STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION
STATE LAND OFFICE BLDG.
SANTA FE, NEW MEXICO
21 October 1981

EXAMINER HEARING

IN THE MATTER OF:

Application of Yates Petroleum Corporation for designation of a tight formation, Eddy County, New Mexico.

CASE 7352

BEFORE: Richard L. Stamets

TRANSCRIPT OF HEARING

A P P E A R A N C E S

For the Oil Conservation Division:

W. Perry Pearce, Esq.
Legal Counsel to the Division
State Land Office Bldg.
Santa Fe, New Mexico 87501

For the Applicant:

Chad Dickerson, Esq.
LOSEE, CARSON, & DICKERSON
P. O. Drawer 239
Artesia, New Mexico 88210

INDEX

E X H I B I T S

MR. STAMETS: We will call next Case 7352.

MR. PEARCE: Application of Yates Petroleum Corporation for a designation of a tight formation, Eddy County, New Mexico.

MR. DICKERSON: Chad Dickerson, of Artesia, New Mexico, Mr. Examiner, appearing on behalf of the applicant, and we have two witnesses.

(Witnesses sworn.)

MR. DICKERSON: We call Mr. Ray Beck at this time.

RAY BECK

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

DIRECT EXAMINATION

BY MR. DICKERSON:

Q. Will you state your name, your occupation, and by whom you're employed, please?

A. Ray Beck, petroleum geologist, Yates Petroleum Corporation, Artesia, New Mexico.

Q. Mr. Beck, would you briefly summarize your educational and work experience background as it relates to this application?

A. I have a Bachelor of Science degree and a Master of Science degree in geology from Texas Tech University.

I worked for Shell in Texas for nine years and I worked for Yates Petroleum for ten years in southeast New Mexico.

Q. And are you familiar with the subject lands in question?

A. Yes.

Q. And have you prepared certain exhibits upon which you intend to rely today?

A. I have.

Q. Would you briefly describe this formation for which tight formation designation is sought, Mr. Beck, by geological parameters? And briefly state the purpose of this application on behalf of Yates Petroleum Corporation?

A. As to the application, Yates Petroleum Corporation seeks tight formation designation for a portion of the Permo-Penn underlying lands in western Eddy County, New Mexico, which are described in Exhibit Number One and shown in map form in Exhibits Numbers Two and Three.

The description of the formation by geological parameters is as follows: The formation sought to be covered by this application is that stratigraphic interval between the top of a marker named the Third Sister Cycle of the Wolfcamp series of the Permian system, and the top of the Canyon series of the Pennsylvanian system.

Correlations of the Third Sister Cycle and the Canyon Series are shown on a network of four cross sections spread over the subject area, Exhibits Five through Eight.

Positions of the Third Sister and Canyon geologic column are illustrated in Exhibit Number Four.

The Third Sister Cycle to Canyon Series varies from approximately 1000 to 1400 feet in thickness.

Q. Mr. Beck, please refer specifically to Exhibit Number One and describe for the Examiner what this exhibit reflects.

MR. STAMETS: If -- I don't believe I've said the witness is qualified, but he is.

Q. What is Exhibit Number One, Mr. Beck?

A. Exhibit Number One is a list which describes the lands which overlie the Permo-Penn interval for which tight formation designation is sought in this application.

Q. And that's approximately 318,000 acres in Eddy County, New Mexico, is that correct?

A. That is correct.

Q. And what is reflected by Exhibit Number Two?

A. Exhibit Number Two is a map of one inch equal 5000 feet scale, which shows the lands described in Exhibit Number One.

The subject area stretches over a portion of western Eddy County, New Mexico from the Pecos River east of the City of Artesia to the Huapache Monocline some forty miles to the southwest.

Also shown by circled well spots are all wells within the outline which have penetrated the above defined Permo-Penn formation and/or lower horizons.

Red colored well spots are wells which are currently producing gas from the above defined Permo-Penn interval.

Deposits of the subject Permo-Penn interval are a complex of three major environments of deposition or facies, shelf, bank, and basin facies.

The shelf facies, lying in bands to the west or northwest, is comprised of interbedded limestones, shales, siltstones, and sandstones.

Terrigenous clastics, that is shales, siltstones, and sandstones, increase, and marine limestones and shales decrease, traversing from east to west or southeast to northwest; that is, in a shelfward direction.

Deposits of the shelf facies are effectively non-porous and impermeable, and constitute an up-dip mega-seal to the bank facies.

The bank facies is composed mostly of marine limestones with a few intercalated marines shales. These marine limestones are made up of bioherms and their associated debris aprons interfingered with oolite bars.

The porosity that is present is a result of preservation of primary porosity, principally of bryozoan material and creation of secondary porosity by leaching of oolitic grainstones and former aragonitic shell material.

Most of the gas production that has been established in the subject Permo-Penn interval has been from deposits of the bank facies.

The basin facies consists mainly of thin-bedded, fine-grained sandstones, siltstones, and shales, which were transported to the relatively deeper basin from the bank and shelf areas during periods of lower sea level.

Main conduits for transport to the basin were through passes between segments of the bank facies.

Scattered within the overall basin facies are isolated limestone or carbonate build-ups, termed isolated mounds. In some of the isolated mounds porosity has been developed and/or preserved, but many are effectively non-porous and impermeable.

Some of the isolated mounds have produced gas. Wells in the basin facies which have encountered mounds are indicated by the letter "M" close by the well spot.

About one-third of the subject Permo-Penn interval in the upper part, has been termed the Antelope Sink Zone, named for an interval in the Sun, formerly Tom Brown, No. 1 Antelope Sink Unit, in Section 18, 19 South, 24 East. This well is shown on two cross sections, Exhibits Six and Eight.

The geographical limits of shelf, bank, and basin shown on Exhibit Two are for the Antelope Sink Zone alone.

Lower zones of the subject Permo-Penn interval are not shown, but their facies trends are essentially parallel to those shown on Exhibit Number Two.

Exhibit Number Two also shows the traces of the cross sections intorduced in later exhibits.

Q. Mr. Beck, please refer to Exhibit Number Three and describe what it shows.

A. Exhibit Number Three is identical to Exhibit Number Two from the standpoint of scale, outline of lands, well spots, and colored well spots.

The purpose of this exhibit is to illustrate the structural attitude of the Permo-Penn formation in the subject area.

Mapping was done on the top of the Antelope Sink Zone in the shelf and bank areas, and on top of the Canyon Series in the basinal areas.

As the cross sections will show, the Antelope Sink Zone is essentially parallel with the Third Sister Cycle above.

Dashed contours are 100 feet contour intervals on top of the Antelope Sink zone. Solid contours are 100 foot contour intervals on the top of the Canyon Series.

These contours indicate that over most of the outlined area the Permo-Penn interval dips to the east, southeast, at approximately 100 feet per mile; however, in the southwestern part of the outlines area, near the Huapache Monocline, the Permo-Penn interval dips east to northeasterly at 200 to 300 feet per mile and structure is complicated by faulting.

Structural relief on the top of the subject Permo-Penn is approximately 3300 feet in the outlined area. Ground level elevations rise approximately 1500 feet from wells near the Pecos River in Township 17 South, Range 26 East, to wells near the Huapache Monocline in Township 21 South, 21 East.

The drill depth to the top of the Third Sister Cycle in the highest well, the Pennzoil No. 1 United Federal, in Section 28 of 21 South, 21 East, is 4927 feet. And the drill depth to the top of the Third Sister in the lowest well, the HEYCO No. 1 Big Boggy State, in Section 36 of 17 South, 26 East, is 6717 feet.

The average depth to the top of the subject Permo-Penn formation is thus 5822 feet, and there's a correction from that in the statement we sent in to the OCD and the USGS. There's a typographical error there of it says 5827, but it's really 5822.

Q. And that mistake is not material, Mr. Beck, is it --

A. No.

Q. -- for the purposes of this application?

A. No, sir, it's just a typographical error.

Q. Refer to Exhibit Number Four and describe what it shows.

A. Exhibit Number Four illustrates the stratigraphic column present in western Eddy County, New

Mexico.

This geologic section was compiled from New Mexico Oil Conservation Division reference cross sections and other industry accepted correlations.

The main purpose of this exhibit is to show the Permo-Penn stratigraphic interval sought to be covered by this application in relation to geologic time and other stratigraphic horizons.

Q. Refer to Exhibit Number Five and describe what it reflects.

A. Exhibit Number Five is a northwest to southeast stratigraphic cross section, A-A', hung on the Third Sister Cycle of the Wolfcamp Series.

This cross section is transverse to the three major facies trends of shelf, bank, and basin.

Other pertinent correlations shown are the top of the Antelope Sink Zone of the shelf and bank facies, top of the Pennsylvanian, by correlating with the New Mexico Oil Conservation Division reference cross sections, and the top of the Canyon Series.

Drill stem test, core, and completion data are shown on the cross section.

Well No. 6 was cored in the Permo-Penn and the core analysis report is given at a later exhibit.

Wells 2, 3, and 5 are currently producing Permo-Penn gas and have been assigned to the Eagle Creek Permo-Penn Gas Field by the New Mexico Oil Conservation Division.

Wells 4 and 6 should produce Permo-Penn gas but they have not yet been completed in that interval.

Note that Well 8 produced gas from an isolated mound. This well was assigned to the Atoka Cisco West Gas Field, and produced 64,125 Mcf of gas and 146 barrels of condensate before abandonment in 1980.

Q Mr. Beck, please go to Exhibit Number Six and describe what it shows.

A Exhibit Number Six is a northwest/southeast stratigraphic cross section, B-B', which is again hung on the Third Sister Cycle and is transverse to the three major facies of shelf, bank, and basin.

I might just add here off -- off the written thing that we handed in, that we're moving from north essentially to south on these three transverse cross sections.

A key correlation well, the Sun, Tom Brown, No. 1 Antelope Sink Unit, is Well 3. Tops pertinent to this application are picked in this well as follows: Third Sister, 5860; Antelope Sink Zone, 6080; top of the bank facies, 6140; top of the Pennsylvanian, by correlation with the New Mexico Oil Conservation Division reference cross sections, 6190; base of the bank facies, 6449, on the written transcript we sent earlier it was 6420. That's a mistake. It should be 6449. And the Canyon Series is 7060.

Note that the perforated interval straddles the systemic boundary between the Permian and the Pennsylvanian.

And Antelope Sink Unit No. 1 has been assigned to the Antelope Sink Upper Penn Gas Field.

Well 4 should also produce Permo-Penn gas but it has not yet been completed in that zone.

Q. Refer to Exhibit Number Seven, Mr. Beck, and describe what it shows.

A. Exhibit Number Seven is another northwest to southeast stratigraphic cross section, C-C', which is also hung on the Third Sister Cycle.

Wells 4 and 6 are producing gas from the Permo-Penn formation and have been assigned to the Box Canyon Permo-Penn Gas Field.

Q. Now refer to Exhibit Number Eight, please, and describe what it shows.

A. Exhibit Number Eight is a southwest to northeast stratigraphic cross section, D-D', which is hung on the Third Sister Cycle. This longitudinal, or strike, cross section is more or less parallel to the major facies of shelf, bank, and basin.

The purpose of this cross section is to tie the three previous transverse cross sections.

It may be noted that the main gas productive Antelope Sink Zone bank facies correlate very well, on the left, from the Box Canyon Permo-Penn Gas Field to Antelope Sink Upper Penn Gas Field to the Penasco Draw Permo-Penn Gas Field to the Eagle Creek Permo-Penn Gas Field.

Q. Mr. Beck, were Exhibits One through Eight prepared by you or under your direction and supervision?

A. Yes, they were.

MR. DICKERSON: Mr. Examiner, at this time Applicant would move admission of Exhibits One through Eight.

MR. STAMETS: These exhibits will be admitted.

MR. DICKERSON: And that concludes our direct testimony from this witness.

CROSS EXAMINATION

BY MR. STAMETS:

Q. Mr. Beck, you've presented quite a number of logs here. I want to discuss just briefly what produces in this interval, or what may produce.

As you were going through here you named off certain wells and indicated that a zone might be productive later on which wasn't completed there now.

It would appear to me as though in your discussion primarily you are looking at the bank facies or these mounds as being the producing intervals throughout this section.

A. Correct.

Q. Are any of the other zones outside the banks or mounds apt to be productive?

A. In this -- in this geographical area they're all -- they're either completed from the bank facies or from the isolated mounds. There is nothing producing, or there's no sand intervals to be produced -- that are producing. These are all carbonates.

What we tried to do here is include the bank and the isolated mounds together because they're both carbonates, they're both tight, as will be presented by the following witness from the engineering data. We just tried to pick something that could be correlated throughout this geographical area and to include all the carbonates that produce in this thing in that envelope between the Third Sister as we picked it on the Tom Brown Antelope Sink Well and the Canyon.

Really, so far all that's been produced is the bank facies and a few of the isolated mounds, and most of the isolated mounds are really either tight or haven't -- or are limited.

Q. The engineering witness who we will hear shortly, will be making his determinations as to productivity, permeability, from the same bank and mound sections.

A. Yes, sir. He has got every well listed that has penetrated the Permo-Penn at least as far as the Canyon, and all the wells that are currently producing, has the data on all of those, and he can show from that.

We were just trying to establish here the geological parameters of the formations we're wishing to be designated as tight formation, and also the geographical area.

Q. But you would not expect to be making a well in the first 100 feet of the section anywhere.

A. No, sir, it's all tight Wolfcamp beds, and I can think of nothing in the geographical area in this envelope that's not -- that would not be tight.

Q. Okay.

MR. STAMETS: Any other questions of

this witness? He may be excused.

MR. DICKERSON: Call Mr. David Boneau at this time.

DAVID F. BONEAU

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

DIRECT EXAMINATION

BY MR. DICKERSON:

Q. Will you state your name, your occupation, and by whom you're employed?

A. I'm David Boneau. I'm a reservoir engineering supervisor for Yates Petroleum Corporation in Artesia, New Mexico.

Q. Mr. Boneau, have you -- would you briefly summarize your educational and work experience for the Examiner?

A. Yes. I have a BAchelor of Science degree in physics from the University of Notre Dame in 1962 and a PhD in physics from Iowa State University in 1969.

For twelve years after I worked for Phillips Petroleum Company in Bartlesville, Oklahoma, and in Odessa, Texas. In Odessa I was reservoir engineer for the

Goldsmith District and in Bartlesville I served in various responsibilities, including reservoir enginerring supervisor for the Phillips R & D Department.

Q. Mr. Boneau, as part of your responsibilities, have you made an examination and a study of the wells in question upon which you intend to testify today?

A. Yes, sir.

Q. And are you familiar with this application?

A. Yes, sir.

MR. DICKERSON: Mr. Examiner, is this witness considered qualified?

MR. STAMETS: He is.

Q. Mr. Boneau, would you briefly state what you intend to show by the exhibits upon which you will testify?

A. Yes. The data that I'm going to present will show that the Permo-Penn interval defined by the previous witness meets the guidelines set forth by the Federal Energy Regulatory Commission for designation as a tight sand formation under Section 107 of the Natural Gas Policy Act.

These guidelines require, first, an estimated in situ gas permeability throughout the pay section of less than 0.1 millidarcy.

The stabilized production rate against

atmospheric pressure of wells completed for production in this formation without stimulation is not expected to exceed 188,000 cubic feet for production from the average depth of 5822 feet.

And thirdly, no well drilled into this proposed tight formation is expected to produce without stimulation more than five barrels of crude oil per day.

Q. Mr. Boneau, would you refer to Exhibit Number Two, previously introduced, and describe what is pertinent on that exhibit insofar as your testimony is concerned?

A. Okay. Exhibit Two is the map presented by the previous witness on which is outlined the area for which the tight gas designation is sought.

The red dots show the location of the 50 wells that are completed in the designated Permo-Penn interval, as of January 1, 1981.

Triangles indicate wells where drill stem test data was used to calculate in situ permeability of the pay section. There are ten triangles and we'll discuss those permeability calculations in detail later on.

And there's one square which indicates the location of the well where core data is available.

Q. Mr. Boneau, at this time please refer the Examiner to your Exhibit Number Nine and describe what is reflected in it.

A. Exhibit Number Nine is a 29 -- 26 page list of all wells within the boundary of the proposed area that were drilled deep enough to penetrate the designated Permo-Penn interval.

Information on these 333 wells includes well name, location, operator, spud date, total depth, field, and production up to January 1, 1981. The list is current to the start of 1981. That was our cutoff.

Most of these wells were drilled as Morrow prospects to depths near 9000 feet.

There are 119 Morrow producers in the proposed area. These Morrow wells have produced a total of 82.2 billion standard cubic feet for an average of 691 million standard cubic feet per well. The Morrow is the principal gas producing interval in this area.

Many of the deep wells in Exhibit Number Nine will be completed in the designated Permo-Penn formation at some point in the future if the Permo-Penn gas can be produced economically.

In addition, exploratory drilling for Morrow gas will be stimulated somewhat when the tight gas sand designation makes the Permo-Penn interval a more attractive salvage zone.

That's enough about Exhibit Nine, I think.

Q. Refer to Exhibit Number Ten and describe what it shows.

A. Exhibit Number Ten is a list of the 50 wells completed in the designated Permo-Penn interval as of January 1, 1981. Most of the engineering data on the subject formation will come from the wells in Exhibit Number Ten.

Although the average depth to the top of the designated Permo-Penn interval is 5922 feet -- 5822 feet, thank you -- production from 49 of the 50 wells comes from below the 5822 feet. The average depth to the top of the pay zone in these 50 wells is 6490 feet.

These wells have produced a total of 9.01 billion standard cubic feet for an average of 180 million standard cubic feet per well.

MR. STAMETS: Would you give me the average depth for the completion interval on those again, please?

A. Surely. The average depth to the top of the pay zone, the top perforation in the 50 wells, is 6490 feet.

MR. STAMETS: Okay, and then the average production?

A. The average production is 180 million standard cubic feet per well.

MR. STAMETS: Thank you.

A. Surely.

Q. Mr. Boneau, please refer to Exhibit Number Eleven and describe what it represents.

A. Exhibit Eleven is a list of wells that were spudded or completed in the designated Permo-Penn interval after July 15th, 1979.

These eight wells are the only ones out of the 50 wells in Exhibit Number Ten that would be eligible for tight gas prices, according to my understanding of the rules, should the present application for tight gas designation be approved.

Approximately five additional wells have come on line in 1981, and according to my understanding, again these would also be eligible if the tight formation designation is approved.

All production from the other 42 active wells will never be eligible for tight gas prices under current regulations.

MR. STAMETS: Mr. Boneau, to your knowledge, were any of these wells on Exhibit Eleven, plus the five that you discussed, drilled specifically for the Permo-

Penn or were those all deeper wells?

A. My memory says that they were all drilled initially to the Morrow. They were all drilled deeper.

MR. STAMETS: Okay, thank you.

A. I have reason to believe that's correct, since Mr. Beck is over here nodding.

So our point in Exhibit Eleven is that our application mainly seeks a long-term opportunity to produce gas from the designated Permo-Penn formation by recompleting wells originally drilled to deeper horizons, and recompleting them in the future, for the most part.

Q. Now, Mr. Boneau, would you kindly analyze your engineering data available?

A. Do you really want to use all this stuff?

Q. As far as it pertains to this application.

A. How about I try to show it in a list.

Q. Okay.

MR. DICKERSON: Mr. Examiner, please note that the written information furnished as the statement of the meaning and purpose of each exhibit does analyze these formulas and so forth in considerably more detail than Mr. Boneau will now go into.

MR. STAMETS: Well, and I would point

out for the record, too, that this application has been carefully examined by Mike Stogner, who is an engineer on the staff of the Division, and any problems therewith have probably been ferreted out by this time and will show up in the cross examination, if any.

A. Okay. So I'd like to say with the foregoing as kind of a background, and the engineering data part of it, we will try to demonstrate that three criteria are met; first, that the average permeability in the natural state is less than, or equal to, 0.1 millidarcy; that the stabilized flow rate before stimulation is less than 188 Mcf per day; and third, that no well produces more than five barrels of oil per day.

The estimated average in situ gas permeability throughout the pay section was calculated by two standard methods that are widely accepted in the industry.

These methods include, first, permeability calculation from pressure build-up data taken during drill stem tests; and second, laboratory measurements on a cored section of the designated Permo-Penn interval from one well, a single well.

First I'm going to talk about permeability calculated from drill stem test data. This kind of data will give a good representation of the in situ permeability, since the drill stem test is performed while the well was still being drilled; the formation has been altered relatively little from its natural condition. If there is some formation damage due to the drilling mud, most of this damage is removed during the preflow phase of the drill stem test.

In contrast, pressure data taken after the well is acidized or fractured will give higher values for the permeability because the formation has been etched and broken by the treatments.

Okay.

Q. Mr. Boneau, refer to Exhibit Number Twelve, please, and describe what it shows.

A. Exhibit Number Twelve shows data from the drill stem test at ten wells within the proposed area. The locations of these wells are indicated by triangles on Exhibit Number Two.

Of the ten wells only Murphy NW Federal No. 1 is not presently completed in the desginated Permo-Penn formation. This well was cored and drill stem tested in the Permo-Penn interval, but it is now a completed Morrow producer.

The values of permeability calculated from the drill stem tests, which are the second column from the right on Exhibit Twelve, range from 0.003 millidarcy for the Irish Hills "KW" State No. 2, up to 0.091 millidarcy for La Cama No. 1.

The average permeability for the ten wells was determined to be 0.031 millidarcy.

The last column in Exhibit Number Twelve, the one that's labeled "Years to Reach Pseudo-Steady State", gives the approximate time required for a pressure disturbance at the wellbore to reach the outer boundary of the reservoir feeding the well.

Said another way, gas near the outer boundary of a reservoir begins to move towards the wellbore at the time indicated in the righthand column in Exhibit Number Twelve.

Flush production of gas relatively near the well occurs until the whole reservoir is feeding the well. Then the pressure begins to drop with time uniformly throughout the reservoir and the flow rate becomes stabilized.

The calculated time to reach stabilized flow ranges from 1.8 years for Well Cities "JG" State No. 1, up to 33 years for Irish Hills "KW" State No. 2.

The average time was determined to be 10.7 years to reach this stabilized flow.

The idea of using a time to reach stabilized flow was introduced here because it follows naturally from the calculation of the formation permeability from the drill stem test data.

I intend to discuss the stabilized flow idea in more detail after all the data on permeability has been presented.

Q. Mr. Boneau, refer to Exhibit Number Thirteen and describe what it shows.

A. Okay. The second procedure for obtaining in situ permeability is to measure the permeability of actual cored sections of the Permo-Penn rock in a laboratory.

The only core data available comes from the Murphy "NW" Federal No. 1 Well, which was the well marked with a square in Exhibit Number Two.

A log of the Permo-Penn interval in the Murphy Well is -- appears in Exhibit Five as Well No. 6.

Exhibit Thirteen, then, shows the permeability measured by CORE Laboratories for the 72 feet of core recovered from this well. Special tests were run on 16 samples from the Murphy core to evaluate the effect of overburden pressure on the core samples in order to determine a representative value for the in situ reservoir permeability.

Routine core analyses are normally run with a confining or overburden pressure of only 200 psi. The overburden pressure within the Permo-Penn formation is really about 3300 psi, and special core tests were required in order to correct the results of routine core analyses for the effect of the actual overburden pressure.

The results of these special tests, performed at an overburden pressure of 3300 psi, are listed in the last two columns of Exhibit Number Thirteen.

So Exhibit Number Thirteen shows both the routine core data and the special core data on the Murphy cores.

Q. Refer, Mr. Boneau, to Exhibit Number Fourteen and describe what it shows.

A. Exhibit Number Fourteen shows the correlation that was developed between the routine permeability at 200 psi overburden pressure and the in situ permeability at the actual overburden pressure of 3300 psi.

Data from the petroleum literature was used to help define this relationship, since there are relatively few data points available from the Murphy core. And an awful lot of the data points appear in the lower lefthand corner at very low permeabilities, and there aren't very many data points in the body of the figure, and I thought that the Amoco experience in the laboratory would help define that relationship.

So the dashed line in Exhibit Fourteen is a correlation developed by a Mr. Jones and Mr. Owens of Amoco Production Company for rocks where overburden pressure has a minimum effect on permeability, and the reference is on Exhibit Fourteen as SPE 75-51.

And this Amoco work was reported in the Journal of Petroleum Technology in September of 1980.

The solid line in Exhibit Fourteen was drawn parallel to the dashed line in order to better fit the actual points for the Murphy core. This solid line was used to convert the routine permeability values into in situ permeabilities values at 3300 psi overburden pressure.

Q. What is shown by Exhibit Number Fifteen?

A. Exhibit Number Fifteen tabulates the permeabilities of the core material from the Permo-Penn pay section in the Murphy "NW" Federal No. 1. Those sections of the interval that the electric log condemned as nonproductive are omitted.

The average routine permeability for the Murphy Well is 0.116 millidarcy, indicated at the bottom of the fourth column.

It happens that the in situ permeability corrected for overburden pressure taken from core data, which is the number at the bottom of the fifth column in Exhibit

Fifteen, both came out to be 0.035 millidarcy for the Murphy "NW" Federal No. 1, and I don't believe it, but that's the way it turned out.

The Murphy Well can be considered a typical well, since its in situ permeability of 0.035 millidarcy is very close to the average 0.031 millidarcy for the ten wells that we talked about drill stem test data in Exhibit Number Twelve.

So as a summary of the permeability data, we have two types of data, the average in situ permeability from drill stem test data, 0.031 millidarcy; the average in situ permeability from the available core data, 0.035 millidarcy.

Both types of engineering data indicate that the permeability of the designated Permo-Penn pay section is comfortably below the 0.1 millidarcy.

Q. What is shown by Exhibit Number Sixteen?

A. Okay. The second criteria relates to the gas flow rates and then the third criteria is the oil flow rates.

The data on the flow rates before stimulation are not available for the vast majority of the wells that produce in the designated Permo-Penn formation. The natural flow rates are so low that they are routinely neither measured nor recorded. The normal completion procedure has been to perforate and treat the well immediately.

In the absence of data on natural flow rates, we propose to use production data for the stimulated wells at a time in their life when the production rates are approaching stabilized rates.

Exhibit Twelve showed that the time to reach the stabilized rate varied from 1.8 to 33 years and averaged 10.7 years. Thus, actual flow rates measured two years into the lives of the Permo-Penn wells will be either near stabilized rates or still considerably higher than the stabilized rates.

Exhibit Sixteen shows actual production rates for the 24th calendar month in the producing lives of the wells that are producing from the designated Permo-Penn formation.

Only 34 of the 50 wells have been producing for two years or longer, and the average rate of gas production for the 32 wells is 144,000 cubic feet per day at the bottom of the first set of figures in Exhibit Sixteen.

And the average rate of oil production, which is at the bottom of the last set of figures in Exhibit Sixteen, is 0.6 barrels of oil per day.

The gas rates vary from one to 655,000

cubic feet per day, and only two wells produced over 300,000 cubic feet per day.

The oil rates vary from zero to 4.1 barrels of oil per day after two years. Only one well produced over two barrels of oil per day, and no well produced as much as five barrels of oil per day in the 24th month after it began production.

The FERC guidelines require that the gas flow rate be measured against atmospheric pressure. The average flow rate of 144,000 cubic feet per day calculated above for stimulated wells, was measured against pipeline pressures of 150 to 300 psi.

The corresponding flow rate at one atmosphere is given by the equation -- I guess I'm stuck with reading the equation -- the flow rate at one atmosphere is the flow rate, the actual flow rate, times the quantity P_f^2 minus P_s^2 at 1 atmosphere over the quantity P_f^2 minus P_s^2 actual conditions.

Now, you just -- why don't we -- can we just go back and skip this?

MR. STAMETS: Is that shown somewhere?

A. Yeah, it's shown on the paper.

MR. STAMETS: What page is that on, Mr. Boneau?

A. Bottom of page seven.

MR. STAMETS: Okay.

A. Why don't we just go back to saying that we calculated for stimulated wells measured against pipeline pressures of 150 to 300 psi. When we calculate the stabilized flow rate for production against atmospheric pressure the 144 Mcf per day becomes 146 Mcf per day in making that correction.

So the rates in Exhibit Sixteen are maximum values, I believe, since all the data applies to stimulated wells and since many of the wells have not yet actually stabilized. Thus, the average gas production rate is about 146,000 cubic feet per day, or less, and the maximum of oil production rate is about 4.1 barrels of oil per day, or less, under stabilized non-stimulated conditions.

Q. Mr. Boneau, what is known regarding the techniques for protection of the fresh water zones in the land in question?

A. Okay. All the wells proposed for tight sand designation, all of this area, lies within the Roswell Artesian Water Basin, as established by the New Mexico State Engineer. This Roswell Artesian Water Basin is a main source of fresh water to Chaves County and northern Eddy County.

Regulations governing the drilling of oil and gas wells within the Basin are enforced by the New

Mexico Oil Conservation Division in order to protect the fresh water formations.

These regulations require that a water protection string be set and cemented through the fresh water bearing strata.

The base of the Artesian aquifer lies at a depth of about 1000 feet at the north end of the proposed area and at a depth of about 1400 feet at the south end.

In a typical casing program conductor pipe is set at a depth of 300 to 400 feet and cement is circulated to surface in order to protect the shallow fresh water.

Then an intermediate string of casing is set about 100 feet below the base of the Artesian aquifer at a depth of 1100 to 1500 feet. Cement is circulated to surface behind the intermediate string to protect the Artesian aquifer.

The production casing is then set at the total depth of the well, which is usually in the Morrow formation, and cemented with 400 to 1000 sacks of cement. This provides a cement shield approximately 1000 feet above the top of the Permo-Penn designated formation.

The application to drill and the casing program for each individual well must be approved by the New Mexico Oil Conservation Division, and by the United States

Geological Survey for wells on Federal lands.

Q. What is shown by your Exhibit Number Seventeen?

A. Exhibit Seventeen summarizes the engineering data that has been presented on the designated Permo-Penn formation.

The average in situ reservoir permeability determined by two standard methods, averages less than the allowed 0.1 millidarcy.

The average stabilized flow rate for gas is below the maximum allowed daily rate of 188,000 cubic feet per day.

And lastly, no well produces as much as five barrels of oil per day under stabilized conditions.

Q. Mr. Boneau, were Exhibits Numbers Nine through Seventeen either prepared by you or under your direction and supervision?

A. Yes, sir.

MR. DICKERSON: Mr. Examiner, at this time Applicant moves admission of Exhibits Nine through Seventeen.

MR. STAMETS: They are accepted.

MR. DICKERSON: And that concludes our direct testimony.

A. Well, may I say one more thing?

Q. Yes, go ahead. Do you have anything else you would like to add, Mr. Boneau?

A. Mike Stogner called me on Monday about-- asking about more detailed data on the drill stem test, and yesterday I prepared quickly some of the data, most of the data, all the data, on four of those ten drill stem tests, and if that question comes up we can talk about it to that extent, or at least I responded to that telephone call to that extent.

MR. DICKERSON: That concludes our direct testimony, Mr. Examiner.

CROSS EXAMINATION

BY MR. STAMETS:

Q. Referring to Exhibit Sixteen, and also Exhibit Twelve, you gave us some information on what you feel a reasonable figure should be for the unstimulated production rates.

Why didn't you show the rates for those DST's on Exhibit Twelve? It would seem like that would give us unstimulated production rates, actual unstimulated production rates.

A. That's a good question and I just happen to have in my pocket a list of those ten drill stem test rates.

Q. Good. I will write those figures down on my copy of this exhibit. I may wind up asking you to do the same later.

MR. DICKERSON: We'll be glad to submit those.

A. The reason that they're not there was that I had the feeling that the 50 wells, that I didn't want to use too small a sample for the average.

Q. Right.

A. And so I went for something that would -- big numbers, and got 34 wells, finally. Okay.

That's no excuse for not giving you ten for you to do whatever you want with them, and I apologize for that.

Oh, hell, I don't -- let's see if I have them in the same order that you have them.

The first one is 25 Mcf --

Q. And that's the Box Canyon Well.

A. Box Canyon.

Q. All right.

A. Cities "JG", 189. Cities "JH", 56. City of Artesia, 83. Federal "BZ" 12, 29. Griffin "JJ", 190. Irish Hills "KW" No. 2, I have 70 written down. I remember it was 69.2, I think, actually, but 70 is fine. La Cama, 136. Murphy "NW", 221. And Powell "DG", 48.

Q. Have you averaged those?

A. The average is 105.

Q. And that's below the magic 188.

A. It's below the 188. It's below the 144 that we get by using actual production at pseudo-steady state conditions.

Q. Have you compared those figures with the ones that you derived on Exhibit Sixteen for the wells that are producing?

A. No, but I'm willing to do it with you now, if you'd like.

Q. Let's just take a look at some there. Box Canyon 4-A, you've got 655 on Sixteen.

A. As compared to 25. Box Canyon 4-A responded to its stimulation. So, that's the highest production rate there. That's right.

Q. And Cities "JG" has produced for less than two years --

A. Less than two years.

Q. -- and there are no figures.

A. "JH" is 96 compared to 56.

City of Artesia, 55, is below the drill

stem test value, 83. Federal "BZ" is 2 compared to it was 29, and the Griffin "JJ", 288, responded somewhat to stimulation.

Q. Is that right? My eyes don't track straight across that page.

Yes, that's correct. Thank you.

A. Irish Hills "KW" has been on line a very -- relatively short time and there's no value. La Cama now produces 337, or its production rate after two years was 337, compared to 136 on the drill stem test.

Murphy is the well that's a Morrow producer, has not yet been completed in the designated Permo-Penn formation.

And the Powell "DG" produces 175 compared to 48 on the drill stem test.

So the actual production is, after stimulation, and let's see if there's really -- really what kind of correlation would we develop.

La Cama, that should stabilize in about two years. You'd think that those numbers would be roughly the same, and it's up to you whether 136 and 337 are roughly the same.

At the bottom, Powell "DG" is 175 compared to 48, but it should take 14 years to stabilize, so it's reasonable that 175 is still above 48.

City of Artesia, that stabilizes in two years, is 55 instead of 83, which is a reasonable comparison, so maybe we could make it sound like there was a reasonable comparison.

Q. When you averaged the rates on Exhibit Sixteen did you include those wells that had produced less than two years in your --

A. Oh, no, no, no.

The average down there is the sum of the numbers divided by 34.

Q. Okay, and 34 of those wells had produced for two years.

A. Right.

Q. And the other with asterisks didn't, but they didn't enter into the calculation.

A. But they did not enter into the calculation one way or the other.

Q. And of those wells, only one is shut-in, so that really has no significant effect on the final outcome of what you've calculated there.

A. Let me state that more precisely. The average 144 is the sum of those numbers divided by 34. 34 is the number of entries, number of numerical entries in the column. So there are -- there are 34 numbers, 14 asterisks, and 2 SI's. The SI's and the asterisks did not enter in the calculation.

I'm sorry to confuse you.

Q. Well, that's all right. That's easy to do in these cases.

Certainly Exhibit Twelve intends to, if not confirm Exhibit Sixteen, but would tend to indicate, if anything, Exhibit Sixteen may be overly generous in this calculation of production against atmospheric pressure.

A. I agree. We -- I told the people that worked on this with me that we were going to make every doubt in the -- on the side of being generous, and we, I think, we did that.

I tried consciously to do that.

Q. Now I presume somewhere are the formulas and factors used in calculating permeability shown on Exhibit Twelve.

A. They -- they are in these pages that I prepared in response to Mike's telephone call, and I have two copies of information on four of the wells. That, I think, is representative of the whole thing and it's just as many as I could get together in an organized fashion in one day.

Q. There is no problem, though, with submitting this information on all of these wells subsequent to the hearing.

A. If you want that information, you'll get that information, I assure you.

Q. Okay. Could you give one copy of what you have to Mike and let him take a quick look at it and see if he has any problems with the data on it?

A. I do have the original on it, an original and two copies, and I'm going to keep the originals.

The reason for the scarcity of -- of copies is that one of the exhibits for each well is a log and it was hand-clored in and the hand-coloring is kind of a limiting factor in getting very many copies made.

Q. But you do have the formula on the front, plus the calculated deliverability -- or --

A. Okay, can I try to explain what's there?

Q. Yeah, you may.

A. There's a summary page on the front with the formulas and the numbers built into the calculations.

There's a Horner plot with a dashed line drawn through what we took as the straight line portion.

There's a gas analysis for the gas from the well, which was used to determine properties like Z, the deviation factor, and the viscosity of the gas.

Then there are three pages that are copied from the Halliburton drill stem test report, which -- the first is like a summary of the drill stem test; then there's the pressure build-up data; and then there's a sheet where Halliburton has listed what it -- the steps it took during the drill stem tests and the rates that it measured.

Then there's a log of the region around the drill stem test interval, with the area showing gas effect outlined in red, and the height of the pay section when the drill stem test was taken from that log.

And on the front page at the bottom we put references of where we got the equations and where we got the charts for the Z factors and the viscosities, and such. We did not include actual copies of those correlations.

MR. STAMETS: Mike will just --

MR. STOGNER: This is what I want.

MR. STAMETS: This is what you want. Okay, so if they can submit that on all the wells, if we have any problems with it, we can correspond and try to get a resolution of them.

MR. STOGNER: This will answer a lot of my questions.

A. On one of the wells I found what I would consider a mistake and it lowered the actual measured permeability, I think, from .003 to .002, or something, but you may notice that I've noted that for your information on this form.

MR. DICKERSON: Should we submit those as numbered exhibits?

MR. STAMETS: Why don't you just submit that as supplemental information to the Exhibit Number Twelve?

MR. DICKERSON: Okay.

MR. STAMETS: And you can just label each one with the well name so it's obvious which they belong to, and then if upon review of this data we have any questions, we may have to seek further clarification.

But it does appear that you have here submitted the type of information that we're looking for on these wells, which will allow us to make the proper evaluation.

Have you got any questions?

MR. STOGNER: Yes, I do have a question.

MR. STAMETS: Okay.

QUESTIONS BY MR. STOGNER:

Q On our Murphy "NW" Federal No. 1, where the core was taken, do you feel this was drilled into one of the isolated mounds?

A. No. No, it's in the bank, I believe, isn't it?

Up here, just barely inside this bank, basin, but it was not a mound up here.

MR. STAMETS: That's No. 6 on A-A'. Okay.

Q. Well, do you feel this is representative to the mounds that are in this tight sand area, this core sample?

A. I feel it's as representative of those as any one core is going to be representative of anything.

Q. The overburden pressure was calculated to be 3300 psi. I guess it was a gradient of .5085 psi per foot and you used the average top of the formation at 6490. Is this again representative of the area, and how did you calculate that?

A. The Murphy core was taken before I worked for Yates Petroleum. I attempted to track down who used 3300 psi as the overburden, as the representative overburden pressure, and it's -- that would be representative of the Murphy rather than the whole thing, since it's talking about the Murphy.

The two people involved both said that the other person was responsible, so I did my own calculation based on what I saw in the literature, and I have trouble re-producing that right at the moment, but I got like it ought to be 4900, which would make the permeability even lower, and so I don't think --

Q. Something like .6 psi per foot gradient?

A. Okay, what I read up on it, you know, and I make no bones on doing this, but I -- I looked into this question and what I found was that people use 1 psi per foot minus the reservoir pressure.

And I found that used in other tight gas sand hearings and in petroleum literature, and that gives, like you say, about .6 psi per foot.

Anyway, we'd say that the 3300 is an order of magnitude number that somebody picked as representative.

MR. STOGNER: That's all the questions I have.

A. And that's all I can support it with.

RECROSS EXAMINATION

BY MR. STAMETS:

Q. One of Mr. Stogner's questions stimulated one more.

Are any of the tests shown on Exhibit Twelve in a mound?

A. I don't think so. Ray?

MR. BECK: There's one right there. No. There's one right there, the well in 2, 19, 24.

A. Irish Hills.

MR. STAMETS: That would be the Irish Hills.

A. Yeah, I thought of that question this morning and I didn't have a chance to look it up, but--

MR. BECK: La Cama.

A. So apparently the answer is La Cama and Irish Hills.

MR. BECK: No, no, Irish Hills isn't in a mound. It's just La Cama.

A. Is that the agreed answer, that one of them is in a mound, and that's La Cama?

MR. BECK: The only triangle that's in a mound is the La Cama Well in 20 of 18, 25.

MR. STAMETS: And that was 136, again below the magic 188 figure.

Mr. Beck, did you -- since you're up and about, did you recommend a type log for this area?

MR. BECK: Well, sir, we reproduced the logs on the cross sections at 2-1/2 inches equal 100 feet, so people could see and actually calculate the porosity off of the compensated neutron - formation density logs, which most of the logs are, there are some sonic logs, but they all constitute logs which can be referred to, and it gives you nine, nineteen, twenty-eight -- about thirty wells which you could look at, which would constitute type logs.

MR. STAMETS: Okay, for purposes of this order, we can select one of these wells as the type log in determining the top and bottom of the formation.

MR. BECK: Oh, the type log, the one that I was referring to most as the type log, is the Well No. 3 of cross section B-B', Exhibit Number Six.

The name of the well is the Tom -- now it's Sun, formerly the Tom Brown, No. 1 Antelope Sink Well, in Section 18 of 19, 24.

And in my testimony I gave the tops of the Third Sister, the top and the bottom, and other pertinent correlations, like Antelope Sink Zone, top of the bank facies, the bottom of the bank facies.

And that would constitute my type log.

MR. STAMETS: Okay. Mike has one more question.

QUESTIONS BY MR. STOGNER:

Q. Dr. Boneau, on page five of your testimony, the drainage area was assumed to equal 320-acre proration unit, do you feel this is a representative of the actual radius of drainage? In this formation?

A. It was taken as 320 acres because that's the proration unit size. But some of the Cisco wells have a good chance of draining that and some of them have a -- will probably drain half or two-thirds, or something, of that.

It's as reasonable a number as I could pick. I cannot stand here and defend that all of them are going to drain 320 acres, no.

MR. STOGNER: Thank you, Dr. Boneau. That's all I have.

MR. STAMETS: Any other questions of this witness? He may be excused.

Anything further in this case?

If there is nothing further, this case will be taken under advisement, subject to submittal of the supplemental data.

And the hearing is adjourned.

(Hearing concluded.)

CERTIFICATE

I, SALLY W. BOYD, C.S.R., DO HEREBY CERTIFY that the foregoing Transcript of Hearing before the Oil Conservation Division was reported by me; that the said transcript is a full, true, and correct record of the hearing, prepared by me to the best of my ability.

Sally W. Boyd CSR

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 7352 heard by me on 10-21 1981.

Richard L. Stamets, Examiner
Oil Conservation Division

SALLY W. BOYD, C.S.R.
Rt. 1 Box 193-B
Santa Fe, New Mexico 87501
Phone (505) 455-7409