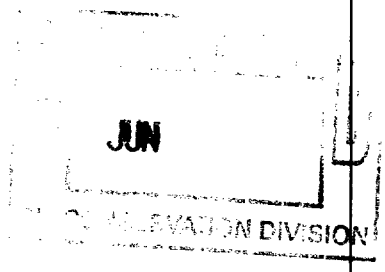
STATE OF NEW MEXICO

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. 10,746

IN THE MATTER OF CASE NO. 10,746 BEING REOPENED

ORIGINAL

REPORTER'S TRANSCRIPT OF PROCEEDINGS

EXAMINER HEARING

BEFORE: MICHAEL E. STOGNER, Hearing Examiner

May 18th, 1995

Santa Fe, New Mexico

This matter came on for hearing before the Oil Conservation Division on Thursday, May 18th, 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.

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Examiner Hearing
CASE NO. 10,746

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A P P E A R A N C E S

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By: JAMES G. BRUCE

* * *

WHEREUPON, the following proceedings were had at 9:55 a.m.:

EXAMINER STOGNER: Call Case Number 10,746.

MR. CARROLL: In the matter of Case Number 10,746 being reopened to the provisions of Division Order Number R-9952-A, which promulgated temporary special rules and regulations for the East Catclaw Draw-Delaware Pool in Eddy County, New Mexico.

EXAMINER STOGNER: At this time, I'll call for appearances.

MR. BRUCE: Mr. Examiner, Jim Bruce from the Hinkle law firm in Santa Fe, representing Devon Energy Corporation, Nevada.

I have one witness to be sworn.

EXAMINER STOGNER: Are there any other appearances in this matter?

Will the witness please remain standing?

(Thereupon, the witness was sworn.)

RICHARD J. MORROW,

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

DIRECT EXAMINATION

BY MR. BRUCE:

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

A. My name is Richard J. Morrow.

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

A. I'm employed by Devon Energy Corporation as a senior reservoir engineer.

Q. Have you previously testified before the Division?

A. Yes, I have.

Q. And were your credentials as a reservoir engineer accepted as a matter of record?

A. Yes, they were.

Q. And are you familiar with the engineering matters pertaining to this pool?

A. Yes, I am.

Q. And in fact, did you testify in front of the Division regarding the promulgation of these special pool rules a couple years ago?

A. Yes, I did.

MR. BRUCE: Mr. Examiner, is the witness qualified?

EXAMINER STOGNER: He is.

Q. (By Mr. Bruce) Initially, Mr. Morrow, what is Devon's position here today?

A. As you'll recall by Order Number 9952-A, in November of 1993, we were granted temporary field rules for a period of 18 months, with an increased gas allowable of 6000-to-1 GOR.

Q. And you are appearing here today in support of the continuance of that rule?

A. Yes, we would like that 6000 GOR limit to be permanent.

Q. Mr. Morrow, would you please refer to your Exhibit 1 and just orient us regarding this pool?

A. Exhibit Number 1 is a map of the area. I've outlined Sections 9 and 16, Township 21 South, Range 26 East, of Eddy County, New Mexico. This is the East Catclaw Draw Delaware Pool.

In Section 9 there are seven wells which have been -- which are operated by Chi Energy.

We are in the process of developing Section 16. There are currently four producing wells, and we are in the process of depleting four additional wells in the Delaware.

MR. BRUCE: Mr. Examiner, the official pool boundaries in the Division's records right now are all of Section 9 and the west half of Section 16, although I think there's a nomenclature case expanding the pool boundaries coming up on June 1.

Q. (By Mr. Bruce) Mr. Morrow, let's discuss the geology of this pool briefly, and could you refer to your Exhibit 2 and describe its contents for the Examiner?

A. Exhibit Number 2 is simply a map of the same area, showing the structure of a Cherry Canyon Marker,

which is within the producing Delaware formation in this pool.

It shows a structural high, which covers Section 9 and 16 and a few portions of the surrounding section.

Q. Is there a fair amount of structural relief in this particular Delaware pool?

A. Yes, there is. Our Cactus State Number 1, which is in the northeast of the northwest quarter of Section 16, is probably the highest well in the pool, and this marker -- It is at an elevation of plus 192.

Some of the lower producing wells are essentially 100 feet downdip from that well in a very short distance, so there is quite a bit of structural relief in this pool.

Q. Would you then move on to your Exhibit 3 and identify it for the Examiner and discuss the particular zone of interest in this pool?

A. Exhibit Number 3 is a -- basically a north-south cross-section, starting up in Section 9 and extending down through Section 16.

This just basically shows you the producing Delaware section in the pool. There's about 500 feet of Delaware sands. Numerous sands produce in different wells in the pool.

I've shown -- Colored in green are the perforated intervals in the different wells. Perforations range

anywhere from 2700 feet down to slightly deeper than 3200 feet in some of these different sands.

But this just shows the continuous nature of the Delaware sands across this pool.

Q. And these are all Cherry Canyon wells, are they not?

A. Yes, sir, they are.

Q. Let's move on to data from the wells in the pool, and if you could refer to your Exhibit 4, what does that show, Mr. Morrow?

A. Several of these next few exhibits are just updated exhibits from previous hearings.

Exhibit Number 4 is simply a tabulation of the monthly production from the Chi wells in Section 9. These were the first wells in the pool.

And what I would refer you to is the second page. The very bottom line, highlighted in yellow, is the cumulative gas-oil ratio that these wells have produced since they went on production. And I would just like to point out that the gas-oil ratios range from over 2000 in one well to over 4300 in another well. So this just shows that the pool is a high gas-oil ratio oilfield.

Q. And the Chi wells are the oldest wells in the pool, are they not?

A. Yes, sir, they are.

Q. Okay. What does Exhibit 5 show?

A. Exhibit Number 5 is also -- was also used in a previous hearing.

This is simply an equation from a petroleum reservoir engineering textbook by Craft and Hawkins, which shows the fractional recovery of oil in place as a function of different fluid properties.

And I've quoted one sentence down there below which shows that the fractional recovery is fixed by the PVT properties of the reservoir fluid and the produced gas-oil ratio.

We introduced this at a previous hearing to show that the ultimate recovery in this field is a function of the produced gas-oil ratio, and then we attempted to show that the produced gas-oil ratio is independent of producing rate.

Q. And will you shortly show some of that data to the Examiner?

A. Yes, I will.

Q. What about Exhibit 6? Was this shown previously to the Division?

A. Yes, Exhibit Number 6 was a test we ran on our Cactus State Number 1 well prior to the last hearing.

We had been producing this well on a 12/64 choke at a rate of about 80 barrels a day, which is the oil

allowable, and we were producing about -- between 5000 and 6000 gas-oil ratio, as shown on this plot.

We wanted to see how affecting the producing rate would change the gas-oil ratio, if it was sensitive to the oil rate.

So we reduced the choke to a 10/64, reduced the oil rate to about 50 barrels a day, but the gas-oil ratio remained constant. We then reduced the choke further to an 8/64 choke, reducing oil production to about 30 barrels a day, and again the gas-oil ratio remained relatively constant.

So with this data showing that the gas-oil ratio is independent of oil rate, coupled with that previous exhibit, we felt that the ultimate recovery of the pool would not be affected by the producing rate of the well.

Q. Let's get into your new data, Mr. Morrow. Could you refer to your Exhibit 7 and discuss its contents?

A. Yes, this hearing which granted us temporary field rules, the Commission requested that we gather some additional data on the reservoir, one of which was some PVT, pressure-volume-temperature, data on the oil in the ground. And this is just a summary of the PVT data that we took on our Cactus State Number 2 well.

And I would point out three pieces of data on this page.

The very first one, the average reservoir pressure of 1282 pounds when this sample was taken, compare that to the saturation pressure of 1277 pounds, which was determined in the laboratory. This shows that the reservoir is essentially at the bubble point, and any further reduction in pressure will result in free gas being produced in the reservoir.

The third number on that page, going down to the third box, is a solution gas-oil ratio of 512 standard cubic feet per barrel of residual oil. This is relatively low, and it appears contradictory to our request for increased GOR. But in some further exhibits I will show how you have to consider all the various aspects of the reservoir, not simply the PVT data, in determining the producing gas-oil ratio in the field.

Q. Okay, let's do that, let's move on to your Exhibit 8. Would you identify that for the Examiner, please?

A. Exhibit Number 8 is a plot of the gas-oil relative permeability ratios versus gas saturation in the reservoir.

We -- In attempting to gather additional data in this field, we took a core on the Cactus State Number 3, and we've also taken some core samples on the Cactus State Number 5 well.

And as part of our study we took -- we had some special core analysis performed for us. And one of the data they performed -- One of the tests they performed is what's called a gas-oil relative permeability. And what this shows is the relative ease at which gas flows through the reservoir, as opposed to the oil. As you increase the gas saturation in the reservoir, the gas tends to flow easier than the oil.

And what this graph shows is a very low -- what's called a critical gas saturation. As soon as you develop about 1-percent gas saturation from the reservoir, you start getting free gas flowing.

So even though you have a low solution gas-oil ratio, as soon as you drop the pressure a little bit and get a little bit of gas saturation, you can very rapidly climb that curve and get a large producing gas-oil ratio.

Q. So almost as soon as you start producing these wells, the gas-oil ratio will increase?

A. Yes, sir.

Q. And was this noticed on the Chi wells, the original wells in the pool?

A. Yes, almost immediately upon production they started producing over 2000 GOR.

Q. What does Exhibit 9 show?

A. Exhibit 9 is -- There are four pages in Exhibit

9, and these are just production plots from the four wells that we have on production.

I've shown gas-oil ratio, oil production in barrels per day, and water cut for each plot.

Cactus State Number 1 shows that almost immediately upon production, we were producing over 3000 GOR, and since that time it's been fluctuating between 3000 and 5000 GOR, fairly constant at the 80-barrels-a-day oil allowable.

Second page, Cactus State Number 2, is very similar to that. It has a slightly lower GOR, but it's been producing over 2000 GOR, very constant, since the well has been put on production.

The other two wells, 3 and 4, also show a constant GOR since they have been put on production also.

Q. Did you do any simulation of this reservoir?

A. Yes, we did.

Q. And what does Exhibit 10 show?

A. Exhibit 10 are some summary results from some reservoir simulation. We contracted with a group in Dallas, Texas, called the Scotia Group, to do a reservoir simulation of this field.

I believe, Mr. Stogner, you have a complete copy of the simulation study. The rest of the exhibit packets just have about five pages that I've copied out of that

study.

We asked the Scotia Group to model a single well with the properties that we obtained from the PVT and the core analysis. We did not intend for them to perform a rigorous full-field simulation, nor to history-match a specific well. We wanted them to run a one-well depletion study on a 40-acre typical well in the East Catclaw Draw field, which they accomplished for us.

What they did, they ran two cases, one which was restricted by 80-barrels-a-day oil allowable. The second case, the only thing they changed was, they restricted the flow rate to 160 MCF a day, which is the 80-barrels-a-day allowable, times the 2000 GOR limit.

And what they talk about here in the summary and which is shown in the results Table Number 1 there, is that even though the rates differed, that the cumulative volumes of oil and gas recovered during the simulated period were little affected.

On the second page there are, also under the conclusion, Conclusion Number 1 is basically the same statement, that essentially the same cumulative volumes of oil and gas were recovered in the life of the well.

The other -- I've copied some exhibits out of that study. Figure 6 is simply the simulation results showing the well constrained by the 80-barrel-a-day oil

allowable and allowing the gas production to increase to well over 300 MCF a day, with the GOR curve on the bottom there.

Figure Number 7 is the Case Number 2, which is constrained by the 160-MCF-a-day gas allowable, and that shows the oil production falling off rapidly with the increase in GOR.

Figure Number 8 compares the cumulative oil production from Case 1 and Case 2, which shows essentially that the end of 6000 days, which is 16 years, that the cumulative oil and gas-and-oil recovery is the same.

Figure Number 9 shows the cumulative gas production is essentially the same.

So this simulation supports our contention that the rate of recovery will not affect the ultimate recovery of the field.

Q. Would you please summarize your conclusions based on the data you've presented today, Mr. Morrow?

A. We feel that all the data we've gathered supports the continued 6000-to-1 GOR. We showed initially that theoretically -- theoretical equations show that the ultimate recovery will not be affected by rate.

We've shown that in the field, both by the short-term tests on the Cactus State Number 1 where we varied the choke size and showed that the gas-oil ratio was

independent of rate. Also, the long-term production tests on the wells showed that the gas-oil ratio has been high but very steady.

And finally, we had some simulation run that also supports the conclusion that the cumulative recovery will not be affected by the rate.

Q. And in your opinion, this is a solution gas drive reservoir?

A. Yes, we believe it is.

Q. And referring back to your Exhibit 1, there is still a fair amount of undeveloped acreage in this pool, is there not?

A. Yes, we feel we have quite a bit of development potential in our Section 16.

Q. Were Exhibits 1 through 10 prepared by you, under your direction, or compiled from company records?

A. Yes, they were.

Q. And in your opinion, is the continuance of the 6000-to-1 gas-oil ratio for this pool in the interests of conservation and the prevention of waste?

A. Yes, it is.

MR. BRUCE: Mr. Examiner, at this time I move the admission of Devon Exhibits 1 through 10.

EXAMINER STOGNER: Exhibits 1 through 10 will be admitted into evidence.

EXAMINATION

BY EXAMINER STOGNER:

Q. Was the studies that were done -- were they primarily -- or were they exclusively held into that portion of the Delaware formation you're showing to be -- What? The Brushy Canyon?

A. We believe these are Cherry Canyon zones.

Q. The Cherry Canyon?

A. Yes, they were.

Q. Are any other zones like the Brushy Canyon that are productive in this pool?

A. No, there are not.

Q. There are not?

A. These are all Cherry Canyon.

Q. In looking at your Cactus State Number 1 test, especially early on -- or your production rates, especially early on -- it seems like to me maybe 6000 might have been too high, 2000 too low.

What would be the effect should this be rolled back to a 4000-to-1 GOR, poolwide? What kind of effect would Devon experience, or any other operator for that matter?

A. Well, if you look back on the -- Well, both Exhibit Number 6 and Exhibit Number 9, which are production plots for the Cactus State Number 1, initially we were

producing between a 5000 and 6000 GOR.

And if you look at Exhibit Number 9, at one point we did exceed the 4000 GOR, albeit it was only for one month.

We would like to see the 6000-to-1 retained, because even though we think we know what we have in this field, we are still developing it and further wells may be greater than 4000 to 1.

Q. Has that Cactus State Number 1 -- has it been producing off that 8/64 choke when it was installed, since September, 1993? Is that what it's been producing through since then?

A. Oh, no, sir, it's back on at least a 12/64. We may have even opened it to a 14/64 to maintain our 80-barrel-a-day oil allowable.

Q. Do you know when that 12/64 or 14/64 was put back in there?

A. No, sir, I do not. I have don't have that data with me. I could find out very easily, if you'd like me to.

Q. No, I don't think that's necessary. I was just trying to --

A. Basically, it was put back on a 12/64 after we ran this test, prior to the last hearing, it was returned to 80-barrel-a-day test.

The current choke setting, I'm not exactly sure of.

If I may go back to the previous question about whether the 6000 was too high, 2000 too low, what would happen at 4000? One thing I forgot to mention was, in our simulation study there, that gas-oil ratio gets quickly up to 6000 or 7000 GOR on our simulation study and shows that this pool could ultimately produce at that high of a gas-oil ratio.

Q. Usually a solution gas drive reservoir of this type, isn't it somewhat sensitive to raising the -- rise of the GOR for production purposes?

A. I'm not sure I understand your question.

Q. Okay, is a pool of this type, being a solution gas drive -- Normally isn't it somewhat sensitive to such production levels where you do increase the gas production over the oil to -- Doesn't that affect the drive mechanism, usually?

A. Well, again, you have to consider all the various data that goes into the -- not only the drive mechanism, but the relative permeability effects, the completion techniques, the PVT data.

A solution gas drive reservoir may or may not be directly affected by the producing rate. I think we've shown in this particular case that it is not affected by

the results of our choke tests and our long-term production rates.

Q. Those are the other factors?

A. Yes, sir.

Q. How are these wells completed?

A. These are fracture-stimulated --

Q. Initially?

A. -- in several different sands, yes.

Q. Several different sands in the --

A. Yes, within the pool limits.

Q. In the Cherry Canyon?

A. Yes.

Q. Because the pool limit is somewhat big.

A. Yes.

Q. But you just told me that Brushy Canyon and some of those other portions didn't produce.

A. No, sir.

Q. Okay, I guess I want to refer to your Exhibit Number 3, which is your cross-section, and it shows some green perforated areas.

Are there any other portions of the Delaware formation, other than what's indicated here, that are producible?

A. In our wells we have seen some shows that are slightly uphole from the sands that we have perforated, but

they are also still in the Cherry Canyon sequence. So they would still be in the same pool.

We have not perforated in some of the uphole zones that we have seen shows in, to answer your question.

EXAMINER STOGNER: Okay. Are there any other questions of this witness?

MR. BRUCE: No, sir.

EXAMINER STOGNER: You may be excused.

Anything further in this case?

MR. BRUCE: No, Mr. Examiner.

EXAMINER STOGNER: If not, then, the matter of Case 10,746 will be taken under advisement at this time.

(Thereupon, these proceedings were concluded at 10:18 a.m.)

* * *

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. Reopened 10746 heard by me on 8 May 1995.

Michael E. Stogner, Examiner
Oil Conservation Division

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 May 23rd, 1995.

STEVEN T. BRENNER
CCR No. 7

My commission expires: October 14, 1998