when we talk about the depositional environment. But in that is a very stratified reservoir, and I guess that's what I'm trying to get across.

In Exhibit No. 5 -- we skipped one in there; huh, Hai? That's all right. We don't need it. No. 5 shows a core gamma log. This particular one on top, it's from the Humble State K-19. Two pages back is also the State T-10, which is a Shell well. Those wells are, respectively, the 19 is just north of the Marathon tract on the map right here. And the T-10 is just directly 40-acre offset, just south of this location, one of their top allowable wells, the No. 6. I don't know if Marathon looked at that core or not.

What I'm trying to show from this and behind each of these analyses is the actual log, electric log. If you look at the, on the left-hand side, you show a gamma ray with an increasing, it's got marked with the top of the Paddock on there, approximately 6,070 feet -- 72 feet, it looks like. The next column is permeability. The next column to the right is porosity.

And I want to draw your attention to the permeability area in there. If you look at the very upper portion of the Paddock, it shows there's no permeability, less than .0 1. As you move down through the section, you have approximately 10 feet of good permeability up to 8, 8 to 10 to 12 millidarcies permeability. Then it drops immediately back to zero, and then so on. As you go through this reservoir, very characteristic of a very heterogeneous reservoir. Very stratified.

Also in No. T-10, the third page back shows a very silimar character on the core gamma. High permeability, no permeability. High permeability, low permeability. So it's a very stratified reservoir.

Q. (BY MR. PEARCE) I'm sorry. Let's sit back down and collect ourselves. Are there other pages of Exhibit No. 2 that you want to address at this time?

A. Yeah. I'm to it right now. I should have just brought my notes up here. Okay. Let's look at page 44. Page 44 is the Exxon K-18.

Everyone have it? This, again, is just more background material or back-up material to show the stratified nature of the reservoir.

The K-18, this is a graph out of my thesis. I built this core diagram with the core gamma ray on the left-hand side -- or excuse me, this is a gamma ray log. It's not a core gamma ray. And then lithology, core, porosity type, fossils, grain type, and also sedimentary structure.

What I really want you to see on here I've labeled as Cycle 1, starting at the bottom, Cycle 2, Cycle 3, Cycle 4, up to the top of the Paddock. These cycles are cycles that I have correlated back to the electric logs.

And from that I have correlated to each of these other 12 wells, key wells, that I had reduced for this study and actually correlated all of the cored wells to their electric logs and vice versa across the field to create a net of structure stratigraphic -- excuse me, stratigraphic cross-sections through the area, very detailed work on the stratified nature of it.

And this is what I'm just trying to

show is that, through the Paddock interval from Blinebry time up through the top of the Paddock, we have four major depositional cycles.

These are caused by a lot of different variations, a lot of different -- could be sea force swelling -- regardless, what's happening is that this plateau or this shallow carbonate platform is being flooded and then it's being raised up, it's being flooded, it's being raised up, so seas are going in, and the seas are going out.

And each one of these major bed boundaries is a cycle in the new nomenclature, I guess we're calling it, cyclic sedimentation. And these are major cycles within it. Even within each of these individual cycles, if you look at the gamma ray here, you can see a cycle beginning to -- what these are are coarsening-upward cycles. You start out as fine-grain mud. The sea level is actually rising, and as it rises, you get additional buildup of denser and coarser material.

When you get right at the very top of a unit, where your waves are almost right at the top of it, it's cleaning out all the fine-grain muds and depositing them away from it, and it's just leaving the coarsest material, and that's the grainstone banks. And we have a grainstone here, here, here, and then a massive grainstone at the top of it.

Even within this grainstone section, though, if you look at the upper one, which is the massive one, this is, by the way, the only well that was cored through the whole entire -- through the Paddock interval, so it's really the key well through all of it. Even, if you notice, this gamma ray character, it's not a nice clean, upward-showing section. It is very erratic. It also has a number of fine-grain laminated boundaries within it, which are low permeability zones and the like.

Also behind this would be page, let's see, behind page 44 is additional data -- and I won't go into it, lack of time -- is the K-19, which is another Exxon well that I looked at the core. The K-30 has a similar character. Very erratic in the gamma ray and also in the descriptions. And also the Shell T-10, which I have presented as Exhibit No. 5, I believe.

I have on the wall here, right here,

this is also in your exhibits as Exhibit No. 6, shows an east-west cross-section, C-C prime. And I'm only showing a portion of this because this thing will probably go out the door there. These were built by the geologic subcommittee, and I'd say somewhere around 1988. It could be 1987. It didn't have a date on it.

This one did not get in the final report, but it was built by the contingent of Exxon, Phillips, Mobil -- why can't I remember -- Texaco, excuse me, and Texaco -- were the four companies that represented the geologic subcommittee.

I started on the east side here with -- and this also shows an Exxon name on it, by the way, and that's because Exxon at that time was leading the contingent, and they also provided the computer data that hung this particular cross-section. That's why the Exxon name comes on here.

I've colored on this. This goes from the Exxon K --

Q. Excuse me. We're now directing our attention to Exhibit No. 7 --

A. Thank you.

Q. -- which is the cross-section reflected on the line of cross-section in Exhibit 6; right?
A. Right. Thank you.
Q. Thank you.
A. Thank you, counselor.
Q. You're welcome.
A. On Exhibit No. 7 we show a stratigraphic cross-section, and again, this is just a small portion of it. It starts from the Exxon K-18 and goes through across to the -- I can't even read it. That's the Mobil M-No. 9 on the very edge of the field.
I have highlighted in here in the orange color all those intervals that were less than 5 percent porosity. And at that time we used a 5 percent cutoff, so it's less than 5 percent porosity off of the sonic logs. These are all sonic logs.
And what we did in attempt was just try to correlate like intervals, which would show some continuity or discontinuity. By viewing it you can see that there may be 50 percent continuity, maybe not. Nonetheless, just to illustrate the very stratified nature of this reservoir.

We have zones of good porosity, and it can be bisected on the well right next-door to it of no porosity or very low porosity. We have zones of high porosity, which tie back to core data, which can have very, very high permeability. So you have thin zones very characteristic of this type of environment.

Let's see, No. 8, what's No. 8? Well, I've got one left; that's this colored picture. It's in the very back of Exhibit No. 2. This is a depositional environment model.

Q. Let's let people get to the last page of Exhibit No. 2, please.

A. Okay. Depositional environment model. This is a -- this reservoir is a very complex, cyclic sedimentation, very shallow carbonate reservoir. I've indicated in here, and most of the area that we're discussing in here on the Exxon and the Marathon area are predominantly composed of this oolitic grainstone and this oolitic packstone facies, although it's inter-fingered throughout this section with sandstones, which are either wind-derived, which have been blown out across the top of the reservoir, as it has been a low-stand sequence.

As the sea has been down lower, the sand has been blown across the top of it, which creates an impermeable barrier. This is a very simplistic view of it, but we have intervals on the edge of the reservoir here that are oolitic in nature.

We have a skeletal packstone, Wackestone. Then we get in the very back portion of the reservoir in the northern part of the field, which is actually mostly mudstones. And those mudstones have been heavily dolomitized. In fact, you can't even recognize the structures in the original nature of the reservoir, although they do produce in very good quantities.

I had a couple more things. I think that was all on the statement there. I did want to make a statement on the methods to determine additional pay in old wellbores.

There is a fairly new technology called a sheer-wave sonic log that is available, can be run in case total logs, and it is quite accurate to determine not only porosity in vuggy porosity, but also vuggy and inter-crystallin porosity, both. So it can determine both porosity methods. And this is a method that could be run in an existing wellbore without risking any damage to the reservoir, just have to pull the tubing rods and just go in and run the log.

I am familiar with the history of this field pretty much. The -- excuse me, the Texaco O-26, which was over in Section 36 of 17-35, was a new wellbore. In fact, it's not even on this map. Was drilled in 1987. It was run with old sonic -- it was run with a sonic tool, not a 63 vintage. It was run with a sonic tool. Run with a density neutron, modern-day density neutron. And the actual variations between the two was about 3 porosity units. Not all that much difference in variation.

I did want to make, also, a statement that the, all the logs -- and it has been recognized because of this oolitic -- excuse me, because of this multi-porosity that is very prevalent in this reservoir, that we are not seeing the true porosity or the true nature of the reservoir; that even though it is restricted -- excuse me. It's not only restricted just to Marathon's lease or Exxon's lease or these top allowable wells, but it is also restricted to every well in the field.

There's only three or four, maybe five wells that are new wells that have new logs on them. All the other ones use the old sonic logs.

I might also note that in the unitization of the Grayburg-San Andres, which is a prolific field, they actually use the 1963 sonic logs and thought they were wonderful compared to their 1945 vintage logs. So they unitized based on the Glorieta logs as they went through their interval.

As far as the comment on the unitization, I've sat in on lots of meetings with that. Original oil in place, which has been implicated here as being the only criteria or only problem that operators could not agree upon, is incorrect. There are a number of other parameters which other operators, some here and some not here, were disagreeable to, one of them being economics and other things.

I think the reason that this pool has not been unitized, this pool was originally drilled in 1963 and 64, when most of the wells were drilled, all but four or five. They attempted in 1965 to unitize these top allowable wells on this east side, did not want to get together. In 1970 they attempted it again. In early 80 they apparently attempted it again. And in 1985 this final phase has been put together.

I think the reason that it hasn't been put together is just everyone is greedy and they're just trying to get more than their fair share of oil in place.

I did find one thing disturbing on testimony previous on not knowing -- you know, when you do a reservoir study, it's basic geologic, sound geologic principles that you don't take your lease and you only look at your lease, you look around your lease.

I think when you do reservoir studies, especially geologic studies, you have to include all the data, water production, oil production. When you make cross-sections, you take them off your lease to look at stratified -- what kind of correlations you can make off your leases. I think that needs to be something -- it is lacking.

We need to know -- it is our opinion and Mobil's opinion that many of the wells to the east and the southeast have watered-out, and that's why many of the Marathon wells have not --

are not being produced right now, and it's because they have watered-out. And this is due to the natural water drive and edge water drive, whatever, that is present in the reservoir on the eastern side. That's all I have.

Q. Mr. Burnham, looking back at your Exhibit No. 7, which is the stratigraphic cross-section, I believe, do you have an opinion on whether or not zones of varying permeability would transport water at varying rates?

A. Yes. That may not be the best one to show it. Of course, as you're looking at that cross-section, it's a very idealized world there. That's only one dimension. There are two other ones. It's a very stratified, broken-up reservoir.

The core data that I supplied you within Exhibit No. 5, I believe, indicates the actual nature, and yes, there are varying degrees of porosity and permeability. Some just are a median. There are those who have 10,000, 2,000 millidarcies permeability, which would definitely move more water than some of the stuff that was 3 or 4 millidarcies permeability or less.

Q. Anything else you would like to point out to us at this time?

A. I've probably taken too long.

MR. PEARCE: I don't have anything further of this witness. If I may, let's move the admission of Mobil Exhibits 1 through 7 at this time, please.

EXAMINER CATANACH: Mobil Exhibits 1 through 7 will be admitted as evidence.

Mr. Schumacher, you may proceed.

MR. SCHUMACHER: Yes, sir.

EXAMINATION

BY MR. SCHUMACHER:

Q. The log method that you mentioned, Mr. Burnham, sheer sonic log?

A. Sheer wave.

Q. Do you have any idea of what the relative cost is of that method?

MR. NGUYEN: 10 to 15 --

MR. PEARCE: Excuse me. It may be that that question can be addressed by the next witness.

MR. SCHUMACHER: Well, this witness testified about it. If he knows, I'd like to know what --

MR. PEARCE: Fine. Do you know, Mr.

Burnham?

THE WITNESS: It probably will be several thousand dollars. You're looking at the cost of pulling your rods, pulling your tubing, and running the log. I would estimate normal logging as 5,000, 6,000, so total cost, probably less than $10,000.

Q. (BY MR. SCHUMACHER) Is it your testimony that that would help with the estimate of the oil in place?

A. It would give you a very accurate accounting of your porosity within your wellbore, yes.

Q. What about the remaining primary? Doesn't help with that, does it?

A. I think you've already produced all your remaining primary, but that's another story.

Q. You think that's already been produced?

A. Yeah. By the report, shows 80 to 90 percent produced already.

Q. Which report is that?

A. In the November 1990 engineering report.

Q. What percentage did you say it reflects?

A. There's an exhibit in here that shows the percentage from this study of oil in place. Okay. This is exhibit number -- figure 42 out of this report that shows, the title is "Vacuum-Glorieta Cumulative Recovery Percentage of OOIP, 1/1/90." It shows that the Marathon No. 6 and No. 7 -- the No. 6 well is right at 80 percent of original oil in place recovery, and the No. 7 is almost 100 percent.

Q. If for any reason there's any inaccuracy in those figures, though, your sheer wave log wouldn't help rectify that inaccuracy, would it?

A. It would show you the original porosity that you have in your reservoir total porosity, not just the inter-crystallin porosity, which the normal sonic log does show. And, as I've stated before, the study is underestimated, the original oil in place. But it has done it for every well in the field, not just your wells.

Q. How did the technical committee arrive at those figures if the data was inadequate to do so?

A. They used the data that was available, which is the 1963-64 vintage sonic logs. This data was used to calculate by the geologic subcommittee to construct -- again, we initially constructed the structure maps, net thickness maps, hydrocarbon core volume maps. We used a 6 percent porosity cutoff. And these were rolled up into a hydrocarbon core volume map above free water, which was another map that we calculated. And those numbers were given to the engineering committee, and they calculated the numbers there.

Q. All right. But, for example, your sheer wave sonic log is a better method than those old 63 logs; correct?

A. Yes, it would be a way, one way, to determine the total porosity.

Q. You've testified it would be a better way, haven't you?

A. Yes, it would be a good way.

Q. Better than the old 63 logs?

A. It will give you the total porosity, that is correct.

Q. Better than the 63 logs, yes or no?

A. Yes.

Q. You, at least twice I wrote down in quotes, you indicated that this field, I guess, "was very stratified." Was that your testimony?

A. That's correct.
Q. And what that means is, as you explain it, you may have areas of low permeability abutted up against areas of higher permeability; correct?
A. There are zones -- what do you mean by "areas"?
Q. Zones is fine.
A. I look at areas this way, not this way.
Q. All right.
A. In a wellbore, yes, you do. You have very thin zones, porous, thin zones of -- impermeable, tight on up through the reservoir.
Q. And wouldn't it also, then, be fair to assume that if you have areas of vugs and fractures, as were testified to by the Marathon witnesses, that those would be variable across the field, would they not? In other words, the amount of degree of vugs and fractures across the field would not be uniform?
A. As far as vugs, there's vugs predominantly through most of the reservoir, that is correct. As far as fractures, there are no fractures that I saw in the Exxon cores that were not healed. These fractures were all healed at

the anhydride. The only fractures that were open were fractures up in the very northern portion of the eastern portion of the field in the Shell N-No. 6 well. So there are no fractures.

Q. In the cores that you examined?

A. That's correct.

Q. Now, did you examine any cores from any of the top allowable wells?

A. There are no cores in the top allowable wells.

Q. So you didn't examine any?

A. That's correct. But I did correlate those back to their electric logs, and that's all you can do.

Q. You seem to make a suggestion that the Texaco well, from which you did examine the core, was offsetting to Marathon's acreage that's at issue here?

A. Texaco well. The cored welled?

Q. Yes.

A. No. The old 26 is way over here in the western portion of the field -- excuse me, it's right there.

Q. Maybe it was the Shell well?

A. Oh, that's the Shell T-10.

Q. And that offsets Marathon's lease?
A. Directly south of it, that's correct.
Q. Were you intending to suggest that that well should exhibit the identical characteristics to the Marathon well?
A. It will exhibit similar characteristics, yes.
Q. Well, that would be true for a lot of these wells, wouldn't it, that they would exhibit similar characteristics?
A. If you correlate these logs, these core gamma logs in my Exhibit No. 5, back to the core, and you put them on depth so you know where that core actually came from, you can infer and take those correlations across to those other wells, that's correct.
Q. But in fact, based on your earlier testimony about the differences in the various zones and permeability and porosity of each of the zones, unless you've done identical testing or examined cores, for example, from those Marathon's wells and that sort of thing, you might find some lack of similarity in the vugs and fractures that have already been testified to about Marathon wells?

A. Each 40-acre tract is going to be a little different, that is correct. That's a carbonate reservoir for you. It's just the way it is.

Q. I just want to make it clear, you're not intending to say that the T-10 well would exhibit characteristics identical to the Marathon well?

A. What I was testifying to and still will is that the characteristics of the T-10 well, where you have zones of very good porosity, good permeability, thin zones, and then you have tight zone, thin zone, tight zone, thin zone, tight zone, that is characteristic and pervasive throughout the field regardless of where it is.

All of the cores exhibited this -- all of the hole cores exhibited this nature. It's a characteristic of a cyclic, shallow carbonate reservoir.

Q. Thank you. My question was: You're not saying that those two wells will be identical because you don't have enough information to say that; right?

A. I didn't say they were identical.

Q. Okay. That's my question. You talked

about the Marathon wells over east of the acreage that's in question have, quote, "watered-out." What data did you bring with you to support that assertion?

A. Mr. Hai Nguyen has some data to be presented here as soon as I'm done.

Q. So that's something that you know from your own knowledge only in the sense it's been explained to you by someone else?

A. No. I plotted the data on it myself, but I didn't bring the maps with me, no. No. I'm very familiar with the field.

MR. SCHUMACHER: That's all I have at this time.

THE WITNESS: Something -- well, never mind. That's all right.

EXAMINER CATANACH: Mr. Bruce.

EXAMINATION

BY MR. BRUCE:

Q. Mr. Burnham, how many tracts does Mobil have in the proposed eastern unit?

A. One, two, three, four, five, six, seven. I think seven. I'm not sure where that boundary line is.

Q. Where are they? Mostly in the western part?

A. In the proposed east unit?

Q. Yes.

A. We have 160 acres in the, directly around this lease, and then we have 120 acres. And, see, I don't know where that map is. I don't know if our H lease -- when they re-drew the boundaries for the east and west, we have approximately 120 acres if it did go into that unit, in the western portion of that east unit. I don't know where the dividing line is. I've forgotten.

Most of our acreage is directly surrounded by these top allowable wells, and this is the only reason we're concerned with it.

Q. Now, you mentioned the sheer wave logs. Can they be done after a well is acidized?

A. Yes. We've run them in old logs, yes, old holes.

Q. And Mobil doesn't have any top allowable well?

A. No. We have no top allowable wells.

Q. Are Mobil's wells at the stripper stage?

A. Predominantly, yes. Yes, although we

do have significant reserves that are associated with the secondary and the tertiary. That's why we participated in the study.

Q. In your opinion, would Mobil's tracts benefit from unitization?

A. Yes, they would.

MR. BRUCE: I have nothing further, Mr. Examiner.

EXAMINER CATANACH: Anything further of this witness? If not, he may be excused.

MR. PEARCE: Thank you. At this time, Mr. Examiner, I would call Mr. Hai Nguyen as my next witness. I would like the record to reflect that he has been previously sworn.

HAI H. NGUYEN

Having been duly sworn upon his oath, was examined and testified as follows:

EXAMINATION

BY MR. PEARCE:

Q. Mr. Nguyen, have you previously appeared before the New Mexico Oil Conservation Division or Commission and had your credentials accepted as a matter of record?

A. No.

Q. All right, sir. Let's start, where do

you reside, Mr. Nguyen?
    A.   Midland, Texas.
    Q.   By whom are you employed?
    A.   I'm employed with Mobil Exploration and Production U.S., Inc. And I graduated from the University of Texas in --
    Q.   Let me jump in. In what capacity are you employed by Mobil?
    A.   At the current time I'm a reservoir engineering advisor for Mobil.
          MR. STOVALL: Mr. Pearce, could I interrupt and get your witness to spell his name.
          MR. PEARCE: She has a card for you, sir. The spelling of the last name is N-g-u-y-e-n.
          MR. STOVALL: Thank you.
    Q.   (BY MR. PEARCE) Mr. Nguyen, would you briefly describe for us your educational background as it relates to the field of petroleum engineering?
    A.   Yes. I graduated from the University of Texas at Austin in December 1977 with a bachelor's degree in petroleum engineering. In the past two years, I've been pursuing a master's

degree, also from the University of Texas at Austin, at night, and I have one more semester to go.

Q. All right, sir. Upon your graduation with a degree in petroleum engineering in 1977, by whom were you employed?

A. I've been employed with Mobil. In the first two years, I was operations engineer. At that time I was doing well test analysis, conducting various tests, and doing workovers, just normal, like any operations engineer would do.

After that I joined the reservoir engineering department. And since then, in the past 12-and-a-half years, I worked in the reservoir engineering. At this time in my capacity, I have conducted many reservoir studies, including the field from waterflooding to CO_2 flooding, as well as gas recycling and pressure gas maintenance.

I also give seminars in the field of pressure analysis. And besides that I also use computer simulation in black oil as well as compositional model.

Q. All right, Mr. Nguyen, and do your

responsibilities at Mobil have any connection with the Vacuum-Glorieta Field being considered today?

A. Yes.

Q. Have you conducted a petroleum engineering study relating to that pool?

A. I've been working on this project in the last seven months.

MR. PEARCE: At this time, Mr. Examiner, I would ask that Mr. Nguyen be recognized as an expert in the field of petroleum reservoir engineering.

EXAMINER CATANACH: The witness is so qualified, Mr. Pearce. And if I may interrupt you --

MR. PEARCE: Yes, sir.

EXAMINER CATANACH: -- just for a few moments. I'll be right back.

[A recess was taken.]

EXAMINER CATANACH: I'm sorry, Mr. Pearce. You may proceed.

MR. PEARCE: That's all right. Thank you.

Q. (BY MR. PEARCE) Mr. Nguyen, at this time I would ask you to refer, please, to what we've marked as Exhibit No. 8, and could describe this document for us, please?

A. Okay. This is just a reiteration of what Phillips has said today. On this side on the other end, they sent a higher degree of water influx from lower GORs, higher reservoir pressure and higher water production.

Q. And the language you quoted is from page 14 of the committee report that Mr. Burnham discussed dated November of 1990; is that correct?

A. Yes.

Q. All right, sir. Let's look, please, at Exhibit No. 9, and would you describe that for us, please?

A. In this exhibit the red numbers represent the current -- I mean, December 1991 oil production and water production in barrels per day. As you can see, the majority of wells on the east side of the reservoir have shown large water production. In fact, there was a well, Chevron Well No. 10 --

Q. I'm sorry. Locate that well for us, please.

A. It is in Section 27. On the west side of Section 27, Chevron Well No. 10 in December reported 34 barrels of oil and 428 barrels of water per day. This indicated tremendous water production can occur as water influx becomes obvious.

From this map we would like to lead you to Exhibit No. 10.

Q. Okay. Let's open that at this time, please. Could you describe that exhibit for us, please, sir?

A. Exhibit No. 10 is showing the outline of wells that are currently making more than 50 percent water cut and high water production rate, up to 428 barrels of water per day, which were reported in December 1991.

This map indicated that, yes, at the time this well was drilled and completed, there was very little water production and most of these wells were top allowable. Now, you can see at the current time, these well are no more top allowable wells, but they are high water production.

And also, as you can see, once the water gets in, these wells won't produce at a higher rate anymore. The process is irreversible.

Q. Okay. Are you ready to move to Exhibit 11, sir?

A. Yes.

Q. All right. Let's do that, please.

A. We happen to have production curves of top allowable wells in the area including Exxon's. In this exhibit what I want to show to you is that even at the top allowables, these wells have already exhibited a tremendous increase in rate in water production.

Q. All right, sir. Let's look at the first page of that. That appears to relate to the K State 27 well; is that correct?

A. That's right.

Q. All right.

A. And, as you can see, the arrow is showing the northeastern trail of water production increasing. The same we would see on Well No. 29 on the next page.

Q. And that is the --

A. Exxon No. 49.

Q. -- I'm sorry. K State 29?

A. Yes.

Q. All right, sir.

A. Again, we also see on the next page the Texaco-Skelly P State No. 3, which is one of the top allowable wells. And on the next page, the Well 35 and Texaco Well No. 4. I also want to mention to you that we see a decline production in the last page and Texaco Well No. 4.

Q. Let's give people a minute to turn to the last page of that exhibit.

A. This was due to the infill drilling of the Exxon well. So, obviously, interference already occurred even at 107 barrels of oil allowable. Imagine if the allowable has been lifted how much more water will be produced and how much waste will occur.

Again, as you can see, one set of water is being drawn in, the process is irreversible.

Q. All right, sir. Are you ready to address your attention to Exhibit No. 12?

A. Yes.

Q. Would you, please?

A. On this Exhibit No. 12, again, the blue area indicating the area where the wells have been produced with more than 50 percent water cut and high water volume. The red area indicating a structure high, the nose which comes into the

Exxon K State lease.

When the water is drawn into the reservoir uncontrollably, poor recovery will occur from, first, poor areal sweep efficiency. For example, if water had been drawn into Marathon lease into the higher structural wells, one set of wells, the water being drawn into high structure, the water will be freely moved along the lower end of the white area.

As this occurred, we don't know where the waterfront is. It will have a bad effect on waterflood recovery. After all, industry spent ten, fifteen years to design a waterflood pattern, which is doing a better job in areal sweep efficiency. Without a control of pattern, the oil recovery will be much less.

In this exhibit we say that over 1,000 acres of proposed waterflood area will be damaged from uncontrolled water influx. In this area we're looking at about 20 million barrels of original oil in place.

To the State an eighth of 25 percent recovery from waterflooding will result to the State of 600,000 barrels, thus you may lose in this case $12 million. But if we're looking at the total, this side, this unit at this time, as it was mentioned by Phillips, the reserve from waterflooding is 22 million barrels. Should we lose that, the State will lose up to $50 million, almost 5 -- almost 2-1/2 million barrels of reserve from poor control water influx.

Q. Mr. Nguyen, is it your opinion that granting of the Marathon application may in fact threaten to reduce the ultimate recovery from this pool because the premature influx of water may make some oil reserves unrecoverable in the future?

A. Exactly.

Q. All right, sir. Let's look, please, at Exhibit No. 13.

A. Exhibit No. 13 is the exhibit figure coming out of the report. This one shows the porosity permeability from all of the old core datas available in the field, which are from nine wells that you see on the map, ten wells with more than 1500 data points.

As you can see on this map, there's a window I've drawn. This area, this window represents the majority of the poor -- the permeability and the porosity are the characteristics of the reservoir.

Any reservoir engineer would like to have a reservoir like this because we say that will be easy to flood. They exhibit most of the sand reservoir of permeability range. Thus we have a better sweep recovery and sweep efficiency.

However, I want to bring up to you there's another trend with porosity more than 14 percent and permeability from about 8050 millidarcies up to 10,000 millidarcies. This area -- I mean, these data points will cause the problem with waterflooding.

If we are not ready to deal with controlling these rock characteristics which cause problems in natural water influx -- these data points account for about 10 percent of reservoir volume. Thus you can flood it out 10 percent of reservoir volume, and you have a problem leaving behind 90 percent of the reservoir oil.

In a waterflood we are ready to deal with this problem. During primary recovery with water influx, we are not ready to do that. So by allowing more -- by lifting allowables, we'll bring more water into the reservoir uncontrollably, and thus we'll create waste and leave behind reserves otherwise recoverable.

Q. During his testimony Mr. Burnham indicated he believed that there were stringers of varying permeability throughout the reservoir. Am I correct in understanding that the trend that you describe of higher porosity permeability wells in fact are those higher permeability stringers he was discussing?

A. Yes.

Q. And your concern is that those higher permeability zones will prematurely flood out?

A. Exactly.

Q. And do you have an opinion on whether or not that would cause waste of resources if it were to occur?

A. It will.

Q. And to the extent that it prevents the recovery of otherwise recoverable reserves from any tract, does it threaten to impair the correlative rights of any interest owner in the pool?

A. It will.

Q. And on the basis of those conclusions, do you believe it is inappropriate to grant Marathon's application?

A. I believe so.

Q. Do you believe there are other methods of obtaining better data to resolve the unitization problem that's been discussed?

A. I believe so. I would like to bring up the log, sheer wave sonic. I happened to work on the part of -- we had the same problem with the multi-porosity in the Nolley Wolfcamp Field, so we ran sheer wave sonic in the new wells.

And also running it and compared with the rocks, the neutron density, which is porosity logs also, and also we compared the data with the core data, and they fit very well. So that is a good tool. And it's relatively new.

Q. Do you have anything further you'd like to describe for the Examiner at this time, Mr. Nguyen?

A. No.

MR. PEARCE: That's all I have for this witness at this time, Mr. Examiner. I would move the admission of Mobil Exhibits 8 through 13 at this time.

EXAMINER CATANACH: Exhibits 8 through

13 will be admitted as evidence.

Mr. Schumacher, your witness.

MR. SCHUMACHER: Can I have just a second? There's something I don't quite understand, sir.

EXAMINATION

BY MR. SCHUMACHER:

Q. The Marathon 6 and 7 wells that have been discussed, do you regard those as high permeability wells?

A. I do not know. I do not know. But the water influx is there, and it's coming in -- it's coming around. Once you've drawn it in, the problem of waterflooding will become so prominent that waste will occur.

Q. And it's your testimony, based on your Exhibit 12, that that will occur suddenly if this application is granted as opposed to, I guess, what you've described as a gradual influx for the life of this field?

A. Yes. And as you can see --

Q. Let me just understand. The mere act of approving this application will cause the immediate onset of ruinous water influx in this field?

A. No. Ruining reservoir. The area which has not been flooded by the water influx.

Q. Well, you cited in your Exhibit No. 8 the page from the technical committee report. Let me see if you agree with this statement. "Although the field has produced significant amounts of water, aquifer activity can best be described as encroachment rather than active influx providing any significant pressure support." Do you agree with that?

A. Yes.

Q. Now, you talked about the increase in water production from some of these wells being attributable to infill drilling. Look at your Exhibit No. 11 on the first page.

A. Okay.

Q. You would agree with me, would you not, that the increased water production from that well started probably two years before there was any infill drilling surrounding that well?

A. No. It started from 1987.

Q. And that was prior to the drilling in 1989?

A. Yes, it was. But once you see the water coming in, you can see the effect of water production and water cut.

Q. But the infill drilling didn't really cause any sharp increase in the amount of water coming in. That water production curve fits a straight line that you've drawn in there, does it not?

A. Infill drilling exhibits interference or otherwise draining other peoples' lease. For example, Exxon lease, infill drilling, draining will affect the production of Texaco Wells No. 3 and No. 4.

Q. The straight line that's drawn in here in black ink, though, is your best straight line, is it not?

A. It's nice. You can do another line, but it's still following the same trend. What I want to say on that one is, yes, that the trend is there.

Q. Wait just a minute. That's your line, though, is it not?

A. Yes.

MR. STOVALL: Which exhibit are you referring to?

MR. SCHUMACHER: I'm looking at page 1 of No. 11.

Q. (BY MR. SCHUMACHER) And the origin of that line actually predates any infill drilling in 1989, does it not?

A. It does.

Q. And you'd also agree with me, would you not, that Marathon Wells 6 and 7 have not exhibited any similar increase in water production?

A. Not yet. But once the water is being drawn in, it will be like that.

Q. You have evidence?

A. As you can see on this map, the blue area is getting close to No. 8. Exhibit No. 12, Marathon No. 8.

Q. So the infill drilling, then, has increased the water production in that area?

A. I do not say that infill drilling increased the water production. It's just production at a higher rate will draw the water in faster at the uncontrolled fashion.

Q. And that results in an increase in water production, does it not?

A. Yes.

Q. But you would agree with me that the infill drilling around the Exxon wells in fact did not cause any increased water production from the nearby Marathon wells; right?

A. Because the waterfront hasn't gotten there yet.

Q. Yes or no. It hasn't caused it, has it?

A. Hasn't caused it.

MR. SCHUMACHER: I think that's all I have at this time.

EXAMINER CATANACH: Mr. Bruce.

EXAMINATION

BY MR. BRUCE:

Q. Now, Mr. Nguyen, you talked about the sheer wave logs. That's really to determine original oil in place; right?

A. It's to better determine the porosity of the zone.

Q. Could you calculate remaining primaries?

A. No. But we know exactly how much it can contain the oil under that land, under that lease.

Q. Okay. Well, were you here while Mr. Hallenbeck was testifying?

A. Yes.

Q. And he says the problem isn't calculating original oil in place; it's really remaining primary, isn't it?

A. That's right.

Q. That's the sticking point.

A. Uh-huh.

Q. So the sheer wave logs won't help determine remaining primary?

A. Yes.

Q. And so it will leave the main contested point of unitization without a resolution?

A. It's just depending on how much you want your oil, remaining primary oil. In fact, we see --

Q. Yes or no. Will it help determine --

MR. PEARCE: I'm sorry. The witness wants to explain his answer.

MR. BRUCE: Well, I asked a yes or no question. He can go on, but I'll ask the same thing again.

MR. PEARCE: Thank you. Go ahead, Mr. Nguyen.

THE WITNESS: I lost track. As you can see, the water influx is here. What will the water influx create if I don't produce fast enough in my lease? That oil will be pushing to our Marathon lease, and it has done that. Nature has done that. How much more do we want that?

Q. (BY MR. BRUCE) That's been a natural phenomena, that water influx?

A. That's right. My argument is not on afraid of losing the oil in my lease, but once you've drawn the water in, you destroy the reservoir.

Q. I see. Basically the sooner this field is unitized, the better?

A. Yes.

Q. And your proposed test won't help determine remaining primary?

A. What is the question?

Q. The sheer wave logs that you have recommended will not help determine remaining primary?

A. No.

Q. Okay. I don't know what -- Mobil Exhibit No. 12, I think that's the one you talked about the potential of 1,000 acres damage?

A. Uh-huh.

Q. Over what time period?

A. I don't know. First of all, you know, the first log, neutron gravity, gravity will take into account here. Once you take a bucket of water and go up to the top of the mountain, you put it down, you know where the water will go. That will cause a tremendous problem with waterflooding.

Q. Will that thousand acres be damaged in nine months?

A. I don't know.

MR. BRUCE: I don't have anything further, Mr. Examiner.

EXAMINER CATANACH: Anything further of this witness?

MR. SCHUMACHER: No, sir. Wait just a minute. Maybe. One final question.

FURTHER EXAMINATION

BY MR. SCHUMACHER:

Q. Mr. Nguyen, does this same principle apply to higher voidage rates, total voidage?

A. Yes.

Q. Yes?

A. Would you repeat the question?

Q. Does this same principle, the principle you're talking about, about the water influx, does that also apply to the increased voidage rates, total voidage?

A. Increase the voidage rates --

MR. PEARCE: Do you understand the question, Mr. Nguyen?

THE WITNESS: No.

MR. PEARCE: Tell him that and let him do it again.

THE WITNESS: Can you rephrase it?

MR. SCHUMACHER: I'll put the question another way.

Q. (BY MR. SCHUMACHER) Is it production of oil alone that in your opinion would cause the water influx, or is it the production of all reservoir fluids, that is to say total voidage, that would pull water across?

A. The total production.

Q. Not merely oil?

A. That water influx was caused by producing 100 percent oil during the first several years of the life of the field. That's the cause of the water influx coming in.

Q. I'm trying to understand your testimony. I'm not sure if you're telling us that increased oil production from the top allowable wells will cause influx of water or whether it's total voidage, total reservoir voidage, that causes water influx.

Will increased oil production in and of itself pull water across the reservoir?

A. Total production.

MR. SCHUMACHER: That's all. Thank you.

EXAMINER CATANACH: I have nothing of the witness. He may be excused.

MR. PEARCE: One additional item, if I may, Mr. Examiner. I'd like to bring to your attention a letter that was sent, according to its face, and I believe a records check will verify, to Mr. William J. LeMay, dated March 31, 1992, from W. F. N. Kelldorf of Shell Western E&P, Inc.

The effect of that letter is to state Shell Western E&P's opposition to the request of Marathon in this case. I don't think it's appropriate for me to make it an exhibit. I simply point out to you it's in the file, please.

EXAMINER CATANACH: Okay. In the interest of saving time in this matter, I would suggest that closing statements be waived, and if you prefer, you can submit written closing statements if you like, counsel.

MR. PEARCE: I think he's heard enough from us, Rod. I'm not sure.

MR. SCHUMACHER: He was looking at you when he said it.

MR. PEARCE: I am, in that case, a target of opportunity. Yes.

MR. SCHUMACHER: You're target material.

EXAMINER CATANACH: I would also request that counsel for Marathon and counsel for Mobil submit draft orders in this case. I'm not sure if it's appropriate for Exxon and Phillips to submit complete draft orders, but if counsel would provide them a copy of their draft orders, they can amend it or strike out what they disagree with and add to it, if they like, and submit those.

MR. BRUCE: That's fine, Mr. Examiner. I think we would like to submit a written closing argument, but we can probably limit Phillips' and Exxon's request to a couple paragraphs.

MR. STOVALL: The purpose of what we're looking for is not to have four versions of the same thing floating around.

MR. BRUCE: Sound idea.

MR. STOVALL: Those that generally favor it can either agree on something or submit some alternatives on it, and then those who are opposed, Mr. Pearce, can submit theirs -- I don't know what the sequence is -- so that you get some fair opportunity.

MR. PEARCE: I do not know that we ordinarily respond to other peoples' proposed orders. Can you just tell us how long we've got to submit them and we'll submit them.

MR. STOVALL: Let me throw out a suggestion to you and get some response from it. Marathon prepare a draft order, circulate it to Phillips and Exxon, and submit a package of Marathon's and Exxon's, with Phillips' comments, say, because that process is going to take a little time, what, twenty days? Does that give you enough time to do that?

MR. SCHUMACHER: Twenty days for us to get it to Phillips and Exxon?

MR. STOVALL: Twenty days for you to get it to Phillips and Exxon and get their comments and get it in. Normally, we look for a draft order in about ten days. I'm figuring an extra ten. And that would give you, Mr. Pearce, twenty days to submit a draft order. Is that a fair process?

MR. NELSON: And then you want the Marathon draft order with the Phillips and Exxon comments to be submitted as a packet to you?

MR. STOVALL: I think that makes the most sense.

MR. PEARCE: That's fine.

MR. STOVALL: Any problem with that? I'm trying to come up with something in an unique circumstance. And it makes it more difficult to get a draft order if Marathon, Phillips, and Exxon, all three, submitted separate orders.

MR. BRUCE: That ought to be plenty of time. As Mr. Hallenbeck testified, we'd like to get this moving along as quickly as possible, one way or the other.

Before I forget, Mr. Examiner, I think I may have forgotten to move the admission of Phillips and Exxon's exhibits. I would move them at this time.

EXAMINER CATANACH: The Phillips and Exxon's exhibits will be admitted as evidence in this case.

Is there anything further at this time? There being nothing further, Case 10462 will be taken under advisement.

MR. PEARCE: Thank you, Mr. Examiner.

[And the proceedings were concluded at the approximate hour of 6:35 p.m.]

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 10462, heard by me on April 2 1992.

David R. Catanach, Examiner
Oil Conservation Division

CERTIFICATE OF REPORTER

STATE OF NEW MEXICO)
) ss.
COUNTY OF SANTA FE)

I, Debbie Vestal, Certified Shorthand Reporter and Notary Public, HEREBY CERTIFY that the foregoing transcript of proceedings before the Oil Conservation Division was reported by me; that I caused my notes to be transcribed under my personal supervision; and that the foregoing is a true and accurate record of the proceedings.

I FURTHER CERTIFY that I am not a relative or employee of any of the parties or attorneys involved in this matter and that I have no personal interest in the final disposition of this matter.

WITNESS MY HAND AND SEAL April 14, 1992.

Debbie Vestal

DEBBIE VESTAL, RPR
NEW MEXICO CSR NO. 3

NEW MEXICO OIL CONSERVATION COMMISSION

STATE LAND OFFICE BUILDING

STATE OF NEW MEXICO

CASE NO. 10462

IN THE MATTER OF:

The Application of Marathon Oil Company for Termination of Oil Prorationing in the Vacuum-Glorieta Pool, Lea County, New Mexico.

BEFORE:

CHAIRMAN WILLIAM LEMAY

COMMISSIONER GARY CARLSON

COMMISSIONER BILL WEISS

FLORENE DAVIDSON, Senior Staff Specialist

State Land Office Building

Thursday, July 16, 1992

REPORTED BY:

CARLA DIANE RODRIGUEZ
Certified Shorthand Reporter
for the State of New Mexico

ORIGINAL

A P P E A R A N C E S

FOR THE NEW MEXICO OIL CONSERVATION DIVISION:

ROBERT G. STOVALL, ESQ.
General Counsel
Oil Conservation Division
State Land Office Building
Post Office Box 2088
Santa Fe, New Mexico 87504-2088

CHAIRMAN LEMAY: Call Case No. 10462.

MR. STOVALL: The application of Marathon Oil Company for termination of oil prorationing in the Vacuum-Glorieta Pool, Lea County, New Mexico.

Applicant has requested that this case be continued to the August 13th Commission docket.

CHAIRMAN LEMAY: Is there any objection to continuance of that case to the August docket? If not, that case will be continued.

(And the proceedings concluded.)

CERTIFICATE OF REPORTER

STATE OF NEW MEXICO)
) ss.
COUNTY OF SANTA FE)

I, Carla Diane Rodriguez, Certified Shorthand Reporter and Notary Public, HEREBY CERTIFY that the foregoing transcript of proceedings before the Oil Conservation Commission was reported by me; that I caused my notes to be transcribed under my personal supervision; and that the foregoing is a true and accurate record of the proceedings.

I FURTHER CERTIFY that I am not a relative or employee of any of the parties or attorneys involved in this matter and that I have no personal interest in the final disposition of this matter.

WITNESS MY HAND AND SEAL July 27, 1992.

Carla Diane Rodriguez

CARLA DIANE RODRIGUEZ, RPR
CSR No. 4

NEW MEXICO OIL CONSERVATION COMMISSION

STATE LAND OFFICE BUILDING

STATE OF NEW MEXICO

CASE NO. 10462

IN THE MATTER OF:

The Application of Marathon Oil Company for Termination of Oil Prorationing in the Vacuum-Glorieta Pool, Lea County, New Mexico.

BEFORE:

CHAIRMAN WILLIAM LEMAY

COMMISSIONER BILL WEISS

COMMISSIONER GARY CARLSON

FLORENE DAVIDSON, Senior Staff Specialist

State Land Office Building

August 13, 1992

REPORTED BY:

CARLA DIANE RODRIGUEZ
Certified Shorthand Reporter
for the State of New Mexico

ORIGINAL

NEW MEXICO OIL CONSERVATION COMMISSION

COMMISSION HEARING

SANTA FE, NEW MEXICO

Hearing Date AUGUST 13, 1992 Time: 9:00 A.M.

NAME	REPRESENTING	LOCATION
J. Randy Turner	Nearburg Exploration Co.	Midland TX
Dave Cromwell	Yates Petroleum	Midland, Tx
W. T. Kellahin	Kellahin & Kellahin	Santa Fe
Ernest L. Carroll	Losee Carson	Artesia
MIKE BURCH	YATES PETROLEUM	ARTESIA
Brian Collins	Yates Petroleum	Artesia
John Chapman	Marathon Oil	Midland, TX
Craig [illegible]	MARATHON OIL	MIDLAND, TX
Maurice Trimmer	RW Byram	SF
CRAIG CLARK	Yates Pet.	MIDLAND, TX
Bob Shelton	Nearburg	M.T.
Keith Mahler	Phillips Pet	Odessa Tx
James Bruce	Hinkle Law Firm	S.F.

NEW MEXICO OIL CONSERVATION COMMISSION

COMMISSION HEARING

SANTA FE, NEW MEXICO

Hearing Date AUGUST 13, 1992 Time: 9:00 A.M.

NAME	REPRESENTING	LOCATION

A P P E A R A N C E S

FOR THE NEW MEXICO OIL CONSERVATION DIVISION:

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-and-
MARATHON OIL COMPANY
Post Office Box 552
Midland, Texas 79702
BY: **THOMAS C. LOWRY, ESQ.**

FOR EXXON CORPORATION:

THE HINKLE LAW FIRM
Post Office Drawer 2068
Santa Fe, New Mexico 87102
BY: **JAMES BRUCE, ESQ.**

I N D E X

E X H I B I T S

CHAIRMAN LEMAY: Good morning. It's the Oil Conservation Commission. My name is Bill LeMay. On my right is Commissioner Gary Carlson representing the Commissioner of Public Lands. On my left, Commissioner Bill Weiss.

I'll call Case No. 10462.

MR. STOVALL: Application of Marathon Oil Company for termination of oil prorationing in the Vacuum-Glorieta Pool, Lea County, New Mexico.

CHAIRMAN LEMAY: Appearances in Case 10462?

MR. KELLAHIN: Mr. Chairman, I'm Tom Kellahin of Santa Fe, New Mexico, appearing on behalf of Marathon Oil Company, in association with Tom Lowry. Mr. Lowry is a member of the Texas Bar and is counsel for Marathon Oil Company. We will have two witnesses to present.

CHAIRMAN LEMAY: Thank you. Are there additional appearances in Case 10462?

MR. BRUCE: Mr. Chairman, my name is Jim Bruce from the Hinkle Law Firm in Santa Fe, representing Exxon Corporation. I have no witnesses.

CHAIRMAN LEMAY: Thank you. Additional

appearances in the case?

Mr. Kellahin, do you have your witnesses? You want to ask them to stand and be sworn in?

MR. KELLAHIN: Yes, please.

[And the witnesses were duly sworn.]

MR. CARROLL: Mr. Chairman, I'm Ernest Carroll. I represent Yates Petroleum and Mr. Turner is representing Nearburg Exploration. We are the following two cases. I understand that this case will take some time. May we be excused until a definite hour to return?

CHAIRMAN LEMAY: It may take less time than you think.

MR. CARROLL: Well, I don't know.

CHAIRMAN LEMAY: You'll be on this morning, as I understand it, because we're going to consolidate those cases, Yates and Nearburg, and I understand that the case we're looking at right now will not be a contested case. I think it was at the Division level. So you can be excused for an hour, hour and a half.

MR. CARROLL: That's all I want.

CHAIRMAN LEMAY: I think we'll get to it this morning, Mr. Carroll.

MR. STOVALL: Check back with us at 10:00, Ernie, and see where we are.

MR. CARROLL: 10:00? Thank you.

MR. KELLAHIN: May it please the Commission, this request by Marathon Oil Company involves the Vacuum-Glorieta Pool. It is an oil pool in Lea County, New Mexico.

The case was originally heard as an Examiner case back in April of this year. This pool is also the subject of continuing efforts to unitize the primary producing interval in the pool, which is the Paddock zone of the Vacuum-Glorieta Pool.

We're here today to ask for a special oil allowable. The original application sought, on behalf of Marathon, the termination of oil prorationing for the pool. Regardless of how it was characterized, the purpose was to allow the remaining top allowable wells to produce at capacity. The purpose was to produce them at capacity for a sufficient period of time to establish accurate decline curves by which the engineers, working on unitization, could then have reliable data to establish remaining primary oil production parameters for these top allowable wells to make unitization go forward.

Marathon's request, when first heard, was to terminate prorationing on a permanent basis for the pool. After notification to all the working interest owners involved in the pool, a certain group of companies appeared and participated.

Phillips and Exxon supported the termination of the oil prorationing, provided it was for a period of nine months and subject to some testing data gathering requirements that would be shared with the technical committee of the unit. The only opponent to the hearing before the Examiner was Mobil. They have an interest in the pool, and they opposed termination of oil prorationing.

The Examiner entered his order back in May denying the request to permanently terminate oil prorationing. Since then the parties have continued to negotiate and discuss this issue and have substantially altered their position so that today we bring forward an amended request that is no longer opposed by anyone and that has the support of Exxon and Phillips, and our request is this: That the pool be granted a special oil allowable, that that allowable will allow the high-capacity wells, for a period of nine months, to produce at capacity.

And I believe Mr. Craig Kent, our petroleum engineer--I believe there's five wells that may fall within the category of being able to produce in excess of the 107 barrels a day top allowable. And with that opportunity, then, it will be his testimony that a nine-month period ought to be a sufficient period in which to establish production declines on those wells, and it is the only method available, based upon the collective energies and technical talents of all those involved in unitization.

This is the only method available for this reservoir to establish declines, and he's going to talk to you about how we got to that point.

A substantial portion of his work has been taken from the technical committee reports. There is an original technical committee report for the unitization effort and a supplement. I have those available as reference. We have simply lifted our exhibits from those and supplemented them. And I don't propose to introduce them, but they are here as a reference tool for us if you desire to see them or work from them.

The modified request that Marathon is seeking has the support of Phillips and Exxon. We have reached a solution among the technical people about what test data to gather and what information, then, will go into the unitization purposes.

One of the principal reasons the Examiner denied the original request was his belief, based upon the testimony back then, that while this test allowable might have been helpful for unitization purposes, that statutory unitization was still viable and could go on even without the test allowable.

We're here to tell you that that is not going to happen. Unitization has been stalemated because we do not have the threshold 75 percent of the working interest owners that will agree to any formula until we have the decline curve data from which to extrapolate the remaining oil reserves for these top allowable wells. So that is not an option. We've explored it. The Examiner hoped it would work. It has not. And all parties now believe that the test data is necessary.

Mobil has withdrawn their opposition so that this is now an uncontested matter for your consideration.

I'll present two witnesses. Mr. Craig Kent is a petroleum engineer. He'll give you the background history on the pool, the current status of production, and talk to you about the issues that he has examined to satisfy himself that this test allowable oil is an effective use of reservoir energy and will truly represent a scientific effort to get him the data that he needs to continue with unitization purposes.

My last witness is John Chapman. Mr. Chapman is a geologist. He'll show you the geologic picture of the pool. Both gentlemen will describe how the pool has been divided among the interest owners and how unitization is progressing in the western portion. The high-capacity wells are in the eastern portion. And that will be the focus of our presentation.

CRAIG KENT

Having been first duly sworn upon his oath, was examined and testified as follows:

EXAMINATION

BY MR. KELLAHIN:

Q. Mr. Kent, for the record, would you please state your name and occupation?

A. My name is Craig Kent and I'm a reservoir engineer for Marathon Oil Company in Midland, Texas.

Q. Mr. Kent, on prior occasions have you testified before this Commission as a reservoir engineer?

A. Yes, I have.

Q. Pursuant to your employment by your company as a reservoir engineer, have you made a study of the engineering facts with regard to your company's request in the Vacuum-Glorieta Pool?

A. Yes, I have.

MR. KELLAHIN: We tender as an expert reservoir engineer.

CHAIRMAN LEMAY: His qualifications are acceptable.

Q. Mr. Kent, let's turn to the packet of information representing the exhibits and if you'll unfold what is marked as Exhibit No. 1.

MR. KELLAHIN: Each of the exhibits are

numbered and I apologize, the numbering is rather small. All the displays will show a number, and if you search hard enough, I think you'll find it. The first one is an area plat of the Vacuum-Glorieta Pool.

Q. Mr. Kent, if you'll take Exhibit No. 1 and identify that for us?

A. Yes. Exhibit No. 1 is a base map of the Vacuum-Glorieta Pool. Along the outer boundary there's a hatched line which represents the productive limits of the pool.

Down, approximately two-thirds from the right side of the page, there's another hatchered line. That is the dividing line between the proposed Vacuum-Glorieta West Unit and the Vacuum-Glorieta East Unit, the West Unit being indicated on the western side with "Proposed West Unit," the Vacuum-Glorieta East Unit being indicated on the northern boundary by "Proposed Vacuum-Glorieta East Unit."

Q. When we look at the area described as the Proposed West Unit, who is the proposed operator for that unit area?

A. Texaco.

Q. When we look at the Proposed East Unit area, who is the proposed operator for that area?

A. Phillips Petroleum.

Q. Does Marathon Oil Company have an acreage position in both areas?

A. Yes, we do.

Q. Also on the display are some red circles that are drawn around well locations?

A. Yes.

Q. What do those identify?

A. The red circles indicate wells that are producing at top allowable rates currently, or proration units that are producing at top allowable rates.

MR. STOVALL: Mr. Kellahin, it looks like the copies here don't have color, or not all copies have color, so perhaps you'll have to do it by some other reference.

COMMISSIONER WEISS: You called them "red."

MR. KELLAHIN: Did I? I'm sorry. I misspoke.

Q. I'll have you again identify the areas drawn with a circle.

A. Yes. Those wells that are circled with open, black circles, are wells that are currently producing at top allowable rates or proration units that are producing at top allowable rates.

Q. Those wells represent wells that may have additional capacity to produce in excess of the 107 barrels a day top allowable?

A. That's correct.

Q. And there are shown two lines of cross-section on this display as well?

A. Yes, there are.

Q. Give us a brief summary of the background of the pool development and production.

A. The Vacuum-Glorieta Pool was discovered in January of 1963 and was developed basically, by 1967, on 40-acre spacing with 174 proration units. The pool includes both the Glorieta and the Paddock zones, the top of the Glorieta being at approximately 5800 feet and the base of the Paddock being at approximately 6200 feet.

Primary production from the pool has been from the Upper and Lower Paddock zones. Currently, the allowable for this field is set at 107 barrels of oil per day.

Q. I would like you to take us through a series of three maps which you have extracted from the technical committee report and show us the reservoir in relation to the average daily oil production rate, as we go through the development and production of the pool.

Starting, first of all, with Exhibit No. 2, what period of time are we looking at in Exhibit No. 2?

A. Exhibit No. 2 represents the average daily oil production for November of 1971, or approximately eight years after the pool was discovered.

Q. The contour lines on the display represent what, Mr. Kent?

A. They are lines of equal production scaled on 25 barrel-a-day increments.

Q. And that area that's shaded or stippled with the gray shading, what does that represent?

A. That represents those wells that were producing in excess of 100 barrels of oil per day at that time.

Q. Let's move now 10 years later, to November of 81, and have you make the comparison, then, between the average daily oil rate in 71 with what we see occurring in November of 81.

A. Basically what has happened is that in

71, a large portion of the eastern part of the pool and portions of the western part of the pool were capable of producing in excess of 100 barrels of oil a day. By 1981, that area that was capable of producing in excess of 100 barrels a day had shrunk dramatically and, for the most part, it was limited to the eastern part of the field.

Q. The latest tabulation of this type of information was conducted based upon November 91 production data?

A. That's correct.

Q. Let's turn now to the display that shows that information, Exhibit No. 4. Identify and describe this.

A. Again, this is a similar map as was shown on the previous two. The production data shown is for November of 1991. Again, it shows that the wells that were capable of producing over a hundred barrels a day have decreased dramatically and are now exclusively limited to the eastern portion of the field.

Q. Give us a general description of the drive mechanisms that work within the reservoir.

A. There's a combination of drive

mechanisms going on. The western portion of the field is almost exclusively solution gas drive, while the eastern portion of the field is realizing some effects from some water encroachment. The center portion of the field is feeling effects of both drive mechanisms.

Q. Did the technical committee for unitization purposes examine the influence of water on production as they tabulated and analyzed all the available data?

A. Yes, they did.

Q. Characterize for us the type of water affect we're seeing in the reservoir. Is this an active water drive coming from a bottom aquifer up through the production, or is it something else?

A. Basically, what the technical committee concluded was that the eastern portion of the field was under water encroachment from an edge-water drive or edge-water aquifer and they characterized the aquifer as weak to limited, based on material balance calculations.

Q. As the oil has been produced over the last 30 years, how long, in a general range, has it taken the water to move from the east towards the west?

A. Basically, over that 30-year period, the water has moved roughly one to one-and-a-half miles from the eastern edge into the eastern part of the unit.

Q. In making your analysis, Mr. Kent, do you see any indication or evidence that would give you concern, as a reservoir engineer, that if the Commission allows the remaining wells to produce at capacity we're going to affect production by having the premature encroachment or breakthrough of water from the aquifer into the oil zones?

A. No, I don't.

Q. No evidence that you see that that would occur?

A. No. There's no evidence that I've seen.

Q. All right. Give us an indication of the current status of the reservoir in terms of its production.

A. Basically, to date we've recovered approximately 37 percent of the original 172 million barrels of oil in place that was determined by geologic mapping.

Q. Go back and give me the oil in place number. What was that in millions of barrels?

A. 172 million barrels for the entire pool.

Q. And at this point, using that number, what percentage has been recovered?

A. We've recovered 37 percent.

Q. In reviewing your own data for your company and also looking at the technical committee information derived for the unit, was there reservoir pressure information available for analysis?

A. Yes, there was.

Q. Let me turn your attention to what is marked as Exhibit 5. Would you identify and describe that for us?

A. Exhibit No. 5 is a map of the Vacuum-Glorieta Pool which shows contours of reservoir pressure. This was taken from the technical committee report.

Q. What does that tell you, as an engineer?

A. Basically, it tells me that this reservoir is in very late stages of depletion, looking at the current pressures and comparing them with the original reservoir pressure, which was over 2200 pounds.

Q. Based upon available data, can you reach a reasonable conclusion that should the Commission provide a nine-month capacity allowable for the pool, that that should be a sufficient period of time in which to see decline curves established on the top allowable wells?

A. Yes, I think nine months should be sufficient.

Q. What is the status of depletion in terms of the remaining wells, in relation to those wells that are still active?

A. Basically, at this point, there are 48 of the 121 active wells producing less than 10 barrels of oil per day. The average production for the 121 active wells is only 25 barrels of oil a day.

Q. Out of the 48 wells, you've got 121 still active?

A. That's correct.

Q. And out of that number, how many produce 10 barrels a day or less?

A. 48.

Q. What about the rest of those wells?

A. They produce anywhere from 10 to 107 barrels of oil per day, with some of those wells at 107 capable of producing substantially more.

Q. At this point in the life of the reservoir, can you conclude that it is appropriate to undertake secondary recovery of oil by waterflood operations?

A. Yes. It's very definitely something that we should definitely look at.

Q. Has the technical committee concluded that this reservoir, in fact, is a viable candidate for waterflood operations?

A. Yes, it has.

Q. Let's talk about the unitization effort, and lead us through a summary of that process and explain to us what has caused the need for the additional decline curve information as the only choice of information by which to get the remaining parameter for unitization.

A. Basically, unitization efforts have been ongoing for roughly seven to ten years in this field. The technical committee has concluded that there is an additional 22 million barrels of oil that can be recovered through enhanced oil recovery techniques in the proposed east unit alone. And really, in order to do this, we have to unitize. There's really no way that it would be practical to undertake this in any other manner than on the unitization.

One of the problems that's come up is that we don't have any good, solid data on how to determine the remaining reserves for the top allowable wells. Because there's no data, none of the attempts at achieving the inequity formula have been successful. That's kind of left us at the point where statutory unitization is not really an option.

Q. When you look at choices to determine remaining primary oil reserves for those wells in the pool, do you have decline curves established that are an accurate basis to calculate remaining recoverable oil for all those wells except the remaining top allowable wells?

A. Yes.

Q. When you look at establishing calculations for original oil in place, why can't you use conventional geologic tools and volumetric calculations to derive that amount?

A. One of the problems we're faced with in determining original oil in place is that this field was developed at a time when the technology available for logging was pretty much limited to sonic logs. At that time, the sonic logs that were available didn't have some of the sophisticated processing that we use today and tend to underestimate porosity in a vuggy carbonate, which is what we're dealing with here, anywhere from three to four porosity units.

Basically we're looking at a reservoir with average porosity somewhere in the neighborhood of 10 to 12 percent. So an error of three to four porosity units represents somewhere between 25 to 30 percent error in the actual measurement of porosity, which translates directly to an error in the measurement of original oil in place.

Q. Can you think of any other way to arrive at accurate numbers by which to assign values for the remaining primary oil recovery for these top allowable wells?

A. No. Really, the only way that's going to accurately reflect the remaining oil recovery for those wells is to get decline curves on each individual well.

Q. How about recovery factors? If you

could compromise, negotiate or resolve the oil in place numbers, how do you assign a recovery factor by which, then, to apportion recoverable oil to each of the wells?

A. It would be possible to determine an average recovery factor for the field, but with the multiple drive mechanisms we have going on here, the average recovery really is hard to pin down--not pin down, but to take generalizations from the pool and place it on individual wells due to the drastically different production characteristics of the wells.

Q. Is there a consensus among all the operators in the pool that this data is necessary and useful to establish, then, the primary oil reserves remaining to be produced for the top allowable wells?

A. Yes.

Q. Let me have you go on and describe and identify what's marked as Exhibit No. 6. It's captioned, "Vacuum-Glorieta Pool Data Sheet."

A. Yes. Basically, this is just a reiteration of some of the background information that I presented dealing with the discovery of the pool, the area, depth, initial pressure being

2260 pounds, current average reservoir pressure of 350 pounds. It describes the allowable, current active wells.

The center portion of the table represents April 1992 average daily production. The total production from the pool was slightly less than 3000 barrels a day with the eastern half of the pool contributing roughly two-thirds of that production.

The bottom third of the page deals with the cumulative recovery to date. You can see that we've recovered 64 million barrels of oil, 78 Bcf of gas, and slightly over 40 million barrels of water. And the original oil in place number is listed below.

Q. It says, in the middle of the display, current production, April of 92. What is represented within that section of the display?

A. Within that section I've broken the production into oil, gas, water, and the fourth line being reservoir voidage. Then, as you proceed from left to right, I broke that up in the east half, which represents the proposed east unit, west half, which represents the proposed Vacuum-Glorieta west unit, and then the total production numbers for the pool.

Q. And this voidage is in reservoir barrels, isn't it?

A. That's correct. What I've done is corrected the surface volumes for reservoir conditions to determine the volume of fluids that are being removed from the reservoir on a daily basis.

Q. When you look at the bottom line and follow those columns over for voidage, you can see what the total voidage is for the reservoir?

A. That's correct.

Q. You divided it into an east half and a west half, and those correspond to the proposed unit areas?

A. That's correct.

Q. Let me have you identify and describe what is marked as Exhibit 7.

MR. KELLAHIN: We have neglected to put small copies of Exhibit 7 in the exhibit packages. I will supplement that following the hearing, but the large display represents Exhibit No. 7.

Q. So that we can understand what you're showing here, Mr. Kent, describe it for us.

A. Exhibit 7 is a portion of the base map that was shown in Exhibit 1. It represents part of the eastern portion of the pool and it's specifically centered on the area of the pool which contains the top allowable wells.

On the north and south sides of the plat is a hatched line, which again represents the proposed boundary for the proposed Vacuum-Glorieta East Unit. There are five circles on the map which represent those wells which are capable of producing top allowable or the proration units that are capable of producing top allowable.

Q. Identify for us who are the operators of the various wells that have the potential to produce oil in excess of the top allowable?

A. The operators are Exxon and Marathon.

Q. They would be shown by looking at the legend here? For example, those in 33 are Marathon wells, and the remaining appear to be wells within the control of Exxon?

A. That's correct.

Q. Let's go down to Exhibit No. 8. Identify and describe this package for us.

A. Exhibit No. 8 is a cover letter and

minutes of the last working interest owner's committee meeting for the proposed Vacuum-Glorieta East Unit.

Q. What is the conclusion from a review of the minutes and the information that is contained within Exhibit No. 8?

A. The conclusion was that the working interest owners were unable to reach an agreement on an equity formula that had greater than 75 percent support. The working interest owners also recharged the technical committee to update all of the possible participation parameters and, in particular, the remaining primary oil parameter.

Q. This is your effort to document and verify, then, the fact that unitization has been stalemated, if you will, because we do not have the production decline curves established for the top allowable well, and the technical committee now has been charged with fulfilling that responsibility?

A. That's correct.

Q. Will approval of this application allow the operators in the pool to achieve that objective?

A. Yes, it will.

Q. Can they do so? Can the Commission do that without causing waste or impairing correlative rights?

A. Yes.

Q. Let's talk about the concept of waste, in terms of the effective use of reservoir energy in relation to reservoir voidage and barrels of oil recovered during this test period.

A. The top allowable wells are producing at fairly low GORs and fairly low water cuts, when compared to the rest of the wells in the pool. One of the largest components of the voidage calculation is the water production, and, more importantly, the gas production, since gas, at low pressure, occupies a great volume of reservoir space.

Q. Exclusive of the additional incremental oil that would be produced under the test, when you examine wells that are currently producing within the allowable, what is the range of reservoir voidage in terms of oil produced and water produced?

A. I don't understand your question.

Q. Apart from the test, when you look at the wells produced, what is the range of reservoir voidage for those wells?

A. Basically, it's from very minimal for those wells that are producing low oil, low water, to some numbers in excess of thousands of barrels of reservoir voidage a day for wells that are producing at either high water cuts or very high GORs.

Q. When you look at these wells that are able to utilize the additional allowable for the test, describe for us the range of reservoir voidage and the impact on that.

A. Basically, the wells that have additional capacity produce in the range of 3- to 500--right around 300 barrels of reservoir voidage a day.

Q. Let me ask you to turn to a series of four production declines. They're marked as Exhibits 9, 10, 11 and 12. You might just spread those out in front of you, with 9 being to the left and 12 being to the far right.

Tell us, before we describe the displays, using Exhibit No. 7, where these four wells are, starting with Exhibit 9.

A. Exhibit 9 is the Warn State Account No.

5, which is located in Section 33 and is the immediate eastern offset to the Warn State Account No. 6, which is shown as a circled well.

Q. Exhibit 10, then, is one of the circled wells?

A. Exhibit No. 10 is Warn State Account 3 No. 6, which is a circled well near the center of Section 33.

Q. This well on Exhibit 10 represents a well that has the capacity to utilize the test allowable?

A. That's correct.

Q. The well that we just described or identified in Exhibit 9 does not have that potential?

A. That is also correct.

Q. When you compare the information displayed, what does it tell you?

A. Basically, what it tells me is that Well No. 5 reached a water/oil ratio or water cut of roughly 50 percent in around 1972 to 1973, while the Warn State Account 3 No. 6, the immediate western offset, has produced at the most at a water cut of 20 to 25 percent and is currently producing at a water cut of around 10 percent.

Q. So what's the point?

A. Basically this shows that we're not having a great movement of water through this reservoir, because if we were, I would assume that over the 20-year period, since the Warn State Account 5 started producing at 15 percent water cut, and today we would have seen a greater impact of water production on the Warn State Account No. 6.

Q. When we look at Well No. 10, it's not yet established an oil decline, and that production plot continues along on a flat line, does it not?

A. That's correct.

Q. The objective of the allowable, then, is to get a decline on the oil rate established for wells like this?

A. That's also correct.

Q. As we move now to the east and pick up Exhibit 11, what well does that correspond to?

A. Exhibit 11 is for Warn State Account 3 No. 7, which is the western offset to the No. 6 and it's indicated by a box near the center of Section 33.

Q. As we move father east, then, to Exhibit 12, what well does that identify?

A. Exhibit No. 12 is the Phillips Petroleum Santa Fe No. 105, which is in Unit E of Section 33, which is the western offset to the No. 7.

Q. What's the point of this comparison?

A. Again, we're looking at direct offsets. The Santa Fe 105 was producing in excess of 50 percent water cut by the mid to late 70s, while the Warn State Account 3 No. 7 produces today at around 10 to 20 percent water cut and probably, at the most, is produced at 30 percent water cut.

Q. What is your conclusion, based upon this information?

A. Again, looking at direct offsets, you would assume that if we had a strong aquifer where we had water moving at great volumes through this reservoir, that you would see some more effective water production on the No. 7 well when looking at the production plot for the 105.

Q. We have touched upon your reservoir voidage analysis up to now. Let's look specifically in detail about your analysis and conclusions about reservoir voidage. Turn with me to what is marked as Exhibit No. 13. It's the display captioned "Reservoir Voidage Map, April of 92"?

A. That is correct.

Q. Why did you undertake this type of analysis, Mr. Kent?

A. Basically what I wanted to do was look at how much volume was being taken from the reservoir on a daily basis and then try to make some estimates of what the wells with additional capacity could make, and then look at the additional voidage that would be created by that additional capacity.

Q. When we look in Section 28 and find one of the top allowable wells, for example the 34 well--

A. Yes.

Q. --which is in the southwest of 28, there's a number 152. What does that represent?

A. That represents the average reservoir voidage in reservoir barrels per day based on April 1992 production.

Q. That's one of the top allowable wells?

A. That's correct.

Q. Move down and find Well 35 as an example. If you move to the east--southeast a little bit, it says well 36 and it says 273?

A. Yes.

Q. Is that the reservoir voidage for well--is that 36?

A. 35.

Q. Is that Well 35, and that's its reservoir voidage?

A. That's correct.

Q. What's happening with regards to those wells in this area that are really marginal oil producers? What are they doing?

A. Basically, they're producing large volumes of water to recover small volumes of oil.

Q. So their reservoir voidance numbers are substantially higher because they're voiding more reservoir with water withdrawals in order to achieve small oil production?

A. That's correct.

Q. When you look at the efficiency of producing the reservoir at the higher rates that the capacity oil allowable will generate, can you conclude, as a reservoir engineer, that's an effective use of reservoir energy?

A. Yes, it is.

Q. Let's turn to Exhibit No. 14 and have you identify your reservoir voidage calculation and your parameters.

A. Basically, Exhibit No. 14 is a sample calculation of the voidage in the Warn State Account 3 No. 6, using reservoir pressures, formation volume factors for oil, gas and water, solution GOR, and then average daily oil rate.

As you move down through the page, I've broken each component up into oil, water and gas and calculated the reservoir voidage due to each component. And then at the bottom of the page I summed them up to come up with the total reservoir voidage for the well.

Q. In terms of a percentage, can you tell us whether this is an efficient use of reservoir energy?

A. Yes, it is. You can see that the total voidage from that well is 154 reservoir barrels of oil per day. Of that, roughly two-thirds is due to the oil production.

Q. This use of reservoir energy is far more efficient than is being demonstrated by those marginal oil producers in the vicinity?

A. That's correct.

Q. Do you see any opportunity for waste of reservoir energy or oil production by the approval of this application?

A. No, I don't.

Q. Let me direct your attention to Exhibit 15. Identify and describe that for us.

A. Exhibit No. 15 is a sample calculation on the Vogel IPR equation which I used to predict the rates that the top allowable wells would have with additional draw down. This particular example is a calculation on the Warn State Account 3 No. 7.

Q. This is a calculation that allows you to forecast the rate of oil production that will be achieved by the top allowable wells without actually having produced them at that rate?

A. That's correct.

Q. It's a calculation that you can use as an engineer to make that forecast?

A. That's correct.

Q. Have you done it for the top allowable wells?

A. Yes, I have.

Q. What's your conclusion?

A. Basically, I've concluded that several of the top allowable wells and also other wells in the nearby vicinity have additional capacity to produce in excess of the top allowable of 107 barrels of oil per day.

Q. Using the Vogel analysis for those wells, can you give us a total oil volume in barrels of oil a day that might demonstrate the maximum range of oil that would be produced if the application is approved?

A. Yes, I could. Roughly, I've calculated that wells can produce anywhere from roughly, at the top allowable of 107, to 369 barrels of oil per day for one particular well.

Q. Let me have you identify the displays marked Exhibit 16 through 22. What are those, Mr. Kent?

A. Exhibits 16 through 22 are plots of the Vogel calculations that I made. On the Y axis is shown flowing bottomhole pressure. On the X axis is shown oil rate and barrels of oil per day. The line on the graph indicates the various rates that the well could produce at given a flowing bottomhole pressure. The diamond indicates the rate at which the well can produce at a bottomhole flowing pressure of 40 psi.

Q. Why did you make the calculation down to a flowing pressure of 40 psi?

A. Basically, 40 psi is about the least that we could anticipate to have as a flowing bottomhole pressure, a pumping bottomhole pressure in this case, due to just having enough pressure to operate surface facilities and allow oil and water to flow from the wells to the battery.

Q. Current field installations and the mechanics of the wells would provide that 40 psi is the least pressure you could achieve?

A. That's correct.

Q. In running the Vogel analysis and making the plots on all seven of these wells, they're all done in the same conventional way?

A. That's correct.

Q. For example, let's turn to 17. That's an example, I think, of one that has the capacity to produce in excess of the 107. You get to 40 psi flowing pressure, and that will generate 369 barrels of oil a day?

A. That's correct.

Q. When you put all those together and

analyze the summary of the voidage information, have you displayed that on Exhibit 23?

A. Yes, I have.

Q. Let's turn to Exhibit 23 now, then.

A. Exhibit 23 is a summary of the voidage calculations and the Vogel calculations that I made on each individual well that either is producing at top allowable or has capacity to produce in excess of the top allowable.

On the left column is listed the well name. The next column to the right is the potential increase in barrels of oil per day over the April 1992 production. The next column over is the projected increase in gas and Mcf per day. The next column to the right is water production increase in barrels of water per day. The final column on the right is the projected increase in reservoir voidage based on the voidage calculations that I made.

At the bottom of that is a line entitled "Total," which represents, again, the total increase of oil, gas and water and reservoir voidage from these wells. I then compared that to the current rates in the east half of the field or the proposed Vacuum-Glorieta

East Unit, and then looked at the percentage increase of each one of those components when compared to the current rates from the east half of the field.

Q. The percentage increase in oil recovery is 22 plus percent at an expense, if you will, to reservoir voidage of just under four percent?

A. That's correct.

Q. Is that an effective use of reservoir energy?

A. I believe that's a very effective use of reservoir energy.

Q. Do you see the opportunity to impair the correlative rights of any of the other owners of production in the pool if this application is approved?

A. No, I don't.

Q. Why not?

A. Basically, we're looking at only increasing the total withdrawal from the reservoir of less than four percent. Most of the surrounding wells are producing at very low oil rates currently.

Q. Without approval of this application, are those interest owners with top allowable wells in a position to simply continue producing at top allowable for a substantial period of time in the future?

A. That's my interpretation.

Q. And we simply postpone unitization?

A. That's correct.

Q. Give us a sense of the volumes involved with the test oil, in relation to what might be production under unit operations. Can you give us a sense of the magnitude of how much oil this represents?

A. I misunderstood your question.

Q. I think you told me it represented X number of days of production at current rates?

A. Right. The voidage, as I've calculated it, the incremental voidage that would be generated by the extra capacity of the wells is roughly 260,000 barrels. That equates to about 10-and-a-half days of production at current rates, which would also equate to a delay in unitization or be equal to a delay in unitization of two weeks.

Q. When you look at the potential for water influx in the reservoir, that's obviously dependent upon pressure changes in the reservoir?

A. That's correct. The rate of water influx is dependent on the pressure differential between the aquifer and the reservoir. The reservoir pressure is obviously dependent on the rate of voidage from the reservoir.

Since we've got such a small increase in voidage based on these calculations, I don't anticipate that there would be any great increase in the water influx rate.

Q. Summarize for us your conclusions to support your opinion that the increase in oil rate, for approval of this request, is not going to cause the influx of water through any high permeability channels that might exist in the reservoir.

A. Basically, there's two concerns here. First, the water influx rate is not solely dependent on oil production but dependent on the total withdrawal from the reservoir. As I've shown through these calculations, that increase in withdrawal is very insignificant when compared to the total withdrawals being experienced.

Q. One of the issues before the Examiner was the argument asserted by Mobil that the increased allowables would cause water coning in the reservoir?

A. That's correct.

Q. Describe for us whether you agree with that assertion?

A. Basically, water coning is a phenomena that's generally associated with bottom-water-drive reservoirs and has been documented by the technical committee. The Vacuum-Glorieta aquifer has been characterized as an edge-water aquifer rather than a bottom-water aquifer. That means that the water is in a downdip play of the coarse and permeable rocks that are connected to the reservoir, rather than contained in a bottom-water-drive where the water is directly underneath the producing formation.

Another thing that needs to be considered when talking about coning is vertical permeability. The Vacuum-Glorieta reservoir is very stratified and has very definite barriers to vertical flow. So, even if we were dealing with an aquifer that was at the bottom, there is the potential to be able to draw water from lower zones to upper zones due to these permeability barriers.

Q. Subsequent to the Examiner hearing, you then have reexamined the issue of water coning. Can you conclude now that that is not a probability in this reservoir should this application be approved?

A. Yes. Based on my observations, it's not a possibility.

Q. Describe for us the data gathering, the information that is going to be arrived at through the test. What are you going to get in addition to established declines on the producing wells? What else is going to be done?

A. Basically, we're going to be able to get better indications of reservoir pressure. Part of the request is to get at least one shut-in bottomhole pressure during the testing period.

Other information that would be gathered would be monthly tests of oil, gas and water, or twice monthly tests, with fluid levels to coincide with these tests which would tell us what the producing bottomhole pressure is that coincides with this particular rate, which should help confirm the Vogel analysis which I performed.

They're also looking for multi-rate

flow tests, which is another method of calculating capacities for the wells. As I mentioned before, part of the request is also for a shut-in bottomhole pressure test on at least one well in the lease where a top allowable well is located. Again, this will give us a better handle on what the current reservoir pressures are in these areas.

Q. Have Exxon, Phillips and Marathon agreed upon the test procedures that you've just described for the testing of these high-capacity wells?

A. Yes, we have.

Q. And Mobil has withdrawn its opposition and does not oppose the granting of this application and has no objection, then, to the testing procedure?

A. That's correct.

MR. KELLAHIN: That concludes my examination of Mr. Kent. We would move the introduction of his Exhibits 1 through 23.

CHAIRMAN LEMAY: Without objection, Exhibits 1 through 23 will be admitted into the record. Questions of the witness?

MR. BRUCE: None by me, Mr. Chairman.

CHAIRMAN LEMAY: Mr. Carlson?

COMMISSIONER CARLSON: I don't think I have any questions.

CHAIRMAN LEMAY: Commissioner Weiss?

EXAMINATION

BY COMMISSIONER WEISS:

Q. Where is this unit in relationship to the ongoing water floods in the San Andres or the CO_2 floods?

A. The CO_2 floods in the San Andres are directly above. These units are stacked, based on different pay intervals.

Q. And the PVT data that you used, was it measured?

A. That was data that was taken from the technical committee report.

Q. It's measured data?

A. Yes.

Q. Is it available?

A. It's in the technical committee report.

MR. KELLAHIN: If Commissioner Weiss would like to have these two copies, I would be happy to leave these with the Commission. They are the technical committee reports.

COMMISSIONER WEISS: Thank you.

Q. One thing that occurred to me during your discussion or your testimony, perhaps proration should be based on reservoir barrels, total reservoir barrels, rather than stock tank barrels of oil. Do you have any comment?

A. We looked into that, but part of the problem there is, there are people that are producing low volumes of oil that are trying to hold onto leases until we can get this unit put together. If we were to go on a voidage basis, we might run into some problems where people could lose leases due to nonproduction.

Q. You mentioned it was highly stratified. How did you determine that? Were cores involved in that determination?

A. I discussed the reservoir with our geologist and he had looked at some cores and made some cross-sections which, based on his interpretation and my interpretation of what he did, I concluded that it was basically very stratified.

Q. Is that information in the technical committee report?

A. It will also be provided in later

testimony.

COMMISSIONER WEISS: That's all the questions I have. Thank you.

CHAIRMAN LEMAY: Just one on the reservoir.

EXAMINATION

BY CHAIRMAN LEMAY:

Q. Do you feel you have communication throughout the reservoir with the permeability barriers you discussed and the stratified nature of it?

A. The permeability barriers, as I see it, are barriers to vertical flow. There is some communication throughout the reservoir, and I think you can see that on the pressure map. There may be some barriers to lateral flow, which is keeping water from rushing into the reservoir, if you will. It impedes the rate of water influx.

But, as far as being able to take this reservoir and flood it, there is sufficient continuity to generate good sweeps and have an effective flood.

CHAIRMAN LEMAY: Additional questions of the witness? If not, you may be excused.

Thank you.

Call your next witness.

MR. KELLAHIN: Call Mr. John Chapman. Mr. Chapman is a geologist.

JOHN CHAPMAN

Having been first duly sworn upon his oath, was examined and testified as follows:

EXAMINATION

BY MR. KELLAHIN:

Q. Would you please state your name and occupation?

A. My name is John J. Chapman, Jr. I'm an advanced geologist with Marathon Oil Company. I am also the New Mexico project leader, which means I am responsible for geologic oversight for all of Marathon's operations in the State of New Mexico.

Q. Have you participated, on behalf of your company, with unitization efforts by acting in your company's behalf with the technical committee?

A. I was not a member of the technical committee team, either the geologic or the overall committee at that time.

Q. Have you reviewed all the technical

committee geologic information?

A. Yes, I have.

Q. And, independent of that geologic information, have you made your own analysis of the reservoir?

A. Yes, I have.

Q. Were you the geologic expert that testified on behalf of your company at the Examiner hearing of this case?

A. Yes, I am.

Q. Subsequent to that hearing, have you continued your study and evaluation of the reservoir?

A. Yes, I have.

MR. KELLAHIN: We tender Mr. Chapman as an expert geologist.

CHAIRMAN LEMAY: His qualifications are acceptable.

Q. Let me direct your attention, Mr. Chapman, to Exhibit No. 24, which is a small display captioned "Top of Paddock."

A. Yes.

Q. What's the purpose of the display?

A. This is the first of several displays that I would like to use to characterize the general geologic setting of the Vacuum-Glorieta Paddock reservoir itself. This is a structure map. Exhibit 24 is a structure map made on top of the Paddock; i.e., the base of the Glorieta. They're one in the same.

Q. This was taken from the technical committee report?

A. This was pulled from the technical committee report.

Q. You've examined it and find it to be accurate for your purposes?

A. Yes, I have.

Q. Before we describe the reservoir, let's give the Commission a sense of what all these displays look like.

A. Okay.

Q. If you'll turn now to Exhibit No. 25, identify that for us.

A. Exhibit 25 is a net pay map of the main Paddock reservoir, that being the Upper Paddock, which is the productive interval in the proposed eastern unit. It's an isopach of feet of porosity equal to or in excess of six percent net porosity.

Q. And the last two exhibits you're going to discuss are Exhibits 26 and 27?

A. Yes.

Q. And those are East/West, North/South cross-sections you've prepared through the specific area of concern when you look at the top allowable wells?

A. That is correct.

Q. Let me have you give us a short summary on the geology of the reservoir, and let's use Exhibits 24 and 25, the structure map and the isopach, to illustrate your discussion.

A. Okay. Returning to Exhibit No. 24, the structure map "Top of Paddock," you can note that the Paddock reservoir, the Vacuum-Glorieta Paddock reservoir, is characterized as an East/West trending anticline, plunging to the east.

The highest end of the overall field is the western end. This structure is set up by the underlying block faulting in the prePennsylvanian sediments, and then the subsequent deposition and compaction over these underlying block faults by the Paddock and other intervening formations.

Q. When you turn to the isopach, what does that show you?

A. The isopach, Exhibit No. 25, is a display of the--as I stated earlier, the net porosity equal to or in excess of six percent in the reservoir. It shows that the reservoir is a constructional reservoir, in geologic terms. The thickest part of the porosity is coincident with the highest part of structure, again reflecting the depositional nature of this reservoir; that being that it is a shelf or shelf margin depositional setting with oolitic and pelloidal shoals being deposited on a shelf or shelf margin setting.

Q. When you look at the structure map, the isopach, and then go back and look at the display that Mr. Kent has prepared--which I think was Exhibit No. 4?

A. That's correct.

Q. Here's a larger copy of it. --and look at those areas where we still have the high capacity oil wells in the reservoir, can you, as a geologist, make any sense of where the remaining high capacity wells are in relation to reservoir thickness or structure?

A. What a comparison of these three exhibits, Exhibit 4, 24 and 25 shows you, is if this reservoir was a homogeneous reservoir, you would expect the highest production capacity wells laid into the reservoir life to be coincident with either crestal structural position or thickest optimal net pay position or some combination thereof.

What you note when you compare the November 1991 production as noted on Exhibit No. 4, is that by and large there's not a direct, one-to-one comparison; i.e., pointing that this is a heterogeneous reservoir, it is not a homogeneous reservoir. It does not behave in a very simple behavior or form.

Q. As a geologist, can you support Mr. Kent's conclusion that he needs decline curve analysis as the only available way to accurately forecast remaining oil primary production for the top allowable spacing?

A. Yes, I can.

Q. Can you think of any other way, as a geologist, that you might answer that question?

A. Not in an economic fashion, no.

Q. Summarize for us, from your perspective, why you can't apply more typical volumetric analysis to get you an oil in place number that everybody is comfortable with and then apply a recovery factor to that number?

A. If I may, I would like to continue to Exhibit 26 and attempt to more fully describe the reservoir. And, in so doing, describe the difficulties we have on a geologic basis of getting an accurate and complete and satisfactory geometric description of the reservoir.

Exhibit No. 26 is a North/South stratigraphic cross-section designated on essentially all maps in the package of exhibits as cross-section NS, the north end being on the right end of the cross-section and the south being on the left. It is a stratigraphic cross-section datumed on the top of the Paddock.

It was constructed in such a fashion as to show the relationship of the porous members of the formation. This is a dip-oriented cross-section which, in this depositional setting, is the most desirable cross-section for showing the depositional relationships of the porosity, the porous and permeable members of the formation.

A general overview description of this reservoir would say that you can characterize this reservoir as a prograding or shingling reservoir. Points along that line would be to, if you note the Skelly State "P" No. 3, the third well from the left on the reservoir, note that in that well the very top of the Paddock held a porous member.

As you move to the south, to the Marathon State Warn Account 3 No. 7, the second well from the left, note that that same porous member has dropped relative to the top of the Paddock.

If you move back to the north, the Humble N.M. State "K" No. 27, the fourth well from the left on this cross-section, again note that porosity was encountered at the very top of the reservoir. As you move back to the south, to the Skelly State "P" No. 3, that same said porous interval has dropped correlatively lower in position. And if you look throughout this reservoir, throughout this cross-section, you will see that porous units tend to start higher in the reservoir at the north end, and then slowly drop to the south.

This is what is normally characterized as a shingling or a prograding reservoir. It ties into the depositional fabric and processes for this reservoir, that being again a shelf or shelf margin setting, where we had prograding oolite and pelloidal shelves in conjunction with lime mudstones that were deposited in this shingling or prograding basin of depositional fabric.

If I could turn briefly to Exhibit No. 27, which is again a stratigraphic cross-section hung on the top of the Paddock, this one being oriented East/West. It's designated on all maps as "Cross-Section W-E," east being on the right, west being on the left.

This approximates the strike direction for the reservoir, and again you see some degree of continuity along strike of some of these porous members. You see some others that are discontinuous. For example, the Mobil State O No. 2, which is the second well from the left on the cross-section, you'll note that the uppermost porous unit in that wellbore is not present in the Marathon State Warn Account 3 No. 7, the well immediately to the right or immediately to the east of it.

If you look down in the central portion

of the Upper Paddock, you'll notice there's substantial porosity in the Marathon State Warn Account 3 No. 7, 3 No. 6, 3 No. 5, that porosity is absent as you move to the west to the Mobil State "O" No. 2, the Humble N.M. State "K" No. 18, so you see a discontinuous nature to this porosity in a lateral sense.

Subsequent to the deposition of these lime mudstones, grainstones, wackestones, packstones, the complete sweep, if you will, subsequent to this deposition, dolomitizing fluids have moved to this reservoir and have affected it. The digenesis of the reservoir is variable. It appears to be fabric selective in that the more porous portions of the reservoir, primary porosity, original depositional fabric, were also the preferred fluid conoids for the dolomitizing fluids. Those areas have seen more extensive dolomitization and therefore the current dolomite porosity tends to mimic the original depositional fabric. This is not unusual behavior in this type of reservoir.

Q. When you look at the geology, what represents to you the geologic reason that we'll see a good producer in close proximity to a well that's not a good producer?

A. The amount of dolomitization is variable through the reservoir. The wells on the northern end of the reservoir are more extensively dolomitized. Those on the southern end of the reservoir are less dolomitized. The entire reservoir could be characterized as varying from a limey dolomite to a dolomitic limestone.

Within each wellbore the section varies there from limey dolomitic lime. It's not 100-percent dolomite nor 100-percent lime in any portion of the reservoir. The primary producing fabric of the reservoir is vugular porosity, varying from small, pinpoint vugs to larger, finger-size vugs, and subsequent what I would call breccia fractures, that being localized fractures in areas that have seen extensive dolomitization.

In conjunction with these vugs and local fractures, you also have intercrystalline porosity in the matrix which contain oil. But all of these fabrics are heterogeneous through the reservoir. They're not uniform and distributed from well to well. Thereby, we see the highly variable well production characteristics from immediate 40-acre offsets, such as was cited by Mr. Kent earlier in his forward decline curves he showed.

Q. When you look at the data in the carbonate reservoir, where is the oil being stored?

A. I think originally it was throughout the reservoir. From examining cores, the stain is uniform throughout, both the matrix porosity and the vugular porosity. The original oil storage was, I feel, fairly uniform throughout. But the movable oil and the production characteristics due to the changes in pore throat geometries, it's highly variable throughout the reservoir and again more directly relates to the fashion in which the reservoir has been dolomitized, the size of the vugs, the localized fractures, et cetera.

Q. Is there available to you, as a geologist, modern logs by which you can selectively identify these porosity zones that are going to contribute to the oil volumes made in the calculations so that you can achieve an accurate oil in place number?

A. Unfortunately, no, there are not. Again, as was cited earlier, due to the era in which this field was developed, the porosity tool, the logging tool of choice in that time was the sonic log. Standard, everyday, plain-Jane, vanilla sonic log. Not a more fancy sheer way like you may have available today.

A sonic log is a distinctly inadequate porosity log in a reservoir that is varying from dolomitic limestone to limey dolomite. It's not a useful tool for recognizing lithology types in a carbonate.

We go through and try and apply a six-percent porosity cutoff as an effective porosity, but you have to assume a standard rock matrix velocity or you have to take from core data as the technical committee attempted to do, you have to apply a uniform gradiant across the field and apply that gradiant's matrix velocity but that, in itself, is inaccurate and an overgeneralization.

So, the six percent cutoff, itself, is less than desirable. Above and beyond that, a sonic tool is notoriously inaccurate in a reservoir that is highly vugged or highly fractured. When a sonic tool hits a portion of the reservoir that has a high presence of vugs, it will frequently do what we call a cycle skip. Basically, the sonic signal will short-circuit and the tool just becomes simply inaccurate.

We do have indication of that phenomenon going on in those logs present in the reservoir. If I may direct your attention again to Exhibit No. 27, the East/West stratigraphic cross-section, I would like to note that the two most center wells on this cross-section, Marathon State 1 Account 3 No. 7 and 3 No. 6 are both wells that are currently top allowable capacity wells or near top allowable capacity wells.

If you examine the sonic curve on both of those wells, you see a very spiky character to those which is an indirect indication that there may be a high degree of vugginess or fracturing present in these wellbores. Unfortunately, neither one of these wells are cored so we don't have direct indication.

If you contrast those two logs to the Marathon State 1 Account 3 No. 5, the next well to the east, second well from the right of that same cross-section, this is a well that production rates dropped off early in the life of the reservoir. It was the same well as shown in Exhibit No. 9, which Mr. Kent earlier referenced. This well, because of low production rates, was dedicated to the underlying Abo unit as an injector, circa 1974.

If you look at the log on this well, you look at the porosity as measured by the sonic tool, indicated in black on my cross-sections, your first indication is to look at that and say, there's abundant porosity, it should be a good well, yet it was not comparable to its neighbors to the west. One character difference from this well to those wells to the west is the lack of that previously mentioned spiky nature of the sonic log, indicating that there is probably not the degree of vugs or fractures in this wellbore. Again, it's only an indirect indication. It's not a direct, measureable quantity.

So, to get back to your original question about geologic characterization and accurate modeling and measuring of this reservoir, with the current existing database that is available, it is simply and merely inadequate. The committee cannot arrive at a strong and easily defendable original oil in place calculation.

That also tends to effect the remaining primary reserve calculations. The exhibit, I believe it's Exhibit No. 8, the minutes of the last meeting where they're trying to establish parameters, four of the motions that were brought forward and dropped, all dealt with original oil in place and remaining primary reserves, some variation thereof. We simply are unable to adequately quantify those two numbers.

And the only data, the only reasonable and economically viable method we have available to us to quantify remaining primary reserves in these wells, is to allow those wells to establish a decline where we can project those primary remaining reserves.

Q. Let's go on to another issue. With these difficulties in a complex reservoir where it is heterogeneous, can you, as a geologist, reach any conclusion about whether this is floodable? In other words, is this a viable geologic area that is suitable for waterflooding? And, if so, describe for us how that is successful in a reservoir such as this.

A. Yes, I can. There are two issues here and the first being, is this a floodable reservoir? We have made great note of the fact that it is a very heterogeneous reservoir and that the porosity is--and permeability is very variable across the reservoir. There's not a great continuity between any one porous member throughout the length and breadth of the reservoir.

However, when you go into a reservoir for enhanced oil recovery operations, what you're concerned with is the local continuity of the reservoir. And that, in this reservoir, is very good. The general rule of thumb that we like to apply to carbonate reservoirs is that we desire to see at least 50 percent continuity in porosity zones from one well to the next, because when you go in to flood a reservoir, that's what you're attempting to do is move hydrocarbons from one wellbore to the next.

By visually examining Exhibits No. 26 and 27, these cross-sections, you can see that when you move from one wellbore to the next wellbore, there is at least 50 percent continuity, probably far in excess of that. This reservoir does have adequate continuity between 40-acre spacing locations to allow us to enter, flood and withdraw fluids from this reservoir.

Q. The final issue to have you comment on is whether or not you, as a geologist, see any risk to the oil production if we withdraw oil at a higher rate in the top allowable wells, whether that is going to effect the movement, migration of water in the reservoir?

A. Okay. There are two issues there, the first being the possibility of vertically coning water through the reservoir. Again, examination of the cross-sections show this reservoir to be a very stratified reservoir. There is a very low degree of vertical permeability in the reservoir.

Examination of the cores show that there are some vertical fractures present. However, those vertical tectonic fractures are all completely healed with anhydrite. There's no good, vertical conduits for fluids to move through in this reservoir. Therefore, the risk of coning water from an underlying water containing portion of the reservoir, that risk is minimal.

The second question is the question of pulling water laterally through the reservoir, the encroachment portion of the question. There is the possibility that we can move fluids from one wellbore to the next on a 40-acre location. That ties back into the continuity question I just addressed as far as the floodability. However, you see this as highly variable across the reservoir, again citing the four previously submitted decline curves with the four offsetting wells showing how there are wells that over two decades ago went on a high water cut and their offsetting neighbors today are still at very low water cuts.

The continuity is variable through the reservoir. The chance of pulling water from two miles away is very minimal because the self-same porous and permeable units are not continuous through the length and breadth of the reservoir. That, in itself, is evidenced by the fact that it's taken the 30-plus years of this reservoir's life--slightly less than 30 years of this reservoir's life, the water front, if you will, has only moved a mile and a half on the eastern margin of the reservoir. It is a very tortuous pathway for those waters to move laterally through the reservoir.

Any encroachment of water that will be seen by taking these wells that are capable of top allowable or in excess of top allowable production, in my opinion, any encroachment that is possible will be very localized, will be localized to the wells themselves, which the production rate is raised on, and will be only temporary in nature and can be overcome in subsequent unitization enhanced oil recovery operations.

Q. If the additional producing rates for the high capacity wells does bypass some primary oil, is that oil that can still be recovered under secondary operations?

A. In my opinion, yes. If that was--if bypass primary oil was not recoverable, there would be no benefit in flooding this field, period. There are already areas under their primary production on the eastern margin, they've already gone to high water cuts and there's already the potential for bypassing the primary oil there.

But with the maintenance of pressure, with the careful maintenance of injection and withdrawal from specific porosity zones and interference testing, et cetera, we should be able to recover and recoop any oil that is bypassed under primary production operations.

It may entail the drilling of subsequent infill locations under unitized scenario, but that's standard and of no concern.

Q. Do you, as a geologist, have any reservations in supporting your company's position in seeking approval of this particular application?

A. No, I do not.

MR. KELLAHIN: That concludes my examination of Mr. Chapman. We move the introduction of his four exhibits, 24 through 27.

CHAIRMAN LEMAY: Without objection, Exhibits 24 through 27 will be admitted into the record.

Questions of the witness?

MR. BRUCE: None.

CHAIRMAN LEMAY: Commissioner Carlson?

EXAMINATION

BY COMMISSIONER CARLSON:

Q. I assume at the Examiner hearing that Mobil had a geologist testify, is that correct?

A. Yes, they did.

Q. Could you summarize what their geologist said?

A. Basically--this, of course, will be flavored with my own impression and opinion--

Q. I understand.

A. Mobil's geologist had just recently finished doing his master's dissertation on this self-same reservoir, and his testimony, in effect, stated, as I had stated, that it is a very heterogeneous reservoir in sum total. He presented many of the same maps that I presented, and presented a cross-section from the unitization technical committee report that was somewhat more generalized.

His testimony tended to say that the reservoir is a heterogeneous reservoir but it's all heterogeneous. It's homogeneous in its heterogeneity, so why make your argument that these two wells are so different from these two wells over here.

I feel that our two testimonies were not in conflict, other than the interpretation of the impact of the heterogeneity of the reservoir.

Q. His interpretation of the impact being?

A. Why--I must admit, I was confused by his interpretation--why argue that these two wells are so good and deserve special treatment. He wanted to limit the discussion to Marathon's wells and ignore Exxon's capacity wells. Why argue that these wells, in his words, need special treatment because they're heterogeneous, when all these other wells which are low capacity producers are also heterogeneous? Why do they not get special treatment?

I saw no rhyme or reason to his argument, personally.

COMMISSIONER CARLSON: Thank you.

CHAIRMAN LEMAY: Commissioner Weiss?

EXAMINATION

BY COMMISSIONER WEISS:

Q. Will the special testing give you an estimate of the original oil in place, a believable estimate?

A. Not really. It will not affect the original oil in place number, I don't believe; it will just determine the primary. It will affect the current estimate in that it may come out and say that primary on some of these wells far exceeds what the original estimates were, and then by default you have to go back and say, well, some of our original oil in place were too pessimistic on some well sites.

It also potentially could do the opposite. It could say that remaining primary on some of these wellbores is much less than our original estimate and could possibly impact the original oil in place there. This testing will give us firm and hopefully incontrovertable evidence of what the primary remaining reserves are, and will give us a parameter that we can all be comfortable with and live and die with in the unitization process.

COMMISSIONER WEISS: No further questions. Thank you.

EXAMINATION

BY CHAIRMAN LEMAY:

Q. Mr. Chapman, you mentioned there are some cores? You have looked at some cores in the field, have you?

A. Yes, I did.

Q. How many, roughly?

A. I looked at three. The technical committee looked at four. There were three cores on Exxon wells that were available in their core storage facility in Midland. I examined those three. The fourth well, if I remember correctly, was from the western margin of the field. I think it was Phillips or Texaco, and I did not have that core available.

Q. How about samples? Did you look at any samples through the field?

A. I have not examined samples through the field. The cores did show a fairly good rain of scattering, as far as geometric location within the field. Unfortunately, none of those cores were current top allowable capacity wells.

My examination of the cores said that samples would be difficult to work with in that it did constantly vary from a limey dolomite to a dolomitic lime. It was just a constant shading of those two rock types. Hopefully, with examination cuttings you might be able to see more direct evidence of vugs, and that would be about it.

Q. Did you say that the cores, none of

them were from the top allowable wells or top capacity wells?

A. Unfortunately, none of the current top capacity wells.

Q. You mentioned the fact that the fractures you noticed in the cores were sealed with anhydrite, and yet when you looked at the top capacity wells, you pointed out the cycle skip in the sonic. Is it possible that the fracturing that existed in the higher capacity wells might not have been sealed by anhydrite and that's why you have the higher capacity wells?

A. It's possible. I would like to characterize--there are two types of fractures in this reservoir. One are the tectonic, the vertical fractures; one are what I referred to as breccia fractures, fractures that are localized in highly dolomitized sections of the reservoir, where you see a high degree of disruption of the fabric, and those are localized just within those porous dolomitic portions.

When I point to the sonic logs and the cycle skipping nature and say this is an indication of possible vugs and fractures, I would lean more heavily on vugs, to start with, because they're much more predominant, and if there are fractures, I would feel they're probably the localized breccia fractures.

If they are through-going vertical tectonic fractures, and that is your explanation or potential explanation of why these wells are still high capacity, I would argue that being such, they would also be tied into those underlying portions of the reservoir which are water bearing and are not oil filled. And if they were such, I would expect to have seen higher water cut through historical production of those wells, and we have yet to see that in any of these wells.

Q. You said that the lower portion of the reservoir is water bearing?

A. Yes.

Q. I was curious why you just perforated mainly the top sections of the pay in the Paddock, thought you might be leaving some oil in place in there. But you assume a lot of what you've colored in there is water bearing?

A. Yes. These are stratigraphic cross-sections and if you refer back to Exhibit No. 24, you can see, for example, the cross-section North/South, N-S, there is, looking at the structure map, there's about 150 feet of structure relief as you go from the north end to the center and then back to the south end on that cross-section.

The original oil column in this reservoir was only about 100 feet and that was filling the matrix and vugs, both. I do feel, as you inferred, that there is probably some additional oil production to be gained by testing some of these other porosity units.

I should note that the perforations I have marked on the cross-sections are solely those perforations which are originally reported in the scout ticket books or have been subsequently reported in scout ticket books. It is not uncommon for some operators to go in and add perforations and never report it. So, there is a chance that in some of these cases there are additional perforations which I have not noted.

Q. Have you looked at either micro logs or microlateral logs for filter cake or any other indications of fracturing in the reservoir?

A. There are a few micro logs available, and I did examine those. In every case, the micro log separation was coincident with measured sonic porosity, so that does not deny the potential for fractures there, but it's not a direct indication; just the normal vugular porosity that we see on the sonic log would be enough to provide that separation.

In no case did I ever note a section of a log where you showed no porosity on a sonic tool but then yet saw separation on a micro log, indication of a fracture in an otherwise tight portion of the reservoir.

Q. One final question. You call this reservoir Glorieta-Paddock. I see no Glorieta pay. Are there perforations in the Glorieta? Does it produce or is it just behind pipe?

A. There are some perforations. On cross-section N-S, Exhibit No. 26, you might note the northernmost well, the Phillips Santa Fe No. 107, those perforations are in the base of the Glorieta.

On the East/West cross-section, Exhibit No. 27, again on the easternmost edge you see those perforations slightly go into the base of the Glorieta. The Glorieta has never been a strong producer out here. It is a sandstone--it's a dolomitized sandstone. The interstitial porosity has been largely infilled with dolomite cement. Very poor production rates, very poor recoveries. The technical committee looked at it and said it's not an adequate reservoir for enhanced oil recoveries because the cementation is so variable and disruptive across the entire reservoir. They did not feel it would be a desirable enhanced oil recovery target.

Q. The term Glorieta seems like it might be an afterthought, then. Is there any production from the Glorieta that you know of in the field that is significant?

A. There is production. I can't quote for you cumulative numbers. I think, from remembering the historical development of the field, of course that was originally a San Andres-Grayburg field and then subsequent deeper drilling encountered the pay in the Glorieta, the Paddock, the underlying Blinebry and on down to the Abo, et cetera.

When they came to the state and tried to establish and determine pools, one of the initial questions was, do we include Glorieta, Paddock and Blinebry all in one common reservoir, and they elected to break out the Blinebry as a separate reservoir. That has been done. It is a separate pool.

The Glorieta and Paddock were lumped into one pool designation and for some reason they applied the term "Vacuum-Glorieta" rather than Vacuum-Paddock, although the Paddock is, by far, the predominant producer.

CHAIRMAN LEMAY: Thank you. Additional questions of the witness? If not, he may be excused. Thank you very much.

Want to wind it up?

MR. KELLAHIN: Yes, sir. I would like to introduce a letter of support from Phillips Petroleum Company. They outline, in summary, the testimony we've provided today. They also show the test procedure and the language which is also shown in the prehearing statement, and I would like to submit their letter.

That concludes our presentation, Mr. Chairman. We're available for additional questions if the Commission desires. I'd be pleased to provide a draft order, if you find that necessary. That concludes our presentation.

CHAIRMAN LEMAY: Mr. Bruce, did you have a statement to make or anything?

MR. BRUCE: No, Mr. Chairman, other than that Exxon does support the application and believes that unitization is the aim of all the parties in this case.

CHAIRMAN LEMAY: Are there any additional statements in this case? If not, we shall take it under advisement. And, Counsel, I would appreciate a draft order, please, if you would write one.

Let's take a break until 11:00 o'clock, and we'll resume, then, with the following case, the Yates-Nearburg case.

(And the proceedings concluded.)

CERTIFICATE OF REPORTER

STATE OF NEW MEXICO)
) ss.
COUNTY OF SANTA FE)

I, Carla Diane Rodriguez, Certified Shorthand Reporter and Notary Public, HEREBY CERTIFY that the foregoing transcript of proceedings before the Oil Conservation Commission was reported by me; that I caused my notes to be transcribed under my personal supervision; and that the foregoing is a true and accurate record of the proceedings.

I FURTHER CERTIFY that I am not a relative or employee of any of the parties or attorneys involved in this matter and that I have no personal interest in the final disposition of this matter.

WITNESS MY HAND AND SEAL August 31, 1992.

Carla Diane Rodriguez

CARLA DIANE RODRIGUEZ, RPR
CSR No. 4