STATE OF NEW MEXICO

ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT

OIL CONSERVATION DIVISION

CASE 10,556

EXAMINER HEARING

IN THE MATTER OF:

In the matter of Case 10,556 being reopened pursuant to the Provisions of Division Order R-9759, which order promulgated special pool rules and regulations for the Old Millman Ranch-Bone Spring Pool in Eddy County, New Mexico

TRANSCRIPT OF PROCEEDINGS

BEFORE: DAVID R. CATANACH, EXAMINER

STATE LAND OFFICE BUILDING

SANTA FE, NEW MEXICO

July 15, 1993

ORIGINAL

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E X H I B I T S

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WHEREUPON, the following proceedings were had at 11:08 a.m.:

EXAMINER CATANACH: Okay, at this time we'll call Case 10,556.

MR. STOVALL: In the matter of Case 10,556 being reopened pursuant to the Provisions of Division Order R-9759, which Order promulgated special pool rules and regulations for the Old Millman Ranch-Bone Spring Pool in Eddy County, New Mexico.

EXAMINER CATANACH: Are there appearances in this case?

MR. KELLAHIN: Mr. Examiner, I'm Tom Kellahin of the Santa Fe law firm of Kellahin and Kellahin, appearing on behalf of Chi Energy, Inc., and I have two witnesses to be sworn.

MR. BRUCE: Mr. Examiner, Jim Bruce representing Mewbourne Oil Company, and I have no witnesses.

EXAMINER CATANACH: Any additional appearances?

Can I get the witnesses to stand and be sworn in?

(Thereupon, the witnesses were sworn.)

MR. KELLAHIN: Mr. Examiner, we'll call as our first witness Mike Hays.

Mr. Examiner, this case is back on your docket as a result of a prior Order by the Division, which was issued in November of 1992, establishing a special gas/oil ratio for this Bone Spring Pool. It was set at that time for a temporary period at the rate of 20,000-to-1 gas/oil ratio.

It's Order Number R-9759, and I'll hand you a copy of that Order.

The major operator in the Pool is Chi Energy, Inc., Mr. Examiner, and they presented the original request and are now back before you today with additional information.

The end result of their technical work leads them to the following conclusion: That the gas/oil ratio should be reduced to 5000 to 1, that the Pool should be governed by the associated pool rules, and that pursuant to those pool rules, then, oil wells would be spaced on 80-acre spacing and gas wells would be spaced on 160-acre gas well spacing.

And that will be the end result of the testimony of Mr. Feagan, who is the petroleum engineer, and Mr. Hays, who's the geologist. That's where they're headed with their technical conclusions.

In addition, with their assistance, we have notified all the operators and any operator within a mile boundary of the existing Pool.

I need to mark this as Exhibit Number 3, but this is our certificate of mailing.

Of those parties notified, including operators inside the Pool and those outside the Pool, the only operator to express an interest was Mewbourne Oil Company. Our package of exhibits shows a letter of support by Mewbourne Oil Company to the recommendations we will make.

The exhibit book is arranged as Exhibit 1, and the pages numbered 1 through 37 I believe.

The second exhibit is a cross-section that Mr. Hays has to present.

With that introduction, I'd like to call Mr. Hays.

MICHAEL D. HAYS,

the witness herein, after having been first duly sworn upon his oath, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. KELLAHIN:

Q. Would you please state your name and occupation?

A. Michael D. Hays. I'm a petroleum geologist.

Q. On prior occasions, Mr. Hays, have you testified before the Division as a petroleum geologist?

A. Yes, I have.

Q. And pursuant to that professional occupation, have you made a geologic study of the Old Millman Ranch-Bone Spring Pool?

A. Yes, I have.

MR. KELLAHIN: We tender Mr. Hays as an expert petroleum geologist.

EXAMINER CATANACH: He is so qualified.

MR. KELLAHIN: Before we get into the specific details of the geology of this particular Pool, let me ask you to turn to the exhibit book -- it's the blue binder -- and if you'll turn past the cover sheet and the introduction, let's look at page 2, which is the regional locator map.

Identify for the Examiner where this Pool is located.

A. The Old Millman Ranch field is highlighted with a yellow highlighter in Township 20-28, and it's in a position in the northwest corner or flank of the Delaware Basin.

Q. In conjunction with this display, Mr. Hays, let's look at page number 3. Identify that page for us.

A. This map is a general lease map, and areas highlighted with the yellow highlighter are the acreage that Chi operates, the east half of Section 4, the west half of Section 3, and the east half of Section 9.

The circled wells, with the dark circle around them, indicate the wells that are currently producers within the Old Millman Ranch-Bone Spring field.

Q. Before we look at the specific displays, would you give us a general sense of the geology, the geologic setting and the geologic components that are characteristic of this Bone Spring Pool at this location?

A. The Pool itself is somewhat anomalous in that it produces a lot of gas. Most Bone Spring first sand pools are oil producers primarily.

The position of this field is right -- as I'll show on one of my other exhibits, is in a position right near the ultimate pinchout of the first Bone Spring sand. The sand continues for tens of miles out into the Basin, but in this location it's right about at the updip limit of the first Bone Spring sand.

Q. How has that structural or geologic position in the Bone Spring reservoirs affected the production of the wells?

A. I think it may be that this ultimate position of the trap here may be the reason that we have a gas cap, what appears to be a free gas cap on the field.

Q. From your perspective as a geologist, do you have a recommendation to the Examiner as to how to establish rules and make decisions about operating procedures for maximizing production in the Pool?

A. It appears that the associated oil and gas rules for this Pool would be the most effective way of doing it.

Q. You have personally reviewed and read the current rules for associated pool rules?

A. Yes, I have.

Q. Based upon your study as a geologist, do you have a recommendation as to what to do about the current 20,000-to-1 gas/oil ratio?

A. I feel that the most prudent thing right now is to reduce the GOR down to 5000 to 1 and develop spacing rules for the gas wells in the field and the oil well that's in the field.

Q. Does Chi Energy have a recommendation to the Examiner as to gas well spacing and oil well spacing?

A. Yes, the spacing that we think is most prudent is a 160-acre gas spacing, and then the oil spacing on 80-acre spacing.

Q. Would the implementation of those spacing sizes for the existing wells disrupt any equity that currently exists for those wells?

A. No, it would not.

Q. You would have the ability in the Pool to dedicate 160 acres to a single gas well?

A. That's correct.

Q. And then that would not be concurrently dedicated to an oil well?

A. That's correct.

Q. The exhibit book contains written summaries of the geology as well as the engineering. Let's go beyond that and start with the structure map on page 5.

Give us your conclusions about that display.

A. The structure map is a scale of 1 to 2000, with a contour interval of a hundred feet. It's contoured on the top of the first Bone Spring sand.

The dip in the vicinity of the field is approximately 200 feet per mile.

Again on this map, I've circled the producers in the first Bone Spring sand and have also marked the location of the cross-section A-A', which goes roughly from west to east and goes through all of the producers that are in the field at this time.

The dashed line again indicates Chi's acreage.

There does not appear to be any structural closure over the field area on this -- in the area, and in my opinion it's a stratigraphic trap within the first Bone Spring sand.

There's approximately 180 feet of relief between the most updip well, which is the Mewbourne well in Section 8, in the northeast quarter, then going down to the Remington Number 1 in the southwest quarter of Section 3.

Q. When you think of oil wells and gas wells in the same reservoir and think in the simplest terms of a continuous reservoir with a structural trap, gas wells at the highest point of structure, the lowest wells produce oil, is that the setting we have for this reservoir?

A. It appears that way at this time, yes.

Q. The next display is an isopach on Exhibit 6.

A. That's correct.

Q. Identify and describe that for us.

A. This is, again, a scale of 1-to-2000 isopach map of the net sand in the first Bone Spring that's greater than 12 percent. The contour interval here is 20 feet.

The 12 percent cutoff is what I consider an effective pay cutoff in this area.

The maximum thickness in the field area is

145 feet of net sand in the Remington Federal Number 1 in the southwest corner of Section 3.

The minimum field well here is the Strata Aquila Fed in the southwest quarter of Section 4. It's currently temporarily abandoned. And it has 18 feet of pay in that well.

As an overall general view, the wells in the east half of Section 4 and the west half of Section 3 have the best porosity and permeability, and it shows up in its production characteristics.

The Mewbourne well is something -- somewhat intermediate between that and the Aquila Fed in the southwest quarter of Section 4.

And generally, this is a view of what I think is the stratigraphic trap that's out there.

Q. Will the adoption of the associated rules, including 160-acre gas and 80-acre oil spacing, afford the opportunity for further development in the Pool?

A. Yes, it would be, particularly, it appears, for oil wells.

Q. So there would still be open spacing units that do not yet have a well, that would have the opportunity, then, to obtain production from the Pool if the Division adopted the associated rules?

A. That's correct.

Q. Let's go to the cross-section. It's Exhibit Number 2, and it's the insert into the exhibit book.
Was this display prepared by you, as well as the other geologic displays?
A. Yes, it was.
Q. These represent your own geologic conclusions?
A. Yes, sir.
Q. What do you conclude from this display?
A. The general conclusion from it is that the producers in the field are producing from the same zone, within thė first Bone Springs sand.
This is a structural cross-section going from roughly west to east. The datum on this structural cross-section is subsea minus 2900 feet.
The logs that I've shown here are density neutron logs. This is porosity data.
The gross intervals of the perforated intervals in the wells is shown here with a line and the little circles that are there to show the perforated interval.
All of the wells, with the exception of the Mewbourne well in the far west, have perforated and treated with sand frac, the entire interval, the Mewbourne well, have treated approximately the upper

two-thirds of the zone and did not treat the bottom third of the zone.

Q. How would you characterize the continuity of the pay among the wells?

A. The continuity of the pay appears to be pretty good, I guess is the best way to characterize it at this time.

Q. Geologically, do they appear to be continuous from well to well within the same pay interval?

A. Yes, they do.

Q. So geologically the gas wells should have some effect on the oil well?

A. It would appear so, yes.

Q. Okay. Do you find evidence in your geologic investigation of a water/oil contact in the reservoir?

A. Not at this time. The wells that Chi operates produce very little if any water at this time.

The three wells, the Winchester Number 1, the Winchester Number 2, and then the Colt Number 1, produce approximately about a barrel a day or something in that range.

And then the most downdip well, the Remington Number 1, the farthest one to the right here, I believe it's something on that same order. It's like a barrel a day.

I made a mistake. The Colt is the one that produces about eight barrels a day. The other three produce about a barrel a day.

There is no clear log evidence of any kind of either gas/oil contact or water/oil contact in the field.

Q. Since the last hearing in which this case was discussed, back in September of 1992, what has been the drilling activity?

A. Chi has drilled the Winchester Number 2, the Colt Federal Number 1 and the Remington Federal Number 1, and have completed them as producers.

The Winchester Federal Number 2, the Colt Federal Number 1 appear to be gas wells. The Remington Federal Number 1 appears to be an oil well. Mr. Feagan will go through some more of the details on it.

Chi also drilled a well in the south half of Section 8, south of the Mewbourne well, and it was completed as a dryhole.

Q. My question is, based upon that activity would you be comfortable as a geologist in having the Division adopt these proposed rules on a permanent basis?

A. Yes, I am.

Q. You don't see any opportunity to have the material change based upon further development?

A. No, at this time it seems pretty clear that we've got gas wells and an oil well, oil leg.

MR. KELLAHIN: That concludes my examination of Mr. Hays.

EXAMINATION

BY EXAMINER CATANACH:

Q. Mr. Hays, how many wells do we currently have in the pool?

A. There are -- The six wells in the cross-section are currently in the pool right now, producing. The Strata Aquila Federal Number 1 is temporarily abandoned at this time. It hasn't produced since the last hearing we had.

Q. Okay, so there's six. Does that include the Strata well?

A. That includes the Strata well, that's correct.

The other well that we drilled was dry and abandoned.

Q. Okay. Of the five wells that are producing, which ones do you believe are gas wells?

A. The Mewbourne FB Number 2, which is the well the farthest to the left.

Q. Hang on a second.

A. Perhaps on the map might be a little easier way to go.

Q. Okay.

A. That's the -- I've identified them here on the map with the characteristics or the style of a gas well and an oil well there.

The starred well, the FB 2, is a gas well, it appears.

The Aquila Number 1, I think, would be a gas well if they allowed it to produce for any significant amount of time. It has not produced any large period of time.

The Winchester Number 1 is a gas well, and the Winchester Number 2, which is the well in the southwest of the northwest of 3, and then the Colt Number 1, which is the well in the southeast of the southeast of 4.

The Remington Number 1 is identified as the oil well.

Q. And you've not been able to identify a gas/water contact in the reservoir, gas/oil contact?

A. No, I haven't. There's some zones that appear to be gas or gassier, just from the characteristics on the density neutron log where you're getting crossover on it; that gives the appearance of a gas effect.

And in the case of the Remington well, if you look at that there's very little crossover, suggesting that it is not a gas -- they're not getting gas effect on those wells.

But using resistivity wells also in conjunction with that, I haven't been able to identify any clearcut structural datum that would indicate a contact.

Q. So are we talking basically just one producing sand member?

A. Yes.

Q. That's all connected vertically?

A. Yes, I think it is. And certainly it is after the wells are treated with massive hydraulic fracs.

Q. Okay. And the wells are generally perforated throughout the sand?

A. Yes. What we typically do on completions with Chi is, we'll put a limited entry frac, 10 or 15 perfs, and then pump approximately a couple hundred thousand pounds of sand into them for a fracture treatment.

So the interval that I've shown on here as the perforations is the gross interval that's been perforated.

Q. You feel there's no horizontal separation of any of these wells in the reservoir?

A. In what sense? Do you mean -- ?

Q. I mean the reservoir is all connected, as far as you can tell, in all of these wells.

A. I think it is, yeah. These are -- Particularly in the Chi wells, they're very good porosities, exceptionally high porosities for the first Bone Spring sand, maxing out at approximately 20 percent. So I think there's pretty good continuity in these wells at this time.

Q. What further development do you anticipate in the Pool?

A. I think the next logical choice to go to would be a well that I think would be an oil well in the northwest quarter of the southwest quarter of Section 3, basically an 80-acre offset there.

And then another logical location would probably be a well in the northeast of the northwest of Section 10.

Q. Is -- Do you feel like the reservoir is going to be essentially limited to this small area in here?

A. I think so at this time. We have pretty good control from all the deep Morrow tests and Wolfcamp tests that are in these areas, so you've got a pretty good -- There's a lot more data than there is, just the wells that we've drilled. And so it appears that way at this time.

EXAMINER CATANACH: I believe that's all I have.

The witness may be excused.

THE WITNESS: Thank you.

MR. KELLAHIN: Mr. Examiner, call at this time Mr. Mike Feagan.

MIKE FEAGAN,

the witness herein, after having been first duly sworn upon his oath, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. CATANACH:

Q. Mr. Feagan, would you please state your name and occupation?

A. Mike Feagan, I'm a petroleum engineer for Chi Energy.

Q. Mr. Feagan, on prior occasions have you testified before the Division as a petroleum engineer?

A. Yes, I have.

Q. Pursuant to your employment by Chi Energy, Inc., have you continued to perform reservoir engineering studies and duties concerning the Old

Millman Ranch-Bone Spring Pool?

A. Yes, I have.

MR. KELLAHIN: We tender Mr. Feagan as an expert petroleum engineer.

EXAMINER CATANACH: Mr. Feagan is so qualified.

Q. (By Mr. Kellahin) Before we look at the details of your actual engineering work, Mr. Feagan, let's talk about your conclusions.

The pool rules currently provide for a 10,000-to-1 gas/oil ratio?

A. 20,000.

Q. I'm sorry, 20,000-to-1 gas/oil ratio.

And what is your conclusion and recommendation?

A. Well, what we've recommended is that this field be put into an associated oil and gas field pool in order to best produce the gas wells, as we previously stated, and the single oil well.

What we also propose to do is drop the GOR from 20,000-to-1 to 5000-to-1. We feel like this will best allow the oil producer to produce more oil and limit the gas producers to some degree in the amount of gas that we're going to be able to produce out of the wells.

Q. Give us the reasons that cause you to reach that conclusion.

A. Well, we -- As Mike previously testified, we feel like we've got three gas wells and we have one oil well, and from the GOR of the gas wells, as we've increased production on those, we've dropped the amount of liquids that we seem to be recovering. Conversely, from the oil well we seem to be producing less gas, the more that we open these wells up.

But there has to be a balance somewhere in between, and we feel like providing this 5000-to-1, it gives the gas wells a chance to produce at a rate that would effectively bring out the most liquids.

And by also limiting the GOR but increasing the spacing, it will allow us to produce the oil wells at a rate that we can best produce the oil.

Q. The associated rules, if they apply to this pool, will cause gas wells to be classified as gas wells once they reach 30,000-to-1 gas/oil ratios?

A. That's correct, yes.

Q. If that happens and the Division adopts the associated rules, is that a problem for any of the gas wells that are currently gas wells?

A. No, all of the gas wells currently are producing in excess of 30,000-to-1, and we'll see that here in the...

Q. If we go to 80-acre oil spacing at this depth, what is the maximum daily oil rate in barrels of oil?

A. That would be 222 barrels a day.

Q. Does the oil well have the capacity to produce in excess of that top allowable?

A. Yes, it does.

Q. Describe for us the drive mechanism of the reservoir.

A. Well, as we mentioned, we feel like this is a gas -- possibly a gas-cap reservoir, and solution gas driving.

Q. Do you agree with Mr. Hays that you don't see any water influx or any water driving the reservoir?

A. No.

Q. Okay, there isn't any, huh?

A. No.

Q. Let's go to some of the specifics of the data that you've compiled on the wells in the pool. I see your written summary. Let's leave the written summary for later.

Turn to the first tabulation, which is page 8.

A. Uh-huh.

Q. What are we looking at here?

A. This is just general well data. The four wells that Chi Energy -- or Chi Operating, actually -- is currently producing in this Old Millman Ranch field.

They're just a list of the perforations which range from 6146 feet to 6400 feet in the four wells.

The stimulation jobs, which I think Mike previously stated, is approximately 55,000 to 60,000 gallons of a cross-linked fluid with approximately 150,000 to 200,000 pounds of sand.

These wells have -- the next -- It shows the completion dates. All have been done since approximately one year ago, the Winchester Number 1 was drilled and completed, the most recent well being drilled and completed in April of 1993.

We show the initial potentials. We ran an absolute open flow on three of the wells that we consider gas wells, which show a fairly high absolute open flow, I feel like. We did not run a four point on the oil well.

The oil gravity indicates that the Winchester Number 1, the Winchester Number 2 and the Colt Federal all have a fairly high API oil gravity or condensate gravity. And the Remington Number 1, which we're calling the oil well, is a lower oil gravity.

And it gives our current producing rates and current GORs, which could be noted at this time is -- Winchester Federal Number 1 is 150,000-to-1, based on current production. The Winchester Federal Number 2 is 38,000-plus-to-1. The Colt Federal Number 1 is 35,270 standard cubic feet per barrel GOR. And then of course the oil well showing current production rates, the GOR of 4697 standard cubic feet.

Q. Do you have sufficient engineering data to reach an engineering conclusion about whether or not these wells are producing from the same common source of supply?

A. Based on geological data we feel like they are.

Q. How about engineering data?

A. Other than the fact that the oil gravity crudes and the gas compositional analysis indicate that they are.

Q. Do you see any pressure differentials between wells that would conclude for you as an engineer that the wells are not in the same source of supply?

A. No, no, by bottomhole pressures, I see none of that.

Q. All right. What do we achieve by applying the associated rules to this pool?

A. What we achieve is allowing us to produce the gas wells at a rate that we're able to recover the ultimate amount of liquids as well as upping the oil rate in order to allow us to recover more oil from the oil well at this time.

Q. In your opinion as a reservoir engineer, is that the optimum way in which to maximize ultimate recovery from the reservoir?

A. Yes, from this reservoir it is.

Q. Let's look at some of the other information you've included. What's shown on page 9?

A. Page 9 is a current production map shown on the bottom with barrels of oil, and then the gas volume in MCF a day.

Over that is shown the current GOR, which I've just stated.

It also shows the current production and current GOR for the Mewbourne Oil Federal B Number 2.

Q. Is there any PVT data for the reservoir?

A. Yes, there is.

Q. And have you examined that data?

A. Yes, and it's been previously submitted here to the Commission.

Q. And is it included in the exhibit book here?

A. Yes, it starts on page 10.

Q. Okay. What's the end result of the analysis of the PVT information?

A. The end result, as stated previously in this case, shows that it is a gas well. This has been done -- This PVT analysis was done in September of 1992 on the Winchester Federal Number 1, and --

Q. Reservoir conditions show that the hydrocarbons are what in the reservoir?

A. Are condensate in the reservoir.

Q. How would you characterize the reservoir there? Is this a retrograde gas condensate --

A. Yes, that's what I would classify it at this time.

Q. After the fluid study information, I think if you'll go to page --

A. -- 24?

Q. You've got some volumetrics in here, I think, starting on page 21?

A. This is just part of the --

Q. That was part of the PVT study?

A. Yes, this is part of the PVT study.

Q. You've got some pressure data starting on page 24?

A. Well, this is pressure data that went along with the four-point test.

Attached for each of the three gas wells is the Form C-122, New Mexico Oil Conservation Division Form C-122, showing the results of that four-point, and the following page for each well shows the actual calculations of the absolute open flow.

Q. Let's go to page 30. I want to talk with you about page 30 and 31 and deal with the issue of gas/oil ratio. We're talking about taking it down from 20,000 to 5000?

A. Correct.

Q. Give us the reasons that you're making that recommendation.

A. Well, because we do have an oil well and gas wells present, we feel like we need to somehow limit our gas production to some degree in order to recover the most liquids out of the oil leg of this thing.

Q. Okay, let's look at the gas wells first --

A. Okay.

Q. -- and see what you've done with the various choke settings.

A. What we did for each of the wells that Chi Operating is operating currently, we varied the choke setting in four different settings at four different producing rates, to see what the results were.

And from the three gas wells we found that as we increased the choke size, increasing the gas volume, we disproportionately increased the oil volume, meaning that we recovered less oil per same ratio for the gas, resulting in a lower GOR as we increased production from those gas wells.

Q. So at higher choke settings you dropped your gas/oil ratio on all three gas wells?

A. That's correct.

Q. When you turned to the oil well, what happened?

A. Now, just the opposite happened. When we opened the choke settings on the oil well, as production increased, gas production also increased, but our GOR increased at that time.

And it ended up -- As a result of our last choke setting of 232 barrels a day, that's a little over what our top allowable would be for an 80-acre spacing. But you can see that the GOR is approximately 5000, and that's what we were looking for, and that's what we based part of our recommendation on, in the 5000-to-1 GOR application.

Q. All right. So it has a real effect, then, on this oil well --

A. Yes.

Q. -- insofar as when you look at the top daily oil rate of 222?

A. Uh-huh.

Q. At this choke setting you've got 232?

A. Uh-huh.

Q. Producing at that rate, you peak out at just slightly over 5000-to-1 oil/gas ratio?

A. That's correct.

Q. So what does that tell you as a reservoir engineer concerning the gas/oil ratios for the oil wells?

A. That that is the actual gas/oil ratio that this well can produce at.

And again, we would like to produce this well at a rate that we can produce most liquids out of the oil leg of this particular reservoir.

Q. Does this well have the capacity to produce in excess of the top oil rate?

A. Yes, it does.

Q. Are you comfortable as a reservoir engineer using the 5000-to-1 as a cap?

A. Yes.

Q. We're not going to be wasting liquids in the reservoir by using that number?

A. No.

Q. Turn to the next display on page 31. I think

you've got the same information, but in a graph form?
A. Yes, the next four pages are that same information, just shown on a bar graph.
Q. Okay. Page 35 is the calculations using the proposed allowables at this spacing configuration?
A. That's correct.
Q. All right, sir. And then finally you've written your conclusions on page 36. Those are your ultimate conclusions as an engineer?
A. Uh-huh, that's correct.
Q. And then page 37 is Mewbourne's letter of support?
A. Yes, we've discussed with both Mewbourne --
Q. Okay.
A. -- the details of those.
Q. Summarize for us your conclusions, then, and your ultimate recommendations to the Examiner.
A. The summary of our conclusions is that we would -- the Old Millman Ranch-Bone Spring Pool would best be produced by putting it into an associated oil and gas pool with gas well spacing of 160 acres, oil well spacing of 80-acre spacing, and a GOR of 5000-to-1.
We're recommending this so that we can better produce the liquids out of the oil well and still

produce the three gas wells, which are the major part of the production of this field.

Q. When we look at the topic of the oil spacing, the 80 acres, for a Bone Spring oil well that is this prolific is that a reasonable number of acres to dedicate to a well like this?

A. Yes, it is. We feel like it is. Through pressure data we have looked at the approximate drainage radius, and we feel like it's in excess of 40 acres. So production seems to validate that too.

Q. If you went to 40-acre oil spacing, then you create the opportunity where you're going to drill an unnecessary well, which will compete for the same reserves as the first well?

A. That's correct, and I think it will do ultimately the amount same amount of -- the same thing. It will be producing the same amount of gas, basically, from two oil wells as one well.

Q. So we're better off with one oil well on 80-acre spacing?

A. Right.

Q. How about the gas wells? What's the basis for the 160 gas spacing?

A. Well, we're currently drilled on 160-acre spacing. We don't see any effect on the others based on bottomhole pressure data at this time.

And other than that, we really have not got a true fit for it, other than the fact that, like I said, we feel like they'll produce at 160 acres, the ultimate recovery that we can for --

Q. And you're stuck with that spacing now because of the --

A. Yes.

Q. -- configuration of the wells?

A. The current -- Yes, the current drilling pattern on this.

MR. KELLAHIN: That concludes my examination of Mr. Feagan.

We move the introduction of the Applicant's Exhibits 1, 2 and 3.

EXAMINER CATANACH: Exhibits 1, 2 and 3 will be admitted as evidence.

EXAMINATION

BY EXAMINER CATANACH:

Q. Mr. Feagan, the situation as you see it is, you've got an interval that is a retrograde gas condensate zone?

A. Uh-huh.

Q. Is the oil well not completed in that zone, or not -- Is that zone not present in that --

A. No, it is, they're completed in the same interval.

Q. The same interval. And it's just -- Why does it show different characteristics in the oil well?

A. I can't answer that question, other than the fact of structurally where it sits.

Q. So at reservoir conditions you've essentially got condensate. As the pressure dissipates, it flashes to gas; is that a correct statement, as you produce it?

A. Well, at reservoir -- Excuse me, say that again. At reservoir conditions you've got condensate, and as you produce, it flashes to gas?

Q. At reservoir conditions it's basically condensate in the reservoir?

A. There is very little liquid in the -- As the PVT analysis will show, the recovery was only .66 percent of one percent liquid recovery out of the study that was done at reservoir conditions.

Q. Okay. And you've seen no evidence of a gas/water, gas/oil contact?

A. No, I sure haven't.

Q. Is this -- This isn't typical of a Bone Spring reservoir in this --

A. No, we've found no analogy to this particular field. We can't find another example of a similar circumstance in the Bone Spring.

Q. On page 30, on those tests that you ran on the well, where you adjusted the choke size --

A. Uh-huh.

Q. -- how long were those left --

A. They were left anywhere in the neighborhood of six to eight days --

Q. On each setting?

A. -- at a minimum. At a minimum, uh-huh.

Q. And this is just the average production during that period?

A. That's right. Yeah, I just took the average of -- And those were done, as it says on the bottom, in May and June of this year.

Q. Are your gas wells capable of 2.2 million a day?

A. Yes, they are.

Q. All of them?

A. All of them. As a matter of fact, if you'll see on the highest choke setting, all of them produced in excess.

Q. Do you have an opinion as to whether 2.2 million a day per well will have any detrimental effect on the reservoir, leave liquids or gas behind?

A. No, we feel like -- Actually, when you look at the production data, like I said, as the GOR increases, we actually feel like we seem to be pulling more liquids with the higher producing rates. So we don't feel like that will be the case.

We will be doing some further bottomhole pressure testing of this reservoir, so...

But currently our allowable is at 2.8 million a day, so we're actually asking to curtail that rate.

Q. Okay, on the 80-acre oil spacing, that's based on what again?

MR. KELLAHIN: Say it again, I'm sorry. You said 80-acre oil? Was that --

EXAMINER CATANACH: Right.

THE WITNESS: Yeah, that was based on bottomhole pressure information we did, bottomhole pressure data we had run, and volumetric calculations and backing in a drainage radius.

Q. (By Examiner Catanach) You don't have those volumetric calculations?

A. No, I don't, not present.

Q. Can you submit those?

A. Yes, sure can.

Q. And on the 160-acre gas spacing, did you say you've seen no interference between wells?

A. That's correct, no interference, based on bottomhole pressure or production testing.

Q. Okay, would it be in the best interests to look at these rules in about another year?

A. Obviously as the operator, we will be looking at them constantly, but it would not be objectionable to us.

Q. Do you think a year would give you enough time to finally establish what you've got in this reservoir?

A. I do, unless there's some drilling done to the south of us that, you know, that extends the reservoir.

EXAMINER CATANACH: Uh-huh, okay. That's all I have of the witness at this time.

MR. KELLAHIN: That concludes our presentation.

EXAMINER CATANACH: Mr. Kellahin, can I ask you for a rough draft order in this case?

MR. KELLAHIN: Yes, sir.

EXAMINER CATANACH: There being nothing further --

MR. CARR: Mr. Catanach?

EXAMINER CATANACH: I'm sorry, Mr. Carr?

MR. CARR: I filed a written entry of appearance on behalf of Maralo, Inc., in this matter, and I'd just like to go on record for Maralo, stating they support the Application of Chi in this case.

EXAMINER CATANACH: Okay, there being nothing further, Case 10,556 will be taken under advisement.

(Thereupon, these proceedings were concluded at 11:55 a.m.)

* * *

CERTIFICATE OF REPORTER

STATE OF NEW MEXICO)
) ss.
COUNTY OF SANTA FE)

I, Steven T. Brenner, Certified Court Reporter and Notary Public, HEREBY CERTIFY that the foregoing transcript of proceedings before the Oil Conservation Division was reported by me; that I transcribed my notes; and that the foregoing is a true and accurate record of the proceedings.

I FURTHER CERTIFY that I am not a relative or employee of any of the parties or attorneys involved in this matter and that I have no personal interest in the final disposition of this matter.

WITNESS MY HAND AND SEAL July 20th, 1993.

STEVEN T. BRENNER
CCR No. 7

My commission expires: October 14, 1994

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 10556 heard by me on July 15 1993.

, Examiner
Oil Conservation Division

STATE OF NEW MEXICO

ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT

OIL CONSERVATION DIVISION

IN THE MATTER OF THE HEARING CALLED BY THE OIL CONSERVATION DIVISION FOR THE PURPOSE OF CONSIDERING:	)	CASE NO. 10,556
CASE NUMBER 10,556 (REOPENED)	)	

ORIGINAL

REPORTER'S TRANSCRIPT OF PROCEEDINGS

EXAMINER HEARING

BEFORE: DAVID R. CATANACH, Hearing Examiner

RECEIVED

MAR 10 1995

Oil Conservation Division

March 2nd, 1995

Santa Fe, New Mexico

This matter came on for hearing before the Oil Conservation Division on Thursday, March 2nd, 1995, at the New Mexico Energy, Minerals and Natural Resources Department, Porter Hall, 2040 South Pacheco, Santa Fe, New Mexico, before Steven T. Brenner, Certified Court Reporter No. 7 for the State of New Mexico.

* * *

I N D E X

March 2nd, 1995
Examiner Hearing
CASE NO. 10,556 (Reopened)

* * *

E X H I B I T S

OXY USA, Inc.	Identified	Admitted
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* * *

A P P E A R A N C E S

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* * *

WHEREUPON, the following proceedings were had at 1:11 p.m.:

EXAMINER CATANACH: We will now call Case 10,556.

MR. RAND CARROLL: In the matter of Case Number 10,556 being reopened pursuant to the provisions of Division Order Number R-5353-M, which order reclassified the Old Millman Ranch-Bone Spring Pool in Townships 19 and 20 South, Range 28 East, Eddy County, New Mexico.

EXAMINER CATANACH: Are there appearances in this case?

MR. CARR: May it please the Examiner, my name is William F. Carr with the Santa Fe law firm Campbell, Carr, Berge and Sheridan.

We represent OXY USA in this case, and I have two witnesses.

EXAMINER CATANACH: Additional appearances?

MR. KELLAHIN: Mr. Examiner, I'm Tom Kellahin of the Santa Fe law firm of Kellahin and Kellahin, appearing on behalf of Chi Energy, Inc., and I also have two witnesses to be sworn.

EXAMINER CATANACH: Any additional appearances?

Okay, will the four witnesses please stand to be sworn in at this time?

(Thereupon, the witnesses were sworn.)

EXAMINER CATANACH: Who would like to go first?

MR. CARR: Mr. Catanach, I'll go first and call the OXY witnesses.

I think we need to note at the outset that Chi will be requesting a change in the spacing in the pool and that we'll be requesting the 80-acre gas well spacing and 40-acre oil well spacing that is different from the temporary pool rules that are now applicable to this reservoir, and if there is a further advertisement or something of that nature that is required, nonetheless, we will go forward and present testimony supporting the pool rules as we believe they should be today.

I would note that as to the presentation of OXY, we will focus on the 40-acre oil well spacing aspect of the case and the 5000-to-1 GOR. I don't believe there is a dispute between the parties, however, as to what's being sought.

EXAMINER CATANACH: Okay.

MR. KELLAHIN: Mr. Examiner, Chi Energy was the original Applicant and obtained the designation of this pool under special rules.

We returned back to the Division which in August 31st of 1993 issued Division Order Number 5353-M, and it was that order, based upon Chi's request, which reclassified the Old Millman Ranch Pool as an associated pool.

It was our belief at that time that the pool could go forward for the next temporary period on 80-acre oil spacing and 160-acre gas spacing.

You may remember that the gas-oil ratio has been the subject of prior discussions. At one point, the gas-oil ratio in the pool was 20,000 to 1. At Chi's request, it was reduced to 5000 to 1, as a result of the August, 1993, Order

Subsequent to the 1993 Order, additional wells have been drilled, further information has been gathered, and we are now before you to ask for further modifications of the rules.

Chi has contacted and worked extensively with OXY and their technical people. We believe we are in agreement in our recommendations. The only other well in the pool not operated either by Chi or OXY is a well to the southwest, operated by Mewbourne. We have a letter from Mewbourne showing that they have no objection to the rule change.

What we're asking you to do is to continue the associated pool rules, to reduce the 80-acre oil spacing to 40-acre oil, to reduce the gas spacing from 160 acres to 80 acres, and to maintain the 5000-to-1 gas-oil ratio, and that will be our recommendations, and we will present a geologist and an engineer in support of those recommendations.

EXAMINER CATANACH: Mr. Carr?

MR. CARR: Mr. Catanach, at this time we're prepared to call Mr. Tinny.

THOMAS J. TINNEY,

the witness herein, after having been first duly sworn upon his oath, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. CARR:

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

A. Tom Tinney.

Q. Mr. Tinney, where do you reside?

A. Midland, Texas.

Q. By whom are you employed?

A. Cities Service/OXY USA, Inc.

Q. What is your current position with OXY?

A. I'm a senior geologist.

Q. Have you previously testified before this Division?

A. No, sir.

Q. Could you summarize for Mr. Catanach your educational background?

A. I graduated in 1981 from the University of Texas with a bachelor of science in geology.

Q. Since graduation from the University of Texas, for whom have you worked?

A. Cities Service/OXY USA, Inc.

Q. So always really the same company?

A. That's correct.

Q. Have you always been employed as a geologist for Cities and then OXY?

A. Yes, sir.

Q. Does the geographic area of your responsibility include the portion of southeastern New Mexico involved in this case?

A. Yes, it does.

Q. Have you made a geologic study of the Old Millman Ranch-Bone Spring Pool area?

A. Yes, sir.

MR. CARR: We would tender Mr. Tinney as an expert witness in petroleum geology.

EXAMINER CATANACH: Mr. Tinney is so qualified.

Q. (By Mr. Carr) Would you briefly state what OXY seeks in this case?

A. OXY is here in support of Chi asking for 80-acre gas proration units, 40-acre oil units, and to maintain the current 5000-to-1 GOR.

Q. Are you asking that the temporary rules with the changes you are recommending be adopted on a permanent basis?

A. Yes, sir.

Q. What is the current depth bracket allowable for 40-acre oil wells in this area?

A. 142 barrels of oil per day.

Q. Now, Mr. Tinney, were you called upon to prepare the geologic parameters that have been utilized by OXY to model this particular reservoir?

A. Yes, I was.

Q. Let's go to what has been marked for identification as OXY Exhibit Number 1. Could you identify this exhibit for Mr. Catanach and then review the information contained thereon?

A. This is a base map showing -- The green circles show all the current producers within the field. The black dots are the oil producers, the open stars are the gas wells, and then the open circles are proposed locations.

Also shown are the different operators within the field. The heavy black lines show the current proration units for each well, and there is a green line that runs from northwest to southeast which is a cross-section that has been prepared.

Q. Did you note the additional circles that indicate potential locations for further development?

A. Yes, sir.

Q. And all wells currently producing from the Old

Millman Ranch-Bone Springs Pool are shown on this exhibit?

A. Yes, sir.

Q. Okay. Let's move to Exhibit Number 2. Would you identify that, please?

A. This is a structure map on the top of the first Bone Springs sand, using the current well control, and the contour interval is 50 feet.

The map shows the present-day dip to the east and to the southeast. Within the heart of the field there is a widening of contours, if you will. You'll notice to the north contours are at pretty regular intervals, and as you get down to where the majority of the producers are, you already actually have a widening of contours. And there's also a gentle nosing across the field.

Also shown is the same northeast to southeast X-section that runs through the center of the field.

Q. Have you seen any oil-water contact in the reservoir?

A. Not at this time, not yet.

Q. Let's go to Exhibit Number 3. Exhibit Number 3 is on the easel behind you. It might be easier if you stand and go to the exhibit.

And I'd ask you first to identify what this is, Mr. Tinney, and then review the information contained on this exhibit.

A. Okay, this is a northwest-to-southeast cross-section that were on the previous exhibits that runs through the center of the field.

The blue is limestone, Bone Springs limestone carbonates. As you can see, the sand is encased within -- the first Bone Springs sand is encased within these carbonates.

To the east and southeast, the sand thickens. You'll note as you move updip and to the northwest, the sand actually pinches out into the carbonate vein.

The black line on the left is your gamma-ray curve. The heavy green line is the density-porosity curve. The density-porosity curve has been contoured, and that's shown by these colors. The gray is less than 12-percent porosity. This pumpkin color right here is between 12- and 14-percent porosity, the yellow is 14- to 16-percent porosity, and the red is anything greater than 16-percent porosity.

There is a direct correlation between permeability and porosity, a linear relationship, so that your better porosity is also going to be your better permeability reservoir.

Also, you'll note that some of the sands are continuous. I feel there's at least three sands that are continuous across the field that I can correlate from every well.

You'll also notice that there are a number of sands that are discontinuous from wellbore to wellbore.

One thing else I'd like to point out is, within the section I was able to pick out nine layers, and those nine layers were -- geologic data was supplied for each layer, and that was supplied to the reservoir engineer for his simulation work.

As you can see if you look at this well, there's nine. As you go updip some of the layers actually pinch out, so you may not have all nine present in each wellbore. But I was able to pick out nine layers based on gamma-ray correlations and the density-porosity pick in the individual sand packages.

Q. Can you indicate where the gas-oil contact would be in the reservoir?

A. OXY believes that the gas-oil contact is a minus 2945, and that's going to be approximately right here on this Chi-operated Winchester Number 1, which is a gas well.

As you can see, there's a small portion that's within the oil leg, but the majority of the well is actually in the gas leg of the reservoir.

And that will go across in this fashion, straight across, so that the Winchester Number 2, as you can see, has the majority of its reservoir within the gas leg.

There's a small portion, albeit a somewhat larger portion in the oil leg.

As you go to the Remington Number 2, which would be this well, which is actually an oil producer, there is a small amount of the well actually has -- is in the gas leg. The majority is in the oil.

And OXY's two operated wells on the cross-section, the Government S Number 3 and the Government AB Number 9, the gas leg is not present within those wells.

Q. Let's go now to OXY Exhibit Number 4.

A. Okay.

Q. Can you identify this and then explain to Mr. Catanach what it shows?

A. Okay. This is a crossplot of core permeability in millidarcies and core porosity. This is four five wells within the field that we have core data on. That includes four OXY wells and one Chi well.

The first thing to note is that the crossplot shows that within these five wells there's no permeability greater than 10 millidarcies. The majority of the points fall between 1 millidarcy and .1 millidarcies, which shows this to be a very low-permeability reservoirs.

One thing I might also note is that for pay calculations, we use a 12-percent cutoff.

As you can see from the crossplot, anything less than 12-percent porosity falls around 1 -- or below .1, excuse me -- millidarcies. So very, very low permeability.

Q. This exhibit, in fact, shows there is a direct correlation or relationship between the porosity and the permeability in the reservoir?

A. That's correct. As I noted from the cross-section exhibit, there's definitely a linear relationship between porosity and permeability, and that your better porosity, upwards of 18-percent porosity, is going to be your higher permeability.

Q. Is the 12-percent porosity cutoff figure that you've been using, to your understanding, consistent with what other operators in the reservoir are actually using?

A. Yes, it is, and that's somewhat based on my experience from the field.

We participated in a well that had less than one on ϕh, based on a 12-percent cutoff. That was the Strata Garza Federal Well. That well is producing about 6 MCF currently, is uneconomic, the well will never pay out.

As opposed to our worst well, using a 12-percent cutoff, which is the AB Number 6, Government AB Number 6, which is a little over 5 on ϕh, and that well is economic, but it obviously is on the low end of the scale.

Q. All right, Mr. Tinney, let's go to Exhibit Number 5. Could you tell us what this is?

A. This is a core permeability. It's a histogram of the core permeability that I showed from the same five wells.

This histogram shows that out of 311 samples, that the mean or the average permeability is a .239 millidarcies -- this is also a millidarcy scale -- with a standard deviation of 3.345.

Within that deviation you can see the heavy dashed line on this exhibit, is the actual mean, the .239, and then the two smaller dashed lines on each side are the standard deviations, one positive and one negative to each side, that 68 percent of your data falls within those standard deviations, which once again shows that overall, the first Bone Springs sand within this reservoir has a very low permeability.

And once again you can also see that none of the permeability is over 10 millidarcies, and there's very few number of samples that actually are on the high end of the scale.

Q. Could you identify for Mr. Catanach the geological data that you developed in the course of your study of this reservoir that is going to be utilized by the next witness in actually conducting the modeling of the reservoir?

A. From the data that we've had, that we've gathered from logs and from core, I provided a structure top on the first Bone Springs sand to our reservoir engineer, for the first layer on the top. And then for each subsequent layer I provided a gross thickness for each layer, a ϕa or an average porosity for each layer, for each grid cell within the model, and then also a geometric mean permeability for each cell, grid cell within the model that he was using.

Q. Were Exhibits 1 through 5 prepared by you?

A. Yes, sir.

MR. CARR: Mr. Catanach, at this time we move the admission into evidence of OXY Exhibits 1 through 5.

EXAMINER CATANACH: Exhibits 1 through 5 will be admitted as evidence.

MR. CARR: And that concludes my direct examination of Mr. Tinney.

EXAMINER CATANACH: Mr. Kellahin?

MR. KELLAHIN: Thank you, Mr. Examiner.

CROSS-EXAMINATION

BY MR. KELLAHIN:

Q. Mr. Tinney, would you help give me a word picture of the reservoir?

When we look first of all at the structure, why did you choose to draw your structure map on top of the first Bone Springs sand?

A. I felt like that, since that was the producing horizon, that that was the best place to start, would be at the top of the first Bone Springs sand. And then it was reflective of -- as far as showing the dip of that sand.

Q. When you use that as the marker point for building your structure map, is it a point on the log that's readily identifiable to you as a geologist?

A. Yes, sir.

Q. Having built the structure map, describe for us what effect structure has on the distribution of hydrocarbons in the reservoir.

A. As you go updip, you actually have a gas cap, if you will. And as I described within the cross-section below the -- we feel like below 2945 subsea, that there's actually a gas-oil contact, and below that point you have an oil leg.

At this point in time there hasn't been a known oil-water contact established. There may be certain sands within the overall reservoir that could be wet, but it's not really readily determinable from log analysis.

There could be some difference -- changes in relative permeability that also would make an individual sand more -- produce more water than oil.

Q. When you look at the distribution of the sand, what's the gross thickness that you have in the reservoir?

A. Thickness varies from an updip position. The Chi wells are somewhere -- 150, 160 feet thick of gross interval.

As you move downdip, RS Number 3 is approximately 275 feet thick, so it's thickening as you move to -- downdip to the east and southeast, and it continues to stay that thickness to the east.

Q. Within that gross thickness, are we dealing with a common reservoir system?

A. I don't know exactly what --

Q. Geologically, how would you characterize that gross interval in terms of its lithology and other geologic characteristics?

A. I believe that there are continuous sands across the field, that some sands are discontinuous between wells, that the sand was deposited from density flows out over the basin or the slope, the shelf slope.

Q. All right, describe for me the depositional -- how these sands were laid out or deposited.

A. Okay. I believe that the sands were deposited in deep water as density flows, that the sand was deposited -- was carried out on these density flows and then settled out.

And then during periods when the sand didn't have sediment being brought out, you had normal shell deposition. You look at the sands in -- from core, you'll actually see fine lamina from these alternating sand-to-shell deposition.

You also had changes within -- periodic changes in bottom oxygen water content, because you'll have this alternating lamina, facies, and then you will periodically have bioturbation that went on from deep-water worms that bioturbated this sediment. So there had to be some change in bottom water oxygen content, in my opinion.

Q. Would you take all those individual characteristics and make a general qualification of that reservoir as to whether it's homogeneous or heterogeneous?

A. I guess it depends on what scale you mean.

If you look at permeability, you have to say that it's heterogeneous, just in the fact that ten percent of your permeability comes from, say, 50 percent of your rock. It's a very small portion of your rock, is given the majority of your permeability.

Q. When you take the reservoir and subdivided it into layers, how many individual layers are productive of hydrocarbons?

A. I think they're all productive. Within -- If you use that 12-percent cutoff, each layer has pay within each layer, depending on which wellbore.

As you can see --

Q. How many layers do you have?

A. I have nine layers, sir.

Q. Nine layers?

A. Yes, sir.

Q. And at any particular point in the reservoir, one or more of those layers will be productive?

A. That's correct.

Q. So you found at least nine layers in a cumulative total sense that have been productive in various combinations of wells?

A. Yes, sir.

Q. When you map them laterally in terms of a cross-section, is any individual layer continuous throughout the entire reservoir?

A. Yes, sir, I believe -- There's one sand within this layer that's continuous across the reservoir.

Q. Before you say "this" and "that", for the record tell me where "this" is.

A. In layer 3, and then in layer 4 and in layer 6.

Q. In terms of developing an isopach, I believe you have either given your simulator, engineering simulator, a ϕh map or some net-pay porosity map about which he then can do his work. Do I understand that correctly?

A. Yes, sir.

Q. And that you constructed a -- was it a ϕh map?

A. I constructed a ϕh and a net-feet-of-pay map, both.

Q. Okay. For each individual interval within the pool?

A. That's correct, and then each grid block has a value associated with that.

Q. Okay. So geologically, you've subdivided the reservoir into at least nine of these layers, each of which has a corresponding isopach?

A. Correct.

Q. Okay. Is there any segregation of hydrocarbon-type among these layers, between oil and gas?

A. There's just a gas-oil contact which goes across, you know, all layers, actually, as you go updip.

Q. So as you look for the gas --

A. In other words, your gas-oil contact is here, and it will run crossways within each layer as they go updip.

Q. All right. You will find in your analysis that the gas-oil contact is consistent in a structural position in all layers?

A. (Nods)

Q. All right.

A. Yes, sir.

Q. What accounts for that?

A. I would venture to say, just the separation, the physical separation of gas and oil.

Q. All right.

A. You have an updip pinchout of the sand, you have migration up to a certain point, to a fill point, and then you have oil -- a gas-oil contact that's actually --

Q. Well, let me ask you this way: In a vertical sense, geologically, do you see any impermeable barriers to vertical flow within the reservoir?

A. Yes, sir.

Q. Okay. And as a result of changes in permeability, then, it will affect how the fluids move in the reservoir?

A. Yes.

Q. What kind of permeability ranges do we have?

A. On the high end you have nothing less than -- from the core data we have to date out of the five wells, you have nothing greater than 10 millidarcies, and the average is .239.

Q. Pretty tight reservoir, isn't it?

A. That's what I've testified to, yes, sir.

Q. And all geologic indications based upon core analysis and other available information would characterize this as a tight reservoir?

A. Yes, sir.

Q. What geologically supports your conclusion about taking the oil spacing to 40 acres? What sense do you have as a geologist that that feels valid and reasonable?

A. I would say I don't have any. I'm depending on the reservoir engineer to tell me basically what he feels like we're draining.

Q. So as far as you're concerned, geologically it's a reservoir-engineering issue?

A. I provided geologic data so that simulations could be run, and obviously the simulations are keyed to the geologic model.

Q. Well, let me put a geologic question to you.

When you look at 40-acre oil spacing within this geologic picture, are you more likely to encounter more of the nine layers on 40-acre oil spacing versus wider oil spacing?

A. No, sir. The number of layers that you encounter will be dependent on the structural position that your well falls within the overall structural dip of the reservoir, and whether you get nine or whether you have seven layers, that's how that's going to fall out.

Q. I'm not sure I understood the answer.

A. Okay, structurally in this position, if you're in this position structurally, you're going to get nine layers.

Q. All right, sir.

A. All right, if you come up here, you may only have eight. This ninth layer is actually pinched out from the base.

Q. Right.

A. Okay, so it really depends on where you drill structurally to how many layers you're going to get.

Q. Well, and that's my point. My question for you is, either structurally and/or based upon distribution of the sand, you have a greater probability of maximizing the number of layers you intersect if you're doing that on 40-acre oil spacing?

A. I don't really agree with that, but --

Q. All right, well, don't agree with it. I'm asking a question.

On each and every of the 40-acre locations in the pool, do we have all nine layers?

A. No.

MR. KELLAHIN: Okay, no further questions.

EXAMINER CATANACH: Mr. Carr?

MR. CARR: Just a couple.

REDIRECT EXAMINATION

BY MR. CARR:

Q. Mr. Tinney, I think you were testifying about vertical permeability. Do you really see any in this reservoir?

A. We see barriers to vertical permeability, so...

Within certain sand packages -- In other words, you know, within this sand there's some vertical permeability, but there's vertical permeability barriers between layers.

Q. And that's why you have developed these nine different layers in the reservoir and have utilized those in the modeling effort; isn't that correct?

A. That's correct.

Q. Now, if you drill at one point on the structure as opposed to another, you may encounter different productive layers, depending on where you place the well; was that not your testimony?

A. Yes, sir.

Q. So isn't it fair to say that you can maximize the drainage achieved by placing oil wells on a 40-acre spacing over what you can achieve on an 80-acre spacing?

A. Yes.

MR. CARR: That's all I have.

EXAMINER CATANACH: Just a couple.

EXAMINATION

BY EXAMINER CATANACH:

Q. Mr. Tinney, you testified that you believe that all of these zones are contributing production to these -- in this field?

A. Yes, sir.

Q. What do you base that on?

A. I'm basing that on log calculations, using the primaries that we set up for pay.

I'm also basing it on sample. I'm actually drilling the well, fluorescence, the chromatograph, the gas analysis, having good, live fluorescence all the way through this section as we drilled it. Even in the -- Say in this well, we had good, live oil fluorescence. Even at the base of this section there was no indication to say the base was wet, like dull fluorescence or whatever there might be, that it might be wet.

Q. Is it generally a practice to perforate all these various zones in these wells?

A. Yes, sir, and on your exhibit the perforations on this cross-section are actually marked, and we do perforations of the entire section.

Q. And this is the first Bone Springs sand interval; is that right?

A. Yes, sir.

Q. Is there other gross sand intervals in the Bone Spring in this area?

A. There is some sand in the second Bone Springs, yes, sir, that's had shows in it. But it to date hasn't been productive.

Q. Okay, this is the only producing interval so far?

A. Yes, sir.

EXAMINER CATANACH: Okay, I don't have anything further of the witness. He may be excused.

MR. CARR: At this time, Mr. Catanach, we call Raj Prasad.

RAJ PRASAD,

the witness herein, after having been first duly sworn upon his oath, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. CARR:

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

A. Raj Prasad.

Q. Where do you reside?

A. Midland, Texas.

Q. Mr. Prasad, by whom are you employed?

A. I'm an independent consultant employed by OXY for the simulation work.

Q. What specifically were you attempting to establish with this simulation work?

A. Specifically, I was trying to find out if the 40-acre oil spacing is worthwhile doing and a 5000-to-1 gas-oil ratio is a better way of exploiting this reservoir.

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

A. No, sir.

Q. Could you briefly summarize for Mr. Catanach your educational background?

A. I have a master's degree in petroleum engineering from University of Tulsa.

Q. And when did you receive the degree?

A. 1970.

Q. And since graduation, for whom have you worked?

A. I worked for H.G. Grue and Associates for ten years as a reservoir engineering consultant, and since 1980 I've been independent consultant most of the time.

Q. While with Mr. Grue and since, have you had an opportunity on occasion to testify before other regulatory bodies?

A. Yes, sir.

Q. And before what agencies have you testified?

A. Railroad Commission of Texas and Mineral Management Services in Louisiana.

Q. Are you familiar with the Old Millman Ranch Bone-Spring Pool and the wells drilled and completed therein?

A. Yes, sir.

MR. CARR: We tender Mr. Prasad as an expert witness in reservoir engineering.

EXAMINER CATANACH: Mr. Prasad is so qualified.

Q. (By Mr. Carr) Have you prepared exhibits for presentation here today?

A. Yes, sir.

Q. Let's go to what has been marked OXY Exhibit Number 6. Would you first identify this and then review the information on these plots for Mr. Catanach?

A. Yes, sir. OXY Exhibit Number 6 is a set of plots, performance plots, for the wells drilled by and operated by OXY.

There are eight wells that OXY has drilled so far, and each plot shows the oil rate, water rate, and gas-oil ratio from each well.

And you will notice that the gas-oil ratio mostly lies between 1000 to 3000 cubic feet per barrel for most of the wells. There is one well that showed gas-oil ratio higher than 10,000, about 10,000, but most of the gas-oil ratios are below 3000, so on that basis they're all classified as an oil well.

Q. And so when we look at the statewide rules for associated pools, all of these wells will be classified oil?

A. Yes, sir.

Q. All right. Let's go to OXY Exhibit Number 7. Would you identify that?

A. Yes, OXY Exhibit Number 7 is a grid map that we utilized for modeling the reservoir, Bone Spring Ranch reservoir.

This is a 50-by-50 grid, and we used the nine layers that were defined by the geological model.

Q. All right. Attached to this is a list. Could you identify and review that?

A. Yes, this list shows all the data that were collected and used in this simulation study. As Mr. Tinney pointed out, the logs and cores were used for defining the geological layers and obtaining the properties for each layer, which were important to the model, for each model grid.

Then we also have collected the PVT sample from OXY Government S 4 well, which has been included in the simulation study.

Then we collected pressure buildup test from OXY Government S 3 well, which has been included -- or at least the results of those have been incorporated in the model study.

And we collected some capillary pressure and gas-oil relative permeability data from OXY Government AB 8 well. This information has been incorporated in the model. And again, we modeled the performance of all the wells in this pool through November of 1994.

Q. Mr. Prasad, what type of model did you use?

A. We used a commercial model, Eclipse 100, that has been developed by Intera ECL Company from Denver.

Q. And this is a black-oil model?

A. This is a black-oil model, suitable for modeling associated gas, solution gas and oil and water flow performance.

Q. And this model has been generally accepted by the industry?

A. Yes, it has, very well accepted model.

Q. What experience have you personally had using this model?

A. I have used this model for several other studies that I have done for OXY and Conoco.

Q. Now, Mr. Prasad, to match historical performance data from the reservoir with the model's calculated performance, what adjustments, if any, were made to the data?

A. We basically used all the data that we collected geologically, as well as through PVT and capillary pressure and relative permeability.

We made only one change to match the performance: When we initialized the model with the permeability that we calculated from the core, the model was not able to produce these wells at the rates that have historically produced, so we made adjustments on the permeability in order to be able to produce at the rates that the historical performance indicates, and essentially we multiplied the core permeability data by a factor of 2.5 to be able to produce these wells at the rates that they have produced.

Then we also investigated that S-3 buildup data shows that if you calculate a flow capacity, which is K times H, from the buildup data, that data showed it was about 2 1/2 times more -- or 2 1/2 times the permeability thickness plotted that we obtained from the core data.

So we thought that we had a good justification for multiplying a factor of 2.5 to the core permeability data, and that is the only adjustment we made in this model.

Q. All other data was utilized just as this information was obtained?

A. That's correct.

Q. Did you make any particular assumptions about any of the wells that were being utilized?

A. For the performance calculations, we used the state rule and the field rule limitations to calculate the performance of the well in the future cases.

Q. Did you assume any additional wells would be drilled or --

A. Yes.

Q. And that's shown later in the results?

A. That will be shown later.

Q. All right. Let's go now to Exhibit Number 8, the historical matches, and I'd ask you to review those for the

Examiner.

A. Yes, there are a set of plots here, I think about six of them, that are included to show the historical performance match that we calculated from the model to match the performance of the wells.

Figure 3 and 4 are the two wells that we selected from the OXY-operated oil wells, and here we input the oil producing rate that we have historically observed, and we calculate the gas production and the pressure from the model.

Q. Now, in terms of the color-coding used on the exhibit, the red indicates what?

A. The red line indicates the historical production, oil and gas, and the black line indicates the model-calculated production.

Q. All right. Let's review first what is marked Figure 3, the first of these.

A. Figure 3 is the performance match for the Government AB-6 well, which is operated by OXY. And you notice that the oil rate has got only a red curve, no black. What it says, that the model input the oil rate. So the model rate and the actual historical performance rate is the same.

On the gas rate, the model-calculated values are shown in black, and the actual values are shown in red.

And you'll notice that it's a reasonable match on the gas production rate.

On the pressure match, the model-calculated values are shown in the black line and the measured values shown on the cross, and we can see that the match is very good on the pressure.

Q. All right. Let's go to Figure Number 4, the second page of this exhibit.

A. Figure Number 4 is also the similar matches for OXY-operated S-3 well. Here again, you will see only red plots for the oil rate, which indicates that in the model the oil rate was input, and naturally they will be the same curve.

We calculated the gas rate, and I would say that the match is very good on the gas production rate.

And we calculated -- or the model was calculating the pressure data, which is shown in the black line, which matches the crosses, which are the measured data, very well.

Q. Okay, now Figure Number 5?

A. Figure Number 5 is performance match for the Chi-operated Winchester Number 1 well. Here, Winchester Number 1 well is a gas producing rate, so in the model we input the gas production rate and we calculated the oil production rate and the pressures from the model, and those matches are shown here.

You will notice that the gas production rate, there's only a red curve, which is the measured data. And since it was input to the model, there is no black data; they're all the same.

The oil production rate, the red curve is the measured data and the black is the model-calculated values, and I would say that the match is excellent on the oil production rate.

If you look at the pressure match, the model pressures are higher than the one single value that I had to match. Again, these pressures, the measured values, are much before any production began from this well, and it shows me that the well had not been shut in sufficient time to build up to the original reservoir pressures.

Q. Okay. If we go to Figure Number 6, what does this show?

A. Figure Number 6 is again a match of the Winchester Number 2 well, operated by Chi Producing, and this is also a gas-producing well, and gas rates were input to the model, so you see only one curve for the gas production rate.

The oil production rate match is excellent. We have the black curve, shows the model-calculated values, and the red curve is the measured values, and the match is very good on that.

Again, the pressure match, you will see that the measured values are much lower than the model-calculated values. And this match also -- This pressure data was collected much before the model production began, and again it shows that the shut-in time was probably not large enough for this pressure to build up to the original value.

Q. All right. Now, we've looked at history matches on two oil wells, two gas wells.

Let's take a look at the entire field, and I direct your attention to the next page, which is marked "Figure 1".

A. Okay, this is the oil production rate for the entire field as calculated by the model and as measured by -- historically, added for all the oil and the gas wells.

The match -- The model-calculated values are shown in the black, and the measured values are shown in the red. And again, for the gas wells we were calculating oil rate, so there is some difference between the model and the measured values, but the matches are very good.

Q. Okay. And the last page of this exhibit?

A. The last page of this exhibit shows the gas production performance match for the gas production for the entire field, which means that we included the gas production from the gas wells, as well as the gas production from the oil wells.

And again, the model was calculating the gas production from the oil wells. For that reason, they are close to the measured values, but not exactly the same as the measured values, and I would say that this match shows a very good match of the gas production.

Q. Mr. Prasad, based on your experience modeling reservoirs and the kinds of matches you've been able to achieve as set forth in Exhibit Number 8, what degree of confidence do you have in this model?

A. I have a very high degree of confidence.

Q. Now that you've matched the historical performance, what is the next thing that you did with the model?

A. Once we got a good history match from this model, then we used this model to calculate the performance, future performance, under various operating conditions and under various development --

Q. Let's go to OXY Exhibit Number 9, and I would ask you to identify this and review the information on the top portion of the exhibit.

A. Okay, the top portion -- That top table on this exhibit shows various field rules that were utilized to calculate the performance of the wells, either drilled or

-- drilled within an earlier period to control their production phenomena.

And we have three different field -- I mean rules -- that we have tried to calculate the performance.

Under the current field rules it shows we should have an 80-acre oil unit and then a 160-acre gas unit with an oil allowable of 222 barrels a day and a GOR limit of 5000 to 1 cubic feet per barrel, which calculates a gas limit of 1.11 million cubic feet per day and a gas limit for gas wells of 2.22 million cubic feet per day.

And then the next column shows Chi's proposed ruling in which the oil unit will be 40-acre, gas unit will be 80-acre, oil allowable will be 142 stock tank barrels per day, GOR limit that they are proposing is 5200, and gas limit based on the GOR limit will be 710,000 cubic feet a day, and gas limit for gas wells will be 1.42 million cubic feet per day.

And then the last column shows the statewide rules under which the oil unit will be a 40-acre oil unit, gas unit will be 160 acres, oil allowable will be 142 barrels a day, GOR limit will be 2000 to 1 cubic feet per barrel, and the gas limit for oil wells will be 284 MCF a day, and the gas limit for gas wells will be 1136 MCF a day.

Q. Now, before we review the bottom portion of this exhibit, let's go to OXY Exhibit Number 10. Would you review that exhibit for the Examiner?

A. This exhibit shows the future possible well locations under the current field rules or under the Chi's proposed rules, and the red circle that I have -- we have got there on this plot shows the future oil wells that can be drilled under the current field rules.

Now, there may be more oil well locations that can be drilled. We have selected that makes economic sense to show on this plot.

The black circles show the new oil wells that could possibly be drilled under the Chi's proposed ruling, and the green circles -- two green circles are the two possible gas locations that can be drilled under the Chi's proposed ruling.

Q. All right, let's go back to Exhibit Number 9, and let's go to the bottom portion of this exhibit, and I would like you now to review for Mr. Catanach the results of your modeling.

A. All right. Under the operating rules that we stated earlier, we made three production performance runs.

Number 1 run, or case 1, is the current operation in which we did not drill any wells. We used wells drilled to date and produced them under the current field rules to calculate the recovery through the year 2014, which is a

20-year prediction, and we calculated the gas and the oil production recovery through the year 2014.

Then the second case that we ran is, under the current field rules, we included five additional drilling locations that we showed on Exhibit 10, and we calculated the performance of the field and calculated the oil recovery and the gas recovery under those conditions.

And the third run that we made is based on the Chi's proposed ruling in which we drilled the seven possible oil locations and the two gas wells, and we calculated the production performance for this particular case, to the year 2014.

Q. Based on your modeling, what conclusions can you reach about the appropriate rules for the reservoir?

A. The conclusion that we reach is that by adopting Chi's proposed rule, oil recovery will not be adversely impacted, but it will result in 3.2 billion cubic feet increase in gas recovery by the year 2014.

Q. Now, Mr. Prasad, have you also attempted to determine the impact on ultimate recovery from the reservoir of reverting from a 5000-to-1 GOR to a 2000-to-1 GOR?

A. Yes, sir.

Q. And what have you been able to conclude?

A. By changing the GOR from 5000 to 1, to 2000 to 1, what we found is, by the year 2014, which is a 20-year prediction period, there will be 69,000 net barrels-of-oil equivalent lost in the hydrocarbon, by going from 5000 to 2000 GOR limit.

Q. In your opinion, will maintaining the 5000-to-1 GOR limit and the -- obtaining the additional recovery of 69,000 barrels of oil be in the best interests of conservation and the prevention of waste?

A. Yes, sir.

Q. What conclusions can you generally reach from your modeling of the reservoir?

A. The conclusions that I reached from the modeling of this reservoir is that 40-acre oil units is what we should be doing for the oil, and we do not have any problem with Chi's proposal of 80-acre gas well units, and we should have a 5000-to-1 gas-oil ratio limit.

Q. Have you evaluated the Chi proposal in the context of the impact it could have on the correlative rights of the operators in this pool?

A. Yes, sir.

Q. And do you see any adverse impact to the correlative rights of any operator in the pool from the adoption on a permanent basis of the proposal made here today by Chi?

A. No, sir.

Q. In your opinion, will the approval of the Chi Application in all other respects be in the best interests of conservation, the prevention of waste and the protection of correlative rights?

A. Yes.

Q. Were Exhibits 6 through 10 prepared by you or compiled under your supervision?

A. Yes, sir.

MR. CARR: At this time, Mr. Catanach, we move the admission of OXY Exhibits 6 through 10.

EXAMINER CATANACH: Exhibits 6 through 10 will be admitted as evidence.

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

EXAMINER CATANACH: Mr. Kellahin?

MR. KELLAHIN: Thank you, Mr. Examiner.

CROSS-EXAMINATION

BY MR. KELLAHIN:

Q. Sir, would you help me with your last name? Would you spell it, please?

A. Yes, P like Paul, r like Robert, a, s like Sam, a, d like David.

Q. You've done that before, haven't you?

A. Several times. A lot of people call me Brusard.

Q. Prasad?

A. Yes.

Q. Mr. Prasad, let me go to your last testimony about the difference in the gas-oil ratios. You used the term barrel-of-oil equivalent?

A. Right.

Q. Are you meaning, sir, that in your analysis what you've taken is barrels of oil, taken the gas production, converted that into barrels of oil, added them together and gotten a number?

A. Yes, sir.

Q. And under that analysis, using your simulation, you have satisfied yourself that if the gas-oil ratio reverts to 2000 to 1, it's going to be a loss of at least 67,000 stock tank barrels of oil equivalent? Did I say that correctly?

A. 69,000 stock tank barrels of oil equivalent.

Q. All right. When we look at the exhibit -- I think it's 9 or 10, is this -- the little spreadsheet, is this --

MR. CARR: Nine.

Q. (By Mr. Kellahin) Nine? Exhibit 9. Make sure I've understood how you have analyzed the simulation results.

If you look at the last column and find the wells that you have displayed on Exhibit 10, if a total of nine additional wells are drilled --

A. Yes, sir.

Q. -- then under barrels of oil recovered we get more oil, even with the additional wells being drilled?

A. Yes, sir.

Q. And we get another half BCF of gas if all those additional wells are drilled?

A. Over which case are you talking about?

Q. I'm looking at the Chi proposal, the very bottom case.

A. Right.

Q. We're getting 4.3 BCF --

A. 4.8.

Q. I'm sorry, I've got my decimal in the wrong point. It's 43 BCF?

A. Yes.

Q. All right, and --

A. 42.8 BCF, which is 43.

Q. All right. So we're getting more gas and more oil by going to 40-acre oil, 80-acre gas and keeping the 5000-to-1 GOR?

A. Yes, sir.

Q. And in each analysis, that conclusion remains the same? The first analysis is no more wells are drilled?

A. Yes, sir.

Q. And that gives us a baseline of --
A. Right.
Q. -- recoveries?
A. Right.
Q. If we add some more wells, we can add some production to both oil and gas?
A. Right.
Q. If we change the field rules and drill the additional wells, we're still going to get more oil and more gas?
A. Right.
Q. All right. My question is, can we recover the additional gas without compromising the oil recovery?
A. Yes.
Q. That's what this shows, isn't it?
A. Yes, that's exactly what it shows.
Q. So the additional gas recovered is not at the detriment or expense of any remaining oil?
A. That's what we have concluded, yes.
Q. Okay, no doubt about that?
A. No.
Q. Okay. Let me understand some things about the simulation. The data sheet that you've attached onto the grid map --
A. Uh-huh.

Q. -- shows the source of the input data but does not give me the input values?

A. That's correct.

Q. All right. One of your input values is an initial reservoir pressure, is it not?

A. Yes, sir.

Q. And do you have a sheet or something that will tell you what your initial reservoir pressure was in the model?

A. I don't have it here with me, but we can provide you later.

Q. All right. How did you get initial reservoir pressure?

A. From pressure data that was collected -- I don't remember which well, but we had some pressure data obtained from some early wells, and we got the initial pressure data from those wells.

Q. And you examined the initial pressure data?

A. Yes, I examined the initial pressure data.

Q. Were you satisfied as an engineer that you had achieved the maximum initial pressure based upon that pressure test?

A. We extrapolated them to infinite shut-in time to make sure that they are completely built in. That's how we calculated it.

Q. All right. So there's no weakness in that parameter?

A. No.

Q. What did you use for reservoir height? You have a ϕh component in the model, do you?

A. The reservoir heights were provided from the geological study, and for each grid block we have a gross thickness and the net thickness that we inputted into each and every grid block of the model.

Q. When you say "grid block", is that the same as a cell?

A. The cell, yes.

Q. All right, the cell. And the cell is 50 feet by 50 feet?

A. No, the cells are 50 by 50 by 9. So they total 2500 times 9.

Q. Wait, you're going too fast for me.

A. There are 50 by 50; that means 2500 grids in each layer. And there are nine layers, so there will be almost like 20,000 grid blocks in this model, approximately.

Q. All right. Within each grid, what's the size of a grid?

A. Each grid is -- on an areal basis, there are -- the grid sizes are approximately 250 by 250 feet.

Q. Okay.

A. And vertically they're changing depending on what the gross thicknesses are.

Q. Okay, it's the gross thickness I want to address.

When Mr. Tinney gives you the gross thickness, he's also given you as many as nine layers in his geologic analysis?

A. Right.

Q. All right. How did you convert those layers into the net thickness component for that grid?

A. He also gave me -- For each grid he gave me a gross thickness, and also the net thickness based on his 12-percent porosity cutoff.

Q. Okay. Will the model -- Will the computer recognize that within that grid it is dealing with a homogeneous component where the values are the same?

A. The value is the same -- There is only one value within that grid --

Q. That's right.

A. -- of thickness or permeability. So if you -- I mean, yeah, within that 250-foot grid everything is homogeneous.

Q. That's right. So within the grid we have got the same values?

A. Yes.

Q. And as we move from grid to grid, then, you are changing values to be consistent with his geologic interpretation?

A. But he is providing me those values.

Q. All right, okay. And of all the values that you had available, the one parameter you adjusted to get your history match was permeability?

A. Yes, sir.

Q. When you started, what was the initial permeability you inputted into the model?

A. Those are the values that were provided for each grid by Mr. Tinney from his geological study.

Q. All right, and he started off with a core permeability?

A. Right.

Q. And then I assume by some extrapolation or analysis, he converted that into a log value where he could identify per well with a corresponding permeability was to be?

A. Yes, he -- Yeah, he probably calculated it from a transport -- some kind of correlation between the logs and the core. He probably had a permeability-porosity correlation.

Q. All right. So for each grid, then, as we get a log value per well, you've adjusted the permeability initially into the model?

A. It's been calculated from a permeability-porosity correlation.

Q. All right. And to get the model to match history, then you have adjusted the permeability?

A. Yes, sir.

Q. To what range did you have to adjust the permeability to achieve the match?

A. I multiplied a factor of 2.5 for the entire 2500-times-9 grids.

Q. Okay.

A. All of these values were multiplied by a factor of 2.5.

Q. And you consistently use 2.5 as the adjustment?

A. Right.

Q. Why did you choose 2.5?

A. The basis for that 2.5 was, I started looking at the permeability thickness product -- we call it flow capacity -- from the buildup test of S 3, and that showed me that the S 3 buildup calculates the KH value, which is 2.5 times the core-derived KH values, and that was one reason.

Second reason for multiplying by 2.5 is that when I inputted the permeability data provided by the geologist, we were not able to produce the model at the rates that historically these wells have produced.

Q. Mr. Carr asked you the degree of confidence you had in the reliability of the model to make accurate forecasts, and you said you had a high degree of confidence.

A. Yes, sir.

Q. Can you express that confidence in terms of a percentage?

A. My -- The way I would address this question is that, based on today's information, everything that we have available in terms of information, this is the best results that we can obtain.

Now, if we find some more drilling and it changes the geologic picture or, you know, we obtain some certain other information -- for example, oil-water contact, or -- which will -- or obtain some more pressures which shows differently, then of course the model can change.

But as of right now, I have a very good confidence that we have used all the data appropriately to calculate the performance that we have calculated right now.

Q. I have no quarrel with that. My question is that computer-generated reservoir simulation is certainly not an exact science? It's based upon lots of assumptions?

A. Yes, sir, but we use them quite often --

Q. I understand.

A. -- in our analysis.

Q. And this Examiner sees simulations on a frequent basis, and some of them have an expert such as you that doesn't have a lot of confidence in the result because they don't have enough in values to utilize.

A. Yes.

Q. And so what I'm trying to ask you is, how good is this model in forecasting results?

A. I'm pretty confident that the results that we are getting from this model are reliable.

Q. Okay. Can you express it in terms of a plus or minus in terms of a degree of accuracy?

A. I would say that we have probably 70-percent-plus in degree of accuracy.

Q. One of the other components of modeling work is to establish a geometry for the boundary, if you will?

A. Yes, sir.

Q. When we look at the grid, help me visualize how you established a boundary for your model. Is there a geologic component to the boundary?

A. Yes, sir, and that was provided to me from the geological study.

Q. Were you using a reservoir boundary based upon the zero line of an isopach map?

A. Yes, sir.

Q. So that's how you got a boundary?

A. Yes, sir.

Q. Okay. And that boundary was large enough, then, to include all the current producing wells?

A. Yes, sir.

Q. Okay. How many model runs did you have to make before you got a history match that you were satisfied with?

A. Oh, I would -- I didn't count them, but I would say roughly not more than 15 runs.

MR. KELLAHIN: Okay. Thank you, Mr. Examiner.

MR. CARR: I have no redirect.

EXAMINATION

BY EXAMINER CATANACH:

Q. Mr. Prasad, do you know how many wells there are in this field?

A. OXY-operated wells, there are about eight of them, and then there are two wells on the -- Are you talking about all together?

A. Yes, sir.

Q. Producing? Fifteen wells have been producing, and I think that Parker has drilled one well recently that probably is not included in the model history match, but they have been included in the model prediction runs.

Q. Okay. I'm looking at your Exhibit Number 9, and under the current field rules you've got that you can possibly drill five additional oil wells. And then on this -- On Exhibit 10 you've shown them on the map as red circles; is that correct?

A. Right.

Q. There are some additional oil well locations that can be drilled?

A. Yes, sir.

Q. Why were those excluded?

A. We drilled them in the model, and we found that because of the limited reservoir in that area, they were not making economical recovery, so we excluded them in our analysis. See, as an operator they will drill only the wells that's economical for them.

Q. So according to your model, those wells will not likely be drilled?

A. Not under the current information that we have.

Now, things can change based on, you know, the further drilling and whatever they develop as far as reservoir information is concerned.

Q. So even if we change the pool rules to 40-acre spacing, they'll still not get drilled; is that correct?

A. No -- Yeah, if the model stays the same, if the geological models do not change, then those locations may not get drilled.

Q. Okay. Under the proposed pool rules, you're drilling nine wells all together, seven oil wells, two gas wells. And those will basically be drilled to increase gas recoveries, not oil recoveries?

A. That's what it shows, yes.

Q. But you're also showing that oil recovery won't be harmed in any way?

A. That's correct.

Q. Does your model show -- Will most of that gas be recovered from the gas wells, or how is it distributed?

A. Most of it will be coming from the gas wells. But yeah, the oil well -- associated gas will be produced from the oil wells too.

Q. Do you have any conclusions as to whether this reservoir is rate-sensitive at all, as far as producing too much gas or too much oil off these proration units?

A. We did not make any variations in the rate other than what the field rules or the proposed rules are indicating, but I doubt that there will be any rate-sensitivity to this model, to this reservoir.

Q. Under the current pool rules, the only difference -- you would be able to drill an additional oil well on an oil proration unit; you just wouldn't be able to drill oil wells on a gas proration unit. So the only basic difference is, you're able to drill two new gas wells with the new pool rules?

A. Yes, sir.

Q. Will it be in effect increasing the gas limit and the oil limit on all these proration units -- Well, I guess I've already asked you. You see no detrimental effects in increasing the gas limit on these --

A. No, I don't.

Q. -- proration units?

But you didn't run any simulation on that, did you?

A. I ran the simulation according to the rules that we were proposing, yes, sir.

Q. What rates did -- What gas rates did those show for the new gas wells, the simulation?

A. I believe -- I don't have those runs right now with me, but I believe most gas wells were limited to the proration rates. I mean, they probably had a better capacity to produce but were limited to, say, 1.42 million a day because of the proposed rules.

Q. Okay. Drilling -- By drilling these additional wells, it's not going to -- Is it going to accelerate the recovery?

A. Some. Some will be acceleration, some will be adding reserves.

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

MR. CARR: May I ask a couple?

EXAMINER CATANACH: Sure.

FURTHER EXAMINATION

BY MR. CARR:

Q. Mr. Prasad, to follow up on the last question, you indicated that there would be some acceleration of production, some new recovery.

If we look at the four oil wells that are shown on Exhibit Number 10 in the extreme eastern portion of Section 3, would -- in your opinion, would those new wells be recovering oil that currently can be recovered from the existing well on those spacing units?

A. Yes, sir.

Q. Would they be recovering additional oil that cannot be recovered by the current well on the spacing unit?

A. That is correct.

Q. Do you have any estimate as to how much additional recovery might be obtained on any one of those spacing units as a result of placing a second well thereon?

A. I have the estimate for, say, the five wells that we are proposing under the current field rules. And if you look at the oil recovery that I have calculated to the year 2014, with the five additional wells the oil recovery is

3.4, and without these five wells the oil recovery is 3.1. So roughly we are getting about 300,000 barrels for the five wells, which is like 60,000 barrels per well.

Q. And that is oil that otherwise will not be recovered?

A. That is correct.

Q. Now, if we change the spacing rules as recommended by Chi, I believe in response to a question from Mr. Catanach you indicated that it would make available two additional gas well locations, as shown on Exhibit Number 10, in the eastern portion of Exhibit 4, correct?

A. Yes, sir.

Q. Would it not also, by going to the proposed rules, free up or make available two additional oil well locations in the northwest of Section 3?

A. Yes, sir.

Q. So in Section 3, the northwest quarter could then be developed with a gas well on the west half of the northwest, and there would be two 40-acre oil tracts available as well?

A. Yes, sir.

MR. CARR: That's all I have, Mr. Catanach.

EXAMINER CATANACH: Okay. Mr. Carr, those are both your witnesses, right?

MR. CARR: Yes, sir, that concludes OXY's presentation.

Chi has two witnesses.

EXAMINER CATANACH: Would either of your witnesses be able to address issues regarding downspacing, regarding the interest ownership within proration units and whether or not that's going to have an effect on anybody?

MR. KELLAHIN: We can for our properties.

MR. CARR: I could call Mr. Foppiano, if you would care to have Mr. Foppiano testify on that.

EXAMINER CATANACH: I think we need to address it.

MR. CARR: Okay, then I'd call him at this time, with your permission.

MR. FOPPIANO: I haven't been sworn.

EXAMINER CATANACH: Would you stand to be sworn?

RICHARD E. FOPPIANO,

the witness herein, after having been first duly sworn upon his oath, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. CARR:

Q. State your name for the record, please.

A. My name is Richard E. Foppiano. It's spelled F as in Frank, o, p, p as in Paul, i, a, n, o.

Q. Where do you reside?

A. Midland, Texas.

Q. By whom are you employed?

A. OXY USA.

Q. And what is your current position with OXY?

A. I'm the regulatory affairs advisor for OXY's operations out of Midland, Texas.

Q. Mr. Foppiano, have you on prior occasions testified before this Oil Conservation Division?

A. Yes, I have.

Q. Are you familiar with the status of the ownership of the various leases that are operated by OXY in the Old Millman Ranch-Bone Spring field?

A. Yes, I am.

Q. And can you provide testimony today concerning the impact of the change in spacing being considered here today on those interest owners in OXY-operated properties?

A. Yes, I can.

MR. CARR: Are the witness's qualifications acceptable?

EXAMINER CATANACH: They are.

Q. (By Mr. Carr) Mr. Foppiano, I'd like to direct your attention to what has been marked as OXY Exhibit 10, and I'd like to refer to that exhibit, and f you could provide to Mr. Catanach a summary of the -- or the general status of the ownership of the leases involved, and then identify the impact that downspacing would have on the owners of those interests.

A. Yes, the wells that we have drilled are on very large government leases, and as you can see from -- Exhibit 1, I think, clearly shows the lease names. Government S lease is one, Government AB lease is another, and all of our development has occurred on those two leases at this point.

And if those units, those currently existing 80-acre units were reduced to 40-acre, in our opinion there's no impact because those are very large leases and the equity is already being -- would be distributed the same anyway to the federal government.

Q. So you see no change in the ownership that would occur as a result of the downspacing, that the existing wells' ownership would have the ownership it has today, and that under the new locations the ownership would be the same as it is under the existing well?

A. That's correct, it would not impact the distribution of proceeds from any of our existing wells to downspace from 80 to 40.

Q. Do you have anything further to add to your testimony?

A. No, I do not.

MR. CARR: I pass the witness, Mr. Catanach.

MR. KELLAHIN: No questions.

EXAMINATION

BY EXAMINER CATANACH:

Q. Mr. Foppiano, these are federal leases; is that correct?

A. Yes, sir.

Q. And you currently only operate oil wells, right?

A. That is correct.

Q. Okay. Is OXY the only working interest owner in these wells?

A. I can't testify to that exactly.

Q. Okay. But you can testify that the interest ownership would be the same going from an 80-acre unit to a 40-acre unit?

A. Yes, sir, and I can testify to that because I commissioned a review from our land department with that very same question, and that was their conclusion, that there would be no effect on the interest ownership to do that.

EXAMINER CATANACH: Okay, I have nothing further of the witness. He may be excused.

MR. CARR: We have nothing further of Mr. Foppiano.

EXAMINER CATANACH: Let's take a few minutes before we start your end.

(Thereupon, a recess was taken at 3:40 p.m.)

(The following proceedings had at 3:47 p.m.)

MR. KELLAHIN: Mr. Examiner, I'll call our first witness, Mike Hayes. Mr. Hayes is a geologist.

<u>MICHAEL D. HAYES</u>,

the witness herein, after having been first duly sworn upon his oath, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. KELLAHIN:

Q. For the record, Mr. Hayes, would you please state your name and occupation?

A. My name is Michael D. Hays, and I'm a petroleum geologist.

Q. You'll have to speak up a little bit. The hum of the -- whatever that contraption is, is competing with you.

A. Michael D. Hayes, I'm a petroleum geologist.

Q. And where do you reside, sir?

A. Midland, Texas.

Q. On prior occasions have you testified before the Division as a petroleum geologist and had your qualifications as an expert accepted and made a matter of record?

A. Yes, I have. And yes, they have been.

Q. Have you made a geologic study of the facts surrounding this particular Application to make the rules we have for the Old Millman Ranch permanent?

A. Yes, I have.

Q. And based upon your geologic studies, do you have recommendations for the Examiner?

A. Yes.

MR. KELLAHIN: We tender Mr. Hayes as an expert geologist.

EXAMINER CATANACH: Mr. Hayes is so qualified.

Q. (By Mr. Kellahin) Mr. Hayes, let's get to the conclusion. What do you recommend?

A. I recommend that oil be spaced on 40-acre proration units and gas wells be spaced on 80-acre proration units with a 5000-to-1 GOR allowable.

Q. Let's turn to some of the geologic basis, and then we'll talk to you about the reasons that support your conclusions.

If you'll turn to what has been marked as Chi Exhibit Number 1, can you identify this display?

A. Yes, I can.

Q. Does this represent your work product?

A. This is my work.

Q. What does it show us?

A. It's a structure map on the top of the first Bone Springs sand. It shows several other things, but what I'm showing on this map is, first off, Bone Spring first sand penetrations, or deeper, only. I've taken off some of the shallower tests on there, just to clean up the map a little bit for clarity.

The scale of the map is one inch equals 3000 feet on the map. The contour interval on the top of the first Bone Spring sand is 100 feet.

Q. Are you and Mr. Tinney using the same marker point to get the top of the first Bone Spring sand?

A. I haven't checked exactly all the data points, but I suspect that we correspond almost exactly, yes. We're using the same marker, yes.

Q. Is there a material difference, from your perspective, in your work versus Mr. Tinney's work when it comes to depicting structure?

A. No material difference, no.

Q. All right. Let's set that aside for a moment, then, and go to the next display. Does this also represent your work product?

A. Yes, it does.

Q. And what is this called?

A. This is an isopach map of the net pay in the first Bone Spring sand.

Q. All right. Describe for us what you mean when you have characterized this as a net pay map.

A. What I've done is, I've gone through all the log data available in the map area and have used a 12-percent porosity cutoff to essentially qualify the rock that we think is pay rock, will actually produce hydrocarbons.

Q. Okay, characterize for me so that I have a word description of your geologic characterization of this reservoir.

A. We have -- From looking at the logs and from a core that we cut on the Remington Number 3 -- We took a 120-foot core out of the middle of a well in the southeast of the southwest of Section 3. And that is -- that particular well is an oil well.

And based on that data, generally what you have is a gray, very fine-grain sandstone, and its average porosity in that -- say in the core well, is approximately 11 percent, perhaps 12 to 14 percent average over all the whole field on a log porosity basis.

In general, the average perms are probably on the order of about half a millidarcy. And the -- In general, the rock is very tight from an overall standpoint, and it needs very large fracs to produce at economic rates, on the order of 250,000 pounds of proppant or so to complete the wells.

Q. When you look at Exhibit 2, we're working with a net map?

A. Yes.

Q. And using the net map criteria, what is the point of greatest reservoir net thickness? What is that vertical distance?

A. In this map area it's 185 feet.

Q. Is that characteristic of Bone Spring reservoirs?

A. I wouldn't say it's totally anomalous, bit it's fairly unusual to get that much net pay, yes, especially with the porosities that we're looking at, some very good porosity.

Q. In terms of completion techniques, what would you recommend to an engineer in terms of how best to access the reservoir when you have a reservoir that's got this 150 feet of net pay?

A. Our completion technique -- and I believe OXY's have been fairly similar -- is to essentially perforate the whole large gross interval, including all the net, with approximately ten to twenty perforations, limited-entry frac, and then hydraulically frac it with proppant.

Q. What is the range of stimulation programs you use?

A. I think, as I recall, we started off with approximately 150,000 pounds of sand and slowly over time have ramped up to perhaps as high on some of the wells, close to 300,000 pounds of sand.

Q. What's the purpose of doing that?

A. What we have found in the past, on this field and other Bone Spring fields in the first sand, is that, surprisingly, as good as production is out here, you can perforate these wells, acidize them and swab them back and, in some cases, swab them dry. They simply won't produce -- sometimes, any hydrocarbons, let alone hydrocarbons at commercial rates.

The purpose of the frac is to make economic rates of production.

Q. You've been involved in other hearings to further refine and modify the rules for the pool, have you not, sir?

A. Yes, I have.

Q. You've recommended to the Examiner that they reduce the oil spacing from 80-acre to 40-acre oil. What is accomplished geologically if that is allowed to occur?

A. Geologically, I believe that this deposit here, the first sand, is a turbidite or density-current-type deposit. From examination of the core photos that we have, other regional data on the wells, even just examining the map data, I think there's a high degree of variability within the zone itself, within the overall interval.

As an example, you can look to the southeast corner of Section 3 and you can see two wells there. One is a deeper Morrow test, and the other one is a recent Bone

Spring completion by OXY. And you can see there's a variation from 164 feet to 94 feet in a distance that's probably on the order of 300 feet.

And I wouldn't claim that -- That's possible, that's partly related to log runs and different passes and things like that. But you can see that I think the overall example is that there's a high degree of variation, and -- which suggests to me a fairly large lack of continuity of pay in the overall pay zone.

Q. When we look at the northwest quarter of Section 3, I believe that is a 160-acre spacing unit that's currently dedicated to a gas well; it's your Winchester 2, I think?

A. That's correct.

Q. All right. And under the current associated rules, you cannot drill and produce an oil well in that 160 at this point?

A. That's my understanding of the state rules, yes.

Q. All right. And if the rule is changed, what opportunity does that afford you in the northwest quarter of 3, that you do not now have?

A. We would probably fairly quickly go out and drill two oil wells on 40-acre spacing.

Q. Based upon your geologic investigation, what is your estimate of the probability that those would be oil wells, as opposed to another gas well?

A. I believe there will be oil wells. There's certainly some risk that there's a possibly that it could be gas.

But if I refer you back to Exhibit Number 1, you can see the subsea 2900-foot contour cutting across the field area. And the significance of that, from just a map-view visual basis, you can see that the gas wells tend to lie above the 2900-foot subsea contour and the oil wells within the pool tend to lie below the 2900-foot contour.

And my recommendation to Chi has been -- and in fact we've staked wells in those positions -- is that my best estimate at this time is those two wells will be oil wells, based on this map.

Q. Are you familiar enough with the ownership within your spacing unit to advise the Examiner that if he changes the spacing down, he is not disrupting the equity of the interest owners that currently share in the production on current spacing patterns?

A. My understanding is that there will be no change in ownership based on my knowledge of what I know of the working interests in there.

Q. Is there a geologic predicate, if not a basis, for your recommendation of changing the gas well spacing from 160 to 80?

A. Is there a geologic basis for that --
Q. Yes, sir.
A. -- position?
Yes, I think just like in the oil wells, that essentially you have fairly poor continuity over the large interval of the pay, and I don't personally feel that over 160 acres all these zones are all connected so that you would recover all the gas in those -- in the spacing units, 160 acres.
Q. All right. Mr. Tinney has provided us with a cross-section in which he's identified what in his opinion are as many as five layers or various intervals within the first sand of the Bone Springs?
A. Yes, I believe it's nine.
Q. I'm sorry, nine.
A. Yes.
Q. That's right, nine intervals or layers.
Do you have an opinion on that topic? And if so, what is it?
A. I'm not totally intimate with how he chose those layers. My personal feeling is that that's -- They have to do something for their model that's within reasonableness of trying to get beds or zones that look basically the same.
The reality is, if -- from some of the core data

that I've seen, is that the beds are in fact on the order of perhaps a millimeter or two thick, so in fact there's literally thousands of individual beds within the overall gross thickness.

But from a practical standpoint for simulating the reservoir, I suspect that that's a reasonable place to start, with nine layers, something like that.

I don't know precisely how he divvied those up, but that seems reasonable to me.

MR. KELLAHIN: Okay. That concludes my examination of Mr. Hayes, Mr. Examiner.

We move the introduction of his Exhibits 1 and 2.

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

MR. CARR: I have no questions of Mr. Hayes.

EXAMINATION

BY EXAMINER CATANACH:

Q. Mr. Hayes, is it your testimony that -- did you testify that over a 160-acre proration unit, that these nine sand layers may not be continuous?

A. I believe that's so. It may be more so on the gross nine layers, but certainly on a real geologic basis of the hundreds or thousands of layers that are actually there, I don't believe they're continuous. In fact, you can see some termination of beds just within a four-inch core on core data.

Q. So your conclusion is that another gas well may have to be drilled just to encounter some of these beds that may not be encountered?

A. I believe so. In fact, if I can refer to Tom's cross-section here, you can see where there are beds that are terminating, even within his nine-layer model, and I think if you certainly went to a larger number of layers you would see even more terminations, rather than less.

Q. You -- I believe you mentioned that in the northwest quarter of Section 3, you have the potential for two oil-well locations?

A. That's correct.

Q. Where would you locate those wells?

A. In fact, we have staked wells out there. The position, roughly, if I can identify, is approximately 660 off the north line and 1980 off the west line. Now, it isn't exactly that; I don't know precisely where it is.

But I moved it, I think, 100 feet because you can see that deep Morrow well there. There's a gas well on our map that isn't circled. Just the producers are circled on this map -- or, no, on both maps, actually. And that's a deep-plug Morrow well that cannot be re-entered mechanically, and so I've put it approximately in that position and moved it a little bit for to keep it away from the old wellbore.

And then the other location would be approximately 1980 from the north and 1980 from the west, within the parameters that are allowed under the present field rules, 150 feet from the center of the quarter quarter.

Q. Do you believe both of those would be oil wells?

A. I do. There is some risk that you might get gas enough to actually hit the gas qualification, but I believe they'll be oil wells.

EXAMINER CATANACH: I have nothing further.

MR. KELLAHIN: I'd like to call at this time, Mr. Examiner, David Myers.

DAVID C. MYERS,

the witness herein, after having been first duly sworn upon his oath, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. KELLAHIN:

Q. Mr. Myers would you state your name and your occupation?

A. David Myers. I'm a petroleum engineer for Chi Energy.

Q. Mr. Myers, on prior occasions have you testified before the Division as a petroleum engineer?

A. No, I have not.

Q. Summarize for us your education.

A. I graduated in 1982 from the University of Texas with a bachelor of science in petroleum engineering, a master's in business from Houston in 1989, and worked for Arco from 1982 to January of 1994 in the capacity of drilling, production reservoir engineering.

Q. And what is it that you currently do?

A. Currently I'm titled as operations manager. Basically, I am the engineer for Chi Energy.

Q. You are the engineering department for your company?

A. Yes, sir.

Q. All right, and where do you reside?

A. I reside in Midland, Texas.

Q. And based upon your duties and your experience, have you made an engineering study of the various recommendations you're proposing to the Examiner?

A. Yes, sir, I have.

MR. KELLAHIN: We tender Mr. Myers as an expert petroleum engineer.

EXAMINER CATANACH: Mr. Myers is so qualified.

Q. (By Mr. Kellahin) If you'll turn to your first display, sir, will you summarize for us your recommendations?

A. Exhibit 1 [*sic*], what I'm trying to do is go ahead and tell you what I am recommending and also provide an outline for the argument that I'll make here today.

We are going to define the field as an associated pool based on GOR information that corresponds to structure. We're going to show, both in the case of gas wells and oil wells, that we believe the drainage areas will support reduction to 80s and 40s respectively, and we believe that we have data that supports the maintenance of a 5000-to-1 GOR as being beneficial to the reservoir.

Q. Let's turn to the next piece of information. It's marked as Chi Exhibit 4. Identify for us what we're looking at here.

A. What I've attempted to do here is back up and just allow you to see the total field progress that has occurred, specifically since the last hearing in this field, which would have been in July of 1993.

Since that time there have been 15 wells drilled, one of which was dry, the Savage Number 1. We have -- In addition to the data supplied at that point in time, we have an additional 20 months of production history on the Chi-operated wells. We have specifically drilled two additional wells, the Remington Number 2 and the Remington Number 3.

We've conducted about five bottomhole pressure surveys, most of them more recently. Of note relative to those bottomhole pressures is that we have extended the length of time from original 72-hour buildups to as much as 330 hours, to attempt to get a stabilized pressure. We have not been able to get a stabilized pressure, so it is basically time-prohibitive. And as Raj mentioned, we are really kind of relegated to models to extrapolate the pressures.

We have taken a 120-foot full core on the Remington Number 3. Relative to that core we've done PVT work, capillary pressure studies and mechanical core studies.

Currently, Chi is operating one pumping oil well, two flowing oil wells and three flowing gas wells at about 340 barrels a day, 5 million a day in gas and about 50 barrels of water. Cumulative to date for Chi's production has been 190,000 barrels and 5.2 BCF.

In the lower part of that exhibit, given the granting of the downsizing, we would propose that within the next 12 months we would drill the Winchester 3, Winchester 4, and the USA 9 Number 2, all first Bone Spring tests.

Q. All right, sir, let's turn to the next page of information, if you'll find Exhibit 5 and identify and describe for us that information.

A. Exhibit 5 is an attempt just to briefly address the issue of an associated pool. It is a plot of current GOR tests as of January of 1995, with data submitted by Chi to the State, as well as data submitted by OXY to the State.

I think it clearly shows going from 452,000 GOR in the Winchester Number 1, down to a band of 55,000 to 36,000 GOR, which are our other two gas wells, and you can see the gradation of the GORs as you go down in the structure.

Q. All right, sir. If you'll turn to Exhibit 6, identify and describe that display.

A. Exhibit 6 is a presentation of GORs over time, surface producing GORs over time, and it's meant just to infer that the data that I showed you in the previous map was not a one-time deal. The reservoir has behaved as a reservoir with a gas cap.

Q. All right, let's turn to Exhibit 7. Would you identify and describe that display?

A. Exhibit 7 is presented one time. What it is is just an explanation of the methodology that I have spent most -- I have relied on most.

It's basically a decline-curve analysis, taking exponential decline of well data through November of 1994. I've applied a hyperbolic fit to that data, and I have also used a hyperbolic fit on data through February of this year.

In layman's terms, it's basically conservative through optimistic, is what I've tried to do.

Q. One of the things that you wanted to find out is to calculate the drainage effects or drainage areas for certain oil wells and for certain of the gas wells in the pool, right?

A. That's correct.

Q. One of the methods to do that would be based either on P-over-Z plots --

A. That's correct.

Q. -- or you could use them production versus time to get you a recovery number and oil and gas volumes?

A. That is correct.

Q. All right. You chose not to use P over Z because of what problem with the pressure data?

A. In the case of the gas wells, I attempted to take the bottomhole pressure data that we have, extrapolate a P* value for bottomhole pressures run subsequent to the initial test and correct those back to an average reservoir pressure.

The results of that P-over-Z graph for the Winchester Number 1 showed approximately 2.2 BCF recovery, down to, say, a 100-pound abandonment pressure.

Currently that well has made 1.9 BCF and is producing at 1.3 million a day.

In my judgment that was an overly conservative case.

Q. What did that tell you, then, about the pressure you were utilizing in the display? That you didn't have a built-up stabilized pressure at a sufficient period of time?

A. Yes, that is correct.

Q. How long a period of shut in did you have for any pressure test?

A. As I previously mentioned, we started -- When the field development started, 72 hours was a typical buildup. And I believe for the Winchester Number 1, which was the first penetration of that reservoir, that was adequate. There had been no production; it built up immediately.

Subsequent to that, we have gone as long as 330 hours on our buildups to try and get a stabilized pressure.

Q. As an engineer, what does that tell you about the permeability of your reservoir?

A. It tells me the reservoir is very tight.

Q. Okay, does that give you any engineering sense about what you do in terms of spacing wells in this type of reservoir with such low permeability?

A. The sense that I have is that you increase density.

Q. What then did you use Exhibit 7 for?

A. Mine aren't numbered. Is this --

Q. Seven is the production plot.

A. Okay, in both the oil and gas well cases, which I'll be showing you, I used that as the primary mechanism to determine drainage areas for the wells.

Q. All right. Let's turn to the gas drainage calculations. If you'll look at Exhibit 8, it starts a display that deals with the three gas wells, and there are only three gas wells currently to work with, are there not?

A. That's correct.

Q. Describe for us what you did and what you concluded.

A. Okay, the top square, if you will, includes the reserve calculations for the most conservative, obviously, to the most optimistic case, based on the decline curve data that I showed you previously, or technique that I showed you previously, and then we have the averages which range from 2.1 BCF to 3.3 BCF per well.

What I have attempted to do next is look at the gross pay and determine a relationship, an overall relationship for the field between gross and net for the purpose of reserve calculations. What I provide is a comparison of the geologic net pay as determined by the 12-percent log cutoff that both of the previous geologists have discussed they used, would have resulted in an average pay thickness of 130 feet for the three wells.

Based on the core data that we had, I derived an overall 55-percent net-to-gross ratio, which I can use for the entire field, and that was based on a 12-percent log porosity corresponding to 9.5-percent core porosity, which if you plug it into crossplots and a .05 permeability, that's what you're going to come up with.

So on a fieldwide basis what I've assumed is that we have a 55-percent net-to-gross ratio.

In all cases where I had the option here to determine an acreage -- or a spacing -- drainage area that was larger, I have assumed that those variables would be the ones put into the equation. In this case we put in 107 feet because obviously it would support a larger drainage area.

Q. When we look at the bottom of the first block average, what are we averaging?

A. Pay thicknesses for the gas wells.

Q. What then did you do?

A. Basically applied material balance calculation for gas reservoirs. What I've -- I've got a 33-percent water saturation, which is based on capillary pressure data that was performed on a core. I have a 12.8-percent porosity. This is the average core porosity, excluding core pay, that is, excluding the sections below 12-percent log porosity. And the Bgi and the Bga assumed an abandonment pressure of 400 p.s.i. and an initial pressure of 2432.

What I'm coming up with is 632 MCF per acre-feet, which corresponds to about 87-percent recovery, which I think is probably legitimate.

Q. What did you do to convert this into a drainage area?

A. I applied the 632 MCF per acre-feet, the average pay thickness of 107 feet, and ratio'd that with the -- or divided that by the total reserves that I calculated, based on decline-curve analysis.

Q. All right, sir. If we turn to Exhibit 9, then, show us the results of the calculation.

A. The results of those calculations show an average drainage radius of anywhere from 33 to 50 acres; on a single-well basis, anywhere from 16 to 71.

Q. All right. If we look in the far right column of the information within the block and look at the Winchester 1, the far right number is 71.5?

A. Yes, sir.

Q. What does that represent?

A. That represents the most optimistic decline-curve case for the Winchester Number 1, and that would be the drainage radius that I would apply to that well.

Q. And then the Colt Number 1 drains 31.5 acres?

A. Yes, sir. Yes, sir.

Q. Typically, we're more accustomed in work before the agency of seeing Bone Spring wells dedicated to 160 acres and occasionally seeing drainage calculations that are in that range.

What accounts, in your opinion, for the fact that drainage areas in Bone Springs are only in this 32- to 50-acre range?

A. Clearly it's a height issue. The formation is much thicker than the formations that we're typically used to dealing with.

Q. Have you satisfied yourself to a reasonable engineering degree of accuracy that you're working with an appropriate height factor in the calculations?

A. Yes, sir, I have.

Q. All right, sir. What then is your recommendation concerning the gas spacing that's appropriate for the remaining producing life of the pool?

A. My recommendation is to downspace to 80 acres.

Q. Let's turn now to how you've approached the oil-well spacing issue, and if you'll look at Exhibit 10, tell us how you've set up the spreadshseet and then lead us through your work.

A. Okay, similar-type situation. What I've done in this case is actually combine the Remington Federal Number 1 and Number 2 for the sake of simplicity.

What it shows is that those two wells combined will produce between 155,000 and 320,000 barrels of oil.

The second graph is similar to the one -- or the second box is similar to the one I showed you with the gas wells. Basically we come up with 116 feet of pay, based on the geologic cutoff and 125 feet based on a net-to-gross ratio of 55 percent.

What I've then done in the final box -- In between those two boxes what I did was investigate the literature, basically looking at typical solution gas drive reservoir recovery factors, one of which is classic material balance, taking your endpoints.

The second method that I used was an Arp's, basically calculation tables, which gave me a 22-percent recovery factor. There are nomographs that, if you apply the proper inputs, will give you about 24-percent recovery factor, and API has a formula which will give you 26.

The end result is, the range is from 22 to 32 percent.

Based on that, and an initial oil in place of about 430 barrels per acre-foot, what we're seeing is drainage radiuses on the order of four to 15 acres.

Q. What's then your recommendation on the appropriate oil well spacing for the remaining producing life of the pool?

A. My recommendation is to downspace to 40 acres.

As a -- I'll interject one thing. The final number on there is more of a reality check. What I wanted to do was calculate what recovery factor we would have to have in the reservoir to equal a 40-acre spacing, given all the other data supplied. And the bottom line is that we come up to about a 7- or 8-percent recovery factor to justify 40-acre spacing.

Q. All right, sir. Let's turn to the next display; it's Exhibit 11. What is that, and why are we looking at it?

A. This is a two-part exhibit. What -- It is a plot of the P*'s associated with all of the buildups that we have done, and also my calculation of the P*'s of two wells that -- OXY's wells that we traded data on.

My believe is that the P*'s on initial completion are legitimate measures if they're run for a long-enough length of time of bottomhole pressure. Subsequent data is suspect after production.

The items in red are the dates and the pressures next to the wells in which the tests were performed.

Q. How is this information of use to us in this hearing?

A. Okay, this is a two-part -- I'm going to use this in two parts. One is to support the argument for 40-acre spacing in oil, and with regards to that we see the original bottomhole pressure of 2440 in the Winchester Number 1, the first penetration of the reservoir.

The Remington Number 2 bottomhole pressure, which was run only for 72 hours, was roughly 2200 pounds, 2177.

OXY's two wells show bottomhole pressures of 2300 to 2378. This is after the production from the Winchester Number 1. I think that was what? 24 months, we had 24 months of production -- We've had 24 months of production from the Remington 1 and 24 months of production from the Remington Number 2.

We drilled the Remington Number 3 in July of last year and came up with basically what I would consider to be, within engineering accuracy, an original bottomhole pressure. That well, by virtue of the way the wells around it had been spaced, was essentially an infill 40.

Therefore, my conclusion based on this data is that we have not, based on prior production, affected any pressure drainage in this portion of the reservoir. And it would further support, in my opinion, the development of the oil wells on 40-acre spacing.

Q. All right, sir. Let's turn now to Exhibit 12.

A. Actually, we probably need to skip to Exhibit 13.

Q. All right, let's do that.

A. I think they're out of order.

Q. Yes, sir, let's do 13 first and then come back to 12.

A. Okay, related to the gas-oil ratio issue, I think the fact that the -- I'll refer you back to the bottomhole pressure graph before we jump to the GOR graph.

The fact that the pressure was original also would infer to me that we had not negatively swept this region with gas as being pushed down from a gas cap, based on the 5000-to-1 GOR that we have been limited by today.

The second plot is a plot of cumulative GOR over time for the two oil wells that we have on our lease. My belief is that that supports the fact that the GOR has remained relatively constant.

What I would expect to see in a solution gas cap drive reservoir, if damage was being done to the reservoir, is, I would expect that GOR to start going through the roof, as my gas started breaking out and my relative permeability to gas increased so much that I started leaving my oil in the ground.

Q. Do you see that here?

A. I do not see that here.

Q. Would you also see if you were pulling the gas out -- Well, describe for me the relationship and the expansion of the gas cap. How would you be seeing that if you were producing the reservoir too quickly? Is there a relationship there?

A. In a typical homogeneous reservoir, if I was producing it too quickly, I would be expecting two things. One is, I would be expecting my gas cap to be expanding. And I would expect that gas cap expansion to start affecting my oil wells downdip at some point in time, based on their proximity to the original gas-oil contact.

Secondly, I would expect more and more gas to start -- at some point in time, more and more gas to start breaking out of my oil wells, causing the effect that I just discussed.

Q. Here you have evidence to the contrary, do you not?

A. I do not see those effects present, no, I do not.

Q. All right, sir, take us back to 12, then. What does that show us?

A. 12 is basically a summary of where we will be under adoption if the new rules are adopted, primarily from Chi's point of view.

Our current allowables are 1110 barrels of oil a day, 8.8 million cubic feet of gas.

Under adoption of the new rules, initially our allowable will be 852 barrels of oil, 6.4 million cubic feet of gas.

Subsequent to drilling the three wells that I previously mentioned, we will basically be back on square one. We'll be at roughly 1.3 million cubic feet of gas and 8.5, as compared with 1.1 and 8.8 right now.

Q. So what's the resulting opportunity to Chi that you currently don't have under the existing rules?

A. The specific opportunity that we have available to us under the new rules would be to drill the two additional oil wells on the Winchester lease.

Q. Do you believe the rule changes can be made, plus maintaining the 5000-to-1 gas-oil ratio, without causing reservoir waste or without adversely affecting correlative rights?

A. Yes, sir. Yes, sir, I do.

Q. Let's look, then, at Exhibit 14.

A. Exhibit 14 is a summary of what hopefully I've discussed to this point. Basically we believe it is an associated pool with a GOR varying from structure from anywhere from 400,000 to 2000 standard cubic feet per barrel.

The 80-acre gas well spacing is supported by calculations which show drainage radiuses on the order of 32 to 50 acres.

We believe that 40-acre oil well spacing is supported by our drainage calculations of 5 to 14 acres, by a reasonableness test saying that 8-percent recovery is what would be required to justify a 40-acre spacing and the fact that our bottomhole pressure on the Remington 3 was very near original.

I believe that we hopefully have supported the case that the 5000-to-1 GOR limitation to date has not been detrimental to the reservoir, and the current production data would suggest that we should continue with that ratio.

Q. In addition, with your conversations with OXY USA personnel, have you also discussed this proposed rule change with the other operator in the pool?

A. We have discussed it with Mewbourne and --

Q. Have you obtained their written concurrence and recommendation for supporting these rule changes?

A. Yes, we have, and that is the final exhibit.

Q. And that's Exhibit 15?

A. Yes, sir.

MR. KELLAHIN: Mr. Examiner, that concludes my examination of Mr. Myers.

We move the introduction of his Exhibits 3 through 15.

EXAMINER CATANACH: Exhibits 3 through 15 will be admitted as evidence.

MR. CARR: No questions.

EXAMINATION

BY EXAMINER CATANACH:

Q. Just a couple, Mr. Myers.

Do you agree with the reservoir simulation that was presented by OXY?

A. I believe that the simulation appears to be -- to have merit. I am not overly familiar with reservoir simulations, so I'll qualify that.

Q. Changing the pool rules will allow you to drill -- was it two oil wells and one gas well, or three oil wells?

A. It will allow us to drill two oil wells initially. I believe it does allow us for an additional gas well.

Right now we haven't thought too much about gas wells, simply because gas price is pretty poor.

Q. Drilling these two oil wells, that's basically going to increase substantially your gas recoveries and not so much your oil; is that your opinion?

A. I think it will increase our oil recoveries more so than gas.

EXAMINER CATANACH: I don't have any more questions of the witness.

MR. KELLAHIN: That concludes our presentation, Mr. Examiner.

EXAMINER CATANACH: Mr. Carr, anything further?

MR. CARR: Nothing further, Mr. Catanach.

EXAMINER CATANACH: Would you gentlemen like to collaborate on a rough order or submit your own each in this case?

MR. KELLAHIN: We'll have to negotiate the ground rules for the collaboration, Mr. Examiner, but I believe that in the spirit of good will and accommodation to your desires we might be able to get along to do that.

MR. CARR: We'll see.

EXAMINER CATANACH: Okay. There being nothing further in this case, Case 10,556 will be taken under advisement.

(Thereupon, these proceedings were concluded at 3:28 p.m.)

* * *

CERTIFICATE OF REPORTER

STATE OF NEW MEXICO)
) ss.
COUNTY OF SANTA FE)

I, Steven T. Brenner, Certified Court Reporter and Notary Public, HEREBY CERTIFY that the foregoing transcript of proceedings before the Oil Conservation Division was reported by me; that I transcribed my notes; and that the foregoing is a true and accurate record of the proceedings.

I FURTHER CERTIFY that I am not a relative or employee of any of the parties or attorneys involved in this matter and that I have no personal interest in the final disposition of this matter.

WITNESS MY HAND AND SEAL March 9th, 1995.

STEVEN T. BRENNER
CCR No. 7

My commission expires: October 14, 1998

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 10556, heard by me on March 2 1995.

David R. Catanach, Examiner
Oil Conservation Division

NEW MEXICO OIL CONSERVATION DIVISION

STATE LAND OFFICE BUILDING

STATE OF NEW MEXICO

CASE NO. 10556

IN THE MATTER OF:

The Application of Chi Energy, Inc., for Special Pool Rules, Eddy County, New Mexico

BEFORE:

DAVID R. CATANACH

Hearing Examiner

State Land Office Building

September 17, 1992

REPORTED BY:

CARLA DIANE RODRIGUEZ
Certified Shorthand Reporter
for the State of New Mexico

COPY

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I N D E X

E X H I B I T S

EXAMINER CATANACH: At this time we'll call Case 10556.

MR. STOVALL: Application of Chi Energy, Inc., for special pool rules, Eddy County, New Mexico.

EXAMINER CATANACH: Are there appearances in this case?

MR. KELLAHIN: Mr. Examiner, I'm Tom Kellahin of the Santa Fe law firm Kellahin & Kellahin, appearing on behalf of the Applicant, and I have two witnesses to be sworn.

EXAMINER CATANACH: Additional appearances?

Will the two witnesses please stand to be sworn in.

[The witnesses were duly sworn.]

MR. BRUCE: I'm Jim Bruce of the Hinkle Law Firm in Santa Fe, representing Mewbourne Oil Company, and I have no witnesses.

MICHAEL D. HAYES

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

EXAMINATION

BY MR. KELLAHIN:

Q. Mr. Hayes, for the record would you

please state your name and occupation.

A. Michael D. Hayes. I'm a geologist with Chi Energy.

Q. Have you testified as a petroleum geologist before the Division on prior occasions?

A. Yes, I have.

Q. Pursuant to your employment, have you made a geologic study of what is identified on the docket as the Old Millman Ranch Bone Springs Pool?

A. Yes, I have.

Q. Have you completed that study and reached certain conclusions about that reservoir?

A. Yes, I have.

Q. As part of your study and that of other consultants and employees of Chi Energy, what is it that you're seeking to accomplish with this application?

A. We're asking for a GOR increase of 20,000-to-1.

Q. When we look at this pool as currently designated by the Division, how many wells currently produce in the pool?

A. There are three wells that have been drilled and completed in the Bone Springs. Two of them are currently capable of production. One of them is temporarily abandoned or shut in at this time.

Q. Are there additional drilling activities occurring along the boundary and within a mile of the current pool?

A. Yes, there are.

Q. Does Chi propose to drill any of those wells?

A. Yes, we're planning on drilling a well in the west half or the northwest quarter of Section 3.

MR. KELLAHIN: At this time, Mr. Examiner, I tender Mr. Hayes as an expert petroleum geologist.

EXAMINER CATANACH: Mr. Hayes is so qualified.

Q. Have you made a geologic investigation to satisfy yourself that the existing wells in the pool are correlative, one to another, within the pool?

A. Yes.

Q. Let me have you turn to what is marked as Exhibit No. 1. Would you identify that for us, please?

A. Exhibit 1 is a stratigraphic cross-section with the datum as the top of the First Bone Springs Sand.

Q. Is this an exhibit you prepared?

A. Yes, it is.

Q. Does this display show the entire vertical limits of the pool?

A. It shows the entire vertical limits of the First Bone Springs Sand, yes.

Q. Find a well that we can use as a type well, and I would have you describe, then, the approximate top and bottom of the pool.

A. Okay. I'll use what is now marked on here as the Pennzoil Winchester Fed No. 1 but it's now the Chi Energy No. 1. It's located in the northeast quarter of Section 4. The First Bone Springs Sand section runs from approximately 6140 feet to about 6310 feet as the gross interval.

Q. What is the primary producing sand within the vertical limits of the pool?

A. It is the First Bone Springs Sand.

Q. Each of the three wells that are currently completed in that pool are producing from the First Bone Springs?

A. Yes, they are.
Q. Let's come back to this display in just a minute, but let me have you identify Exhibit No. 2.
A. Exhibit 2 is a structure map that is based on the top of the First Bone Springs Sand. And it has a contour interval of a hundred feet on it.
Q. We'll come back to 2. Let's go to 3 and identify No. 3.
A. That's an isopach map of the net pay within the First Bone Springs Sand and I've used a pay cutoff of 12 percent density porosity as a cutoff, and the contrainterval is 20 feet.
Q. Exhibits 1, 2 and 3 were all prepared by you?
A. Yes.
Q. This represents your work product?
A. Yes.
Q. Using Exhibit 2 as a reference map to see the line of the cross-section, can you conclude, from an examination of the cross-section, that you have sufficient reservoir continuity as you move from one well to the next?
A. Yes, it appears to be good reservoir

continuity.

Q. That continuity is established in the First Bone Springs member of the pool?

A. Yes.

Q. Give us a quick review of the cross-section, then, and lead us through the correlation.

A. The cross-section, A - A' basically runs through the heart of the field from the south part of Section 8 to the south part of Section 3. The three key wells that are completed within the First Bone Springs Sand are marked with a circle on Exhibits 2 and 3.

The cross-section shows the gross interval of the First Bone Springs Sand and has the perforated interval put on the cross-section. The Mewbourne FB No. 2 has a perforated interval of approximately 6038 feet to 6131 feet. It goes over to the Strata Aquila Fed which is perforated from 6140 to 6250 feet, and the Chi Winchester Fed No. 1, which is perforated from 6146 to 6300 feet.

Q. Looking at Exhibit 2 now, let's identify, so that we can keep track of them, the three wells in the pool, starting in Section 8 with the Mewbourne well.

A. The completed well is the well in the northwest of the northeast of Section 8.

Q. As you move, then, to the next well in the pool in the southwest quarter of 4?

A. That's correct. That's in the northwest of the southwest of 4.

Q. That's the Strata well?

A. Yes.

Q. They call it the Aquila?

A. Aquila Fed.

Q. The Chi well is located where?

A. In the southeast of the northeast of Section 4.

Q. Looking at the structure map, Exhibit No. 2, describe for us the conclusions concerning structure, in terms of the relationship of the three producing wells, one to another.

A. The three key wells lie roughly on strike to one another. The Mewbourne well is approximately 100 feet updip from both the Aquila Fed and the Chi Winchester Fed No. 1. The wells, like I said, are basically on strike to one another.

Q. Geologically, can you support the

conclusion that these wells, in fact, are producing from the same common source of supply?

A. Yes.

Q. Let's look at the isopach, Exhibit No. 3.

A. Okay.

Q. Identify and describe your geologic conclusions about the isopach.

A. What I've shown here again is a net porosity greater than 12 percent, density porosity greater than 12 percent. The Mewbourne FB No. 2 has approximately 80 feet of net pay which I would consider a good, quality reservoir.

The Strata Aquila Fed has 18 feet of net pay, a much poorer quality reservoir, and the Chi Winchester Fed has approximately 80 feet of pay. So the Winchester Fed and the Mewbourne FB 2 are approximately the same reservoir quality.

If I can refer back to the cross-section, the maximum porosities for the Mewbourne and the Chi wells are the same in that their maximum porosity is around 20 percent; whereas on the Strata well, the maximum porosity within the reservoir is approximately 14 percent.

Q. Using Exhibit No. 3, identify for us the probable additional wells that will be drilled and added to the pool.

A. At the moment, our intent for the next well will be in the southwest of the northwest of Section 3.

Q. That's where you have the well location symbol on the display?

A. That's correct. And if I can refer you back to No. 2, it shows roughly our acreage position as we have there. Our next subsequent well possibly would be a well in the northwest of the southwest of Section 3, to be followed by a well probably in the northeast of the southeast of Section 4, depending on how things develop.

Q. Statewide oil spacing on 40 acres applies to production from the reservoir?

A. That's what I understand, yes.

Q. From a geologist's perspective, do you see any adverse consequences if the gas-oil ratio is increased from the statewide 2,000-to-1 to the requested 20,000-to-1?

A. I don't see any at this time, no.

MR. KELLAHIN: That concludes my examination of Mr. Hayes. We move the introduction of his Exhibits 1, 2 and 3.

EXAMINER CATANACH: Exhibits 1, 2 and 3 will be admitted as evidence.

Mr. Bruce, do you have any questions?

MR. BRUCE: No questions.

EXAMINER CATANACH: I don't believe I have any questions at the moment.

MR. KELLAHIN: I would like to call Mr. Robert Lee at this point.

ROBERT LEE

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

EXAMINATION

BY MR. KELLAHIN:

Q. Mr. Lee, would you please state your name and occupation?

A. My name is Robert Lee. I'm the production manager for Siete Oil & Gas in Roswell, New Mexico.

Q. Are you acting today as an engineering consultant for Chi Energy with regards to this particular property?

A. Yes, I am.

Q. Pursuant to that employment, what is it that you've done concerning the request to increase the gas-oil ratio in the reservoir?

A. We have examined the production data from their well, the offset wells, prepared some graphs, exhibits for you to look at today. We've ran some PVT data which shows that the fluid in the reservoir is a gas.

Q. Have you, on prior occasions, testified before the Division as a reservoir engineer?

A. Yes, I have.

Q. And based upon the data that's been made available to you, are you able to reach certain engineering conclusions with regards to the gas-oil ratio that's appropriate for this reservoir?

A. Yes, I am.

MR. KELLAHIN: We tender Mr. Lee as an expert reservoir engineer.

EXAMINER CATANACH: Mr. Lee is so qualified.

Q. When a reservoir engineer such as you, Mr. Lee, commences a study to determine what is an appropriate gas-oil ratio for the reservoir, what kind of information do you want to have available to you so that you can make the best possible conclusions about that reservoir?

A. I like to look at the production data, especially if he can have production data with different choke sizes or variable rates to see if the gas-oil ratio goes up with increased production, which it does not in this instance.

I like to have some PVT data to see what the fluid is in the reservoir and how that fluid behaves over time, and look at the offset production from the other wells, if it's available, to see if our reservoir is behaving the same as theirs.

Q. How definitive is it to a reservoir engineer to have PVT data?

A. Very much so. It's telling you what goes on down hole in the reservoir.

Q. Do you have PVT data for this reservoir?

A. Yes, we do.

Q. From what well were the fluid samples taken in which the PVT data was analyzed?

A. From Chi's Winchester No. 1.

Q. What have you ultimately concluded about the reservoir, in terms of whether or not this is an oil reservoir, an oil condensate reservoir, a gas reservoir? What is your conclusion?

A. It's a gas reservoir with a little bit of condensate. Very little. Based on the PVT data, you saw that the dew point, the point at which liquid starts to drop out of the gas, was 4900 pounds, and even through the depletion of the reservoir, the maximum liquid build-up was only .66 percent less than seven-tenths of one percent. So, it indicates it's definitely a gas reservoir.

Q. Do you see any definitive scientific data to support the conclusion that this is an oil reservoir?

A. No.

Q. Do we do any harm to the reservoir by leaving hydrocarbons that you might otherwise recover in the reser oir, by increasing the gas-oil ratio?

A. Not in thi instance. The liquids that are left are minuscu e, and you won't be damaging anything by increasi g the amount of gas you can produce here.

Q. Take me th ough the exhibits that you've compiled to p esent in support of your conclusion, starting with Exhibit No. 4.

A. Okay. Exhibit No. 4 is merely a gas analysis that was done by Laboratory Services on the gas from the Winchester Federal No. 1.

Q. Why is this of any use to you?

A. It's useful to compare what was sampled here to what we have on our PVT data to make sure they're fairly comparable, that the composition of the gas hasn't changed drastically from when the well was tested, from when we caught our PVT sample.

Q. Turn now to Exhibit No. 5. Identify and describe that information.

A. This is tabular data from the two offset producing wells, the Mewbourne Federal V and the Strata Aquila Federal. What we've shown here, Mr. Examiner, is the monthly oil and gas production that was reported on the C-115s.

You can see that the Federal V has a GOR, towards the end of the time it was producing in excess of 100,000-to-1. Very gassy. The Aquila, which is only three feet difference in structure from the Winchester well, has a much lower GOR, only 12--well, in one month they had 22,000.

It looks very nominal compared to

production from the Winchester well, which is three feet lower than this one here, like I said. We have doubts as to whether the Aquila production is as good in numbers as what we're getting off our Winchester right now. The GOR is a little strange.

Q. Let's set aside as an anomaly, then, the Aquila production information, and have you now turn to the Exhibit 6 and let's look at the Chi Winchester Federal No. 1 production data.

A. Exhibit 6 is a tabulation of the data of the production from the Winchester well. You can see that it came on line August 27th.

Plotting oil and gas and then calculating GOR for the days it's been on, you can see that the GOR initially was running 40 to 60 standard cubic feet per barrel. In the last week and a half or so, it's kind of settled down into the 27 to 30,000 range there. Once again, a little higher than the Aquila and a little less than the Federal V.

Q. When you compare the Mewbourne Federal 5, which is currently 127,000 cubic feet to one barrel of oil, and look at the Winchester federal for a comparable period of time, we can't make a straight correlation there, we're off on the interval, but there's a difference in the gas-oil ratio. What's the explanation?

A. If you look at the average gas-oil ratio for production that we have for the Winchester well, say for these about 20 days, compared to the production from the federal--from Mewbourne's well, say, the first month that it produced, they had a GOR of about 40,000 and our GOR is about 37,000.

The Mewbourne well GOR went up over time, and we're not sure as to why that was. We don't have a lot of access to the production data from the Mewbourne well. But it's not to say that our well won't behave perhaps comparably to their well. The GOR may be higher than what we have here.

Q. Does the production data you have for the Mewbourne well, fit with the results of the PVT data?

A. Yes, it does.

Q. Does the production data from the Chi Winchester Federal 1 well fit the other data, including the PVT data?

A. Yes, it does.

Q. The Aquila Federal well doesn't fit, the production doesn't match what we would expect to see in the reservoir, using the PVT data?

A. No, it doesn't. Their GOR is quite a bit lower than what you would expect from the PVT data and from the production data from the two offset wells.

Q. Is there any explanation that you can provide us that might explain why the reported volumes of gas and oil for that well may not necessarily represent the true gas-oil ratio for that well?

A. Yes. When Strata first produced this well, there was no low pressure gas line in the area. And Mewbourne set a compressor to sell their gas, so their measurements of the gas were much better than measurements or estimates that Strata were probably making on their Aquila well.

Q. As a reservoir engineer, when you deal with facts that, one, don't fit with all the rest, what do you do?

A. You don't give it much credit. You exclude it.

Q. And the mechanics of how the well would have been produced may explain the fact that the gas may have been underreported?

A. That's correct.

Q. Let's turn to the other information that you've used, and have you identify for us Exhibit No. 7.

A. Exhibit No. 7 is a graphical plot of the production and the GOR from the Winchester No. 1. The left-hand scale, going from zero to 120, represents the barrels of oil per day and the GOR in Mcfs per barrel.

The scale on the right-hand side represents the gas production per day in Mcf. The line with the little dots on it, that's our oil production. You can see that it goes from 30 barrels a day up to about 90 barrels a day at the end.

The line with the little plus signs on them is the gas production. You can see that it's running above the oil curve going from a little less than 1.5 million a day up to a little over two and a half million a day.

The line with the diamonds on it is the gas-oil ratio line. It's interesting to notice here that the gas-oil ratio, when we first brought the well on, was a little higher--jumping around a little bit, more so than it was, say, on the last half of the plot, indicating that the well has stabilized and has kind of lined out to a stable GOR.

Q. In the later portion of the plot, the gas-oil ratio drops with increasing producing rates?

A. That's correct.

Q. What does that tell you?

A. We were able to get a consistent choke setting there, keep the choke on the same setting all the time without it freezing up. We had a lot of problems early on in the well with the choke freezing up. We got the problems resolved and, with the GOR stabilizing there, it's indicating to me that the reservoir flow into the well has stabilized.

Q. Is it much more efficient to produce this well at higher rates that will--

A. Absolutely. Absolutely. Because as we produce it at a higher rate, we're recovering more oil, as is shown by the lower GOR and more gas, and there's nothing there to indicate that I'm damaging anything or leaving reserves behind.

What I would be afraid of seeing would be if I was to really open it up, the gas stream way up, oil fall off to nothing, saying that I'm blowing out a little of free gas. But based on the production characteristics of this well and the PVT data, we know that's not going to be the case.

Q. Is the date of August 27th the date of first production on the Winchester Federal No. 1 well?

A. Yes.

Q. Is it your recommendation to commence the change in gas-oil ratio to 20,000-to-1 based upon the date of first production of the Winchester well?

A. Yes, it is.

Q. Do you see any reason not to do that?

A. No, not at all.

Q. Let's turn now to Exhibit No. 8. Identify and describe that display.

A. This is a plot of the gas rate versus the oil rate, and I've kind of drawn a line or a trend through the data. It shows that it's a passe 1,500-to-1. I have pretty straight line there.

The interesting thing to notice here, what I was trying to do with this, Mr. Examiner, was to come up with what kind of oil rate could I expect if the gas were held at the current allowable of 2,000-to-1.

Q. Let's find that point on the horizontal scale.

A. Right.

Q. If you look at the zero point and take it up to the 500, halfway between that line is the 2,000-to-1 gas-oil ratio?

A. That's correct. So, at that point, it came up to our trend line that you see there. You would be making about three to five barrels a day. And obviously with Chi drilling another well right now, being held at three barrels a day and 240 Mcf, is unreasonable.

Q. It's going to leave condensate in the reservoir, and it's going to be to the impairment of Kaiser's ability to produce hydrocarbons?

A. Exactly. It wouldn't be an economic project and we can't develop the reserves.

Q. As we move up the curve, can you approximate for us what is the most efficient or optimum rate at which to produce the well?

A. Actually, it's difficult to do on the data that we have. Obviously we have not reached that point yet. Right now we're making about 2.6, 2.8 million a day. That doesn't appear to be hurting anything.

What I would envision is that this curve is going to come up and flatten out at some point at what I would deem to be the optimum rate. We'll just watch the gas liquid ratios. We have certain facility constraints right now that prevent us from doing more than what we're doing right now. Once we get those facilities expanded, we'll be wanting to produce this well at higher rates to find an optimum rate.

Q. Based upon the current test information, can you tell us at least what is the current maximum gas-oil ratio that we can effectively produce these wells at?

A. Right now, what we see on our current production, the 20,000-to-1 will be all we can handle right now, and it will be good enough for right now. It would be advantageous to have something higher than that for down the road, once we get our facilities.

Q. I didn't make myself clear.

A. I'm sorry.
Q. Set aside the constraints on handling the volume of gas.
A. Uh-huh.
Q. When we look at the performance characteristics of the well, not limited by the ability to move the gas, what do you see now as at least the minimum gas-oil ratio that's efficient?
A. 20,000-to-1.
Q. In fact, on the curve you can justify more than that, can't you?
A. That's right, because that's where we are today.
Q. Is this a permanent solution for the reservoir, simply to increase the gas oil ratio to 20,000-to-1?
A. No.
Q. What is your recommendation as to what we should do?
A. I think it needs to be deemed to be a gas reservoir, a gas pool, instead of an oil pool.
Q. Is there any additional information or data that you need to gather as a reservoir

engineer to make yourself comfortable in reaching that ultimate conclusion?

A. I don't believe so. I believe that the PVT data that we have in hand now demonstrates that and says it's a gas reservoir.

Q. Let's turn to the PVT data.

A. All right.

Q. That's marked Exhibit No. 9?

A. Yes, it is.

Q. Without giving us all the nuts and bolts of this thing, give us the high spots. Starting off with the protocol, the sampling of the fluids, and whether or not you're satisfied as a reservoir engineer that that was done properly.

A. Yeah. In order to catch the PVT analysis, these were separator samples caught up to surface and not downhole samples. As you read through here, Mr. Examiner, you'll see that there were samples collected on two different days. Samples were caught on 9/9/82, taken back to the lab, the gas samples were okay but the liquid samples had too much water in them; so they had to go back out on 9/11 and catch liquid samples again. Those were sufficient and adequate.

Q. Prior to catching the PVT sample, you want to properly condition the well and make sure it's a stable flow, try to ensure that the fluid in the reservoir is representative of what is, say, coming out the tubing.

I do believe, of course, being a reservoir engineer you probably never condition a well for as long as a reservoir engineer wants it conditioned, but in this instance I do believe that we did reach stable flow, and for several reasons: The GOR is indicative that it was stabilized. Being a very new well like this, the amount of time to condition a well is very small, for a gas reservoir such as this. Probably a day or so is adequate.

Usually, when you condition a well, you start out at a higher rate and lower the rate until you reach the lowest rate at which the gas-oil ratio is not changing, but you also have to have that rate high enough to where it's not slugging or hitting liquids. That was also achieved. I believe that's one of the reasons that the GOR, during the first half here on the plot on Exhibit 7, is rather erratic because we had trouble getting the choke opened up enough to where we could get stable flow.

Finally, probably on about 9/7, the choke gets opened up; we're able to achieve stable flow. It's flowing continuously then and not slugging in heading.

One of the reasons to reduce flow, generally, when you condition a well, is to prevent the tremendous draw-down at the reservoir face and drop out a bunch of liquids. I don't believe that that's the case here. The original reservoir pressure was 2400 pounds. Flowing tubing pressure is 1700 pounds. There's not that much draw-down, by the time you calculate that back to the surface, to the reservoir face; plus the PVT data says that there's virtually no liquids dropping out at that range of pressures. And that is kind of how the well is conditioned and why there were two samples collected.

One of the high points of the report, on page 1, paragraph 3, it talks about taking small quantities of the reservoir fluid into a windowed cell. In there it says the dew point was 403--I think 4903 psig, and that the maximum percent of liquid condensation build-up was only .66 percent of the total volume of the sample in the cell, which shows that the fluid is behaving as a gas, in the entire PVT analysis.

That analysis is shown on page 8, the very last page. You can see the pressures, relative volume of gas and the liquid volume percent that dropped out. And that's pretty much it.

Q. In summary, what is your ultimate recommendation to the Examiner with regards to the application?

A. I would recommend that we be granted the--it would deny us to have it being a gas pool. I know the order hasn't maybe asked for that, but at least today, at least get it to 20,000-to-1 so that we can continue to produce the well at the existing rates.

MR. KELLAHIN: That concludes my examination and presentation of Mr. Lee and his exhibits. We would move the introduction of Exhibits 4 through 9.

EXAMINER CATANACH: Exhibits 4 through 9 will be admitted at evidence.

EXAMINATION

BY MR. CATANACH:

Q. Mr. Lee, are there similar Bone Springs

Pools in this part of the Basin that exhibit gas characteristics like this one?

A. None as dramatic as this one. The Parkway Bone Springs Pool is one of the closest ones that I can think of right now. It's about seven miles to the east. It also exhibited very gassy behavior. In fact, once after we discovered the field we had a GOR increase to 10,000-to-1, but the production characteristics are very, very different from this one. Those wells were coming on 200 or 300 barrels a day, and these wells are not behaving at all like that.

The fluid, and we talked about bringing a sample but didn't, the oil looks completely different also. The Chi well is a very clear, straw-colored condensate between 63, 66 degrees API. The Parkway Bone Spring is about 40, 42 degrees API, black oil. There's no other Bone Spring wells in the area that behave as a gas reservoir like this.

Q. You said the gravity of the Chi well was 62 to 63?

A. 62 to 66 degrees API.

Q. Do you know what the gravity is on the other two wells in the pool?

A. No, I do not.

Q. Do you know if it's similar?

A. I would assume that it was similar based upon the production characteristics, but I haven't seen the samples and we did not get that data from Strata or Mewbourne.

Q. What's the current oil and gas allowable for the pool?

A. I believe it's 142 barrels a day at 284. Is that right? 284.

Q. 284 barrels a day?

A. I'm sorry, 142 barrels per day, and then 284 Mcf.

Q. That's at 2,000-to-1?

A. That's correct.

Q. This is spaced on 40 acres at the present time?

A. Yes.

Q. At the 2,000 GOR limit, you're able to produce three barrels a day and--

A. 240 Mcf or 280.

Q. In fact, the well is capable of making, what, 90 barrels a day?

A. That's what we've seen so far. We

believe it could actually make more than that once we get some of our production facilities changed around a little bit.

Q. How old is this field?

A. I'm not sure when the Millman well was--when the Strata well was drilled.

MR. KELLAHIN: The pool was established on July 1, 1991, by Order No. R-9545.

Q. Mr. Lee, have you done any similar graphs in terms of production for any of the other wells in the pool?

A. No, I did not. This was the main one to be concerned with. And, looking at the tabular data, we kind of, you know, the Federal 5, the rates would drop or your oil and gas rates would drop and your GOR would be going up.

Q. That's directly opposite to what the Chi well exhibits?

A. Um-hm.

Q. What's the explanation for that?

A. We haven't talked to the--I have not talked to the Mewbourne engineers. One possible explanation that I would throw out, looking at it, what I was thinking is that possibly as they were producing the well, they may have choked it back realizing they were getting into an overproduced status. And, as they choked it back, the well may have been loading up. That is sort of what the Chi well exhibits.

The GOR does go up with the lower choke sizes, as you can see is there in the early part of the productive history of the Winchester well.

Q. Have you talked to Mewbourne and Strata regarding your request, or has there been any discussion with those two operators?

MR. KELLAHIN: Mr. Examiner, we've notified those operators and all interest owners in the pool, and I believe we have the support of Mewbourne for the request, and we have no objection from Strata or anyone else.

MR. BRUCE: There have been some discussions, I believe, with Mewbourne, Mr. Examiner.

Q. It's your opinion, Mr. Lee, that the increase to 20,000-to-1 is not going to reduce ultimate recovery from the pool?

A. No, I don't believe it will.

Q. In either oil or gas?

A. That's correct, based on what the PVT data says.

Q. You said it was your opinion this ought to be classified as a gas well. Have you looked at drainage areas at all of this pool?

A. No, we haven't, because in our well there's not enough production history or pressure data to determine any sort of a drainage area.

After you produce it for six, seven months we let it build up and see how much pressure loss we've had and start doing some P over Z plotting. I didn't have any data like that for the Mewbourne well, either.

Q. It's Chi's intent to drill two or three more additional wells and to, essentially, cluster those wells on a 160-acre tract?

A. The well that's being drilled now has to be drilled as per, you know, because of some farmout obligations.

Q. Which well is currently being drilled?

A. Well, the pad has been built--the well in Section 3, directly east of the Winchester 1.

Q. And Chi has intentions to drill a well directly south of that next well, south of the well in Section 3, on the next 40-acre tract?

A. I'm not sure there's any intent to do that right now, if it was classified as a gas pool, you know, for sure or not. Even with only being in the 2,000-to-1 GOR oil pool, I'm not sure that that's something that we would want to do until we get a little bit of production history to where you can start calculating some drainage areas here.

Q. The discrepancies that the Aquila Federal exhibits, you mentioned it might be due to some--I'm sorry, what was it again that you said it might be due to?

A. The Aquila Federal, the gas there was not being sold and coming out of the separators. It was questionable as to whether or not they were measuring the gas as closely as they should have been.

Q. What were they doing with that gas?

A. I'm not sure.

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

MR. KELLAHIN: Mr. Examiner, I submit to you my Affidavit on the mailing of notification to the parties affected by this application. Attached are the copies of the return receipt cards. It's marked as Exhibit No. 10. We would move its introduction at this time.

EXAMINER CATANACH: Exhibit No. 10 will be admitted as evidence.

MR. KELLAHIN: If the Examiner chooses to approve our application, we would request an effective date that corresponds to the date of first production on Chi's Winchester Federal No. 1 well, and that completes our presentation.

EXAMINER CATANACH: To that effect, Mr. Kellahin, let me ask you or Mr. Lee the necessity for that request?

THE WITNESS: As per the OCD rules at 2,000-to-1, we're overproduced probably about 100 days worth of gas. And so we would like to have it put back to the date of first production so that we don't have to shut our well in for 100 days waiting to make up the 2,000-to-1 overproduction, when we have our 20,000-to-1 limitation now.

MR. KELLAHIN: Those producing rates were done in order to establish some of the test information on the gas-oil ratio, and if you believe the PVT data, then I think it's an unreasonable penalty on the well to arbitrarily say that from today forward it gets 20,000-to-1 gas-oil ratio, when in fact it would be appropriate to make it from the date of first production.

EXAMINER CATANACH: Okay. Anything further?

There being nothing further, Case 10556 will be taken under advisement.

(And the proceedings concluded.)

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 10556, heard by me on September 17 1992.

David R. Catanach, Examiner
Oil Conservation Division

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 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 October 5, 1992.

CARLA DIANE RODRIGUEZ, RPR
CSR No. 4