CASE 7399: CURTIS J. LITTLE FOR DESIGNATION OF A TIGHT FORMATION, RIO ARRIBA COUNTY, NEW MEXICO

Case No.

7395

Application

Transcripts.

Small Exhibits

ETC

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 Curtis J. Little for designation of a tight formation, Rio Arriba County, New Mexico. CASE 7395

BEFORE: Richard L. Stamets

TRANSCRIPT OF HEARING

A P P E A R A N C E S

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I N D E X

E X H I B I T S

MR. STAMETS: We'll call next Case 7395, application of Curtis J. Little for designation of a tight formation, Rio Arriba County, New Mexico.

MR. CARR: May it please the Examiner, my name is William F. Carr, with the law firm Campbell, Byrd, and Black, P. A., of Santa Fe, New Mexico, representing Curtis J. Little.

I have two witnesses who need to be sworn.

MR. STAMETS: Are there any other witnesses in this case? I'd like to have both of them stand.

(Witnesses sworn.)

CURTIS J. LITTLE

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

DIRECT EXAMINATION

BY MR. CARR:

Q. Will you state your name and place of residence?

A. My name is Curtis Little and I live in Farmington, New Mexico.

Q. And you are the applicant in this case?

A. Yes, sir.

Q. Have you previously testified before this Commission or one of its examiners and had your credentials as a geologist accepted and made a matter of record?

A. Yes, I have.

Q. Are you familiar with the application filed on your behalf in this case?

A. Yes, sir.

Q. Are you familiar with the subject lands?

A. Yes, sir.

MR. CARR: Are the witness' qualifications acceptable?

MR. STAMETS: They are.

Q. Mr. Little, will you briefly state what you are seeking with this application?

A. We are applying for a portion of and adjacent to a Ballard Pictured Cliffs and South Blanco Pictured Cliffs Gas Pools, to be designated as a tight formation under Section 107 of the Natural Gas Policy Act of 1978.

Q. Where is this proposed area located?

A. The proposed Largo Canyon Tight Gas Area is located in the southeastern portion of San Juan Basin. The area is located in Rio Arriba County about 35 miles

southeast of Bloomfield, New Mexico, in the northwestern part of the state.

Q. Were the exhibits which you propose to offer submitted to the USGS and the Oil Conservation Division fifteen days prior to hearing, as required by Commission rules?

A. Yes, they were.

Q. Would you please refer to what has been marked for identification as your Exhibit Number One and explain what this is and what it shows?

A. Exhibit Number One displays the proposed Largo Canyon Tight Gas Area on a map showing all Pictured Cliff formation wells in the San Juan Basin.

The Largo Tight Gas Area includes approximately 14,400 acres in Townships 25 and 26 North, Range 6 and 7 West.

Q. Does the Pictured Cliffs formation in the Largo Canyon area meet the criteria established in Section 107 of the Natural Gas Policy Act?

A. Yes, it does for the following reasons:

Number one, the estimated average in situ gas permeability throughout the gas section is expected to be 0.1 millidarcy or less.

Number two, the stabilized gas production

rates without stimulation at atmospheric pressure of these gas wells are not expected to exceed the maximum allowable production rate of 68 Mcf for an average depth of 2387 to the top of the Pictured Cliffs formation in the area, and thirdly, no wells drilled in the Pictured Cliffs formation in this area is expected to produce more than 5 barrels of crude oil per day prior to stimulation.

Q. Mr. Little, the 80 -- the 68 Mcf per day production rate, is that the rate established by Commission rules for wells at an average depth of 2387?

A. Yes.

Q. Would you please now refer to your Exhibit Number Two and review this for Mr. Stamets?

A. Exhibit Number Two is a Pictured Cliffs formation completion and production map of the proposed Largo Canyon Tight Gas Area.

The production figures in the top half of the scale for each well is initial potential in the top left and initial potential in Mcf in the top right.

And the bottom, the bottom left is the 1980 production in millions of cubic feet. And the bottom right is the cumulative production to 1-1-81.

Exhibit Two also presents completion and production data from wells surrounding the tight gas area

for comparison purposes.

The trace for the two cross sections, A-A' and B-B', are also illustrated on the cross section.

Q. How many wells are there in the proposed area?

A. In this proposed area there are 33 Pictured Cliffs formation gas wells and 12 that were abandoned in the Pictured Cliffs.

Q. And 12 of the 33 were abandoned?

A. Yes, sir.

Q. What is the average depth to the top of the Pictured Cliffs?

A. The average depth of the wells are 2387 feet.

Q. How extensively developed is this area?

A. The exhibit indicates that the tight gas area in this application is scantily developed compared to the area around it. Examination of cumulative and current gas production rates also indicate the poor quality Pictured Cliffs reservoir rocks in the application area.

A list of the operators, well names, and production figures for the Pictured Cliffs in the Largo Canyon Tight Gas Area is presented in Table -- in Exhibit Three, which is on the righthand side of your book.

The first one is called Largo Canyon Tight Gas Area. There's a typographical mistake on this exhibit Number Three, and that is the sixth column from the left, IP is "MM" and it should be "Mcf".

Q. Mr. Little, would you now refer to your Exhibits Numbers Four and Five and explain to Mr. Stamets what these are and what they show?

A. Exhibits Numbers Four and Five are as of January 1, 1981, cumulative gas production and the 1980 annual gas production maps of the Pictured Cliffs formation for the area around and including the proposed tight gas area.

These maps are color-coded to distinguish natural gas production trends in the area. The red color, for instance, on Exhibit Number Four is used to distinguish areas with cumulative gas production greater than a quarter Bcf, while the white indicates areas less than a quarter Bcf.

On Exhibit Number Five again the red area, this time it was to distinguish wells which produced 12-million cubic feet of gas during the calendar year 1980, or more. Now, again, the white area indicates the areas with less than 12-million cubic feet of production in 1980.

The sand trends are quite evident on both of the maps.

Q. And an examination of these two exhibits would show that a great majority of the subject area is shaded white, is that correct?

A. That is correct.

Q. Why is there so little development in this area?

A. The small cumulative production in the white area and the sparse well locations is due to the tight nature of the reservoir rocks in the area.

Q. What other Pictured Cliffs fields are in the immediate area?

A. In the immediate area we're bordered, or adjacent to, to the northeast by the South Blanco Pictured Cliffs Gas Pool. Exhibits Four and Five show this area to be densely drilled with good Pictured Cliffs wells indicated by the red coloring, and you might note that several of those are way up into several billions of cubic feet.

In the area to the southwest of our application area is the Ballard Pictured Cliffs Field. The field is not fully developed, as is the South Blanco, but again the red coloring indicates much more gas production and better reserves in this area than in the Canyon Largo Tight Gas Area.

Q. Now I have several geological questions

for you.

First of all, how generally would you characterize the Pictured Cliffs formation?

A. The Pictured Cliffs formation is a marine clay-filled sandstone, whose source came from the southwest. The formation was deposited as near shore sandbars, aligned northwest and southeast, with each body becoming progressively younger as you go from the southwest to the northeast.

Q. What is the form of gas entrapment in the area?

A. It's all stratigraphic gas entrapment.

The area of the application is believed to be a seaward deposits of the Ballard Pictured Cliffs Gas Pool rather than the landward or lagoonward side of the Blanco Pictured Cliffs Gas Pool.

Q. Is this a sandstone area or a siltstone area?

A. The sample examination indicates in the area of the application the formation is predominantly siltstone rather than sandstone and together with the clay filling is the contributing factor for the low permeability.

Q. Will you now refer to your Exhibit Number Six and review this for the Examiner?

A. Number Six is a type log of the Pictured

Cliffs formation out in the -- more or less the center of the white area. The location of the log is in the northeast quarter, Section 19, 26 North, 7 West, the upper central portion.

The top of the Pictured Cliffs formation on this log is 2156 feet. It is overlain by a 24-foot coal bed. The base of the Pictured Cliffs is projected to be 2231 and is underlain by the Lewis Shale.

The log is representative of the Pictured Cliffs formation between the Ballard Pictured Cliffs Gas Pool and the South Blanco Pictured Cliffs Gas Pool.

Q. Will you now refer to your cross section A-A', which is marked for identification as Exhibit Seven, and review this?

A. A-A', again the trace of this cross section is shown on Exhibit Number Two. A-A' is in the northern portion of the Largo Canyon Tight Gas Area.

And Exhibit Number Eight is cross section B-B', located in the southern part of the area.

Q. What is the log reference datum shown on these cross sections?

A. The log reference datum is what we consider a time line throughout the San Juan Basin, and it's referred to as a bentonite bed and called a Huerfano marker.

Q. And what do these cross sections show?

A. The cross sections illustrate the Pictured Cliffs formation to be continuous lithologic unit throughout the Largo Canyon Tight Gas Area. Both sections indicate better sand development in the Ballard Field and the South Blanco Field. In the center is the white area, which is our application area.

Q. And what general conclusions can you draw?

A. From the cross sections you can conclude that poorer reservoir rocks are present in the Largo Canyon proposed tight gas area than in the adjacent two gas pools.

Q. Were Exhibits One through Eight prepared by you or under your direction and supervision?

A. Yes, they were.

MR. CARR: At this time, Mr. Stamets, we would offer Little Exhibits One through Eight into evidence.

MR. STAMETS: These exhibits will be admitted.

MR. CARR: I have nothing further of Mr. Little on direct.

CROSS EXAMINATION

BY MR. STAMETS:

Q. Mr. Little, you have asked for a tight formation area. In fact, is what you have here two separated areas?

A. Mr. Stamets, it started off to be one but, as you noticed, we deleted off the entire Largo Canyon Federal Unit at the request of the operator of the unit, and that was taken out of the center of the entire thing.

Q. Okay. So basically, what you've got is a northern unit and a southern unit, or an eastern and western, or some such thing as that, A, B, whatever. You do have at this time two isolated areas that you seek tight sand determination for.

A. Yes, sir, that's correct.

Q. Okay. Exhibit Number Two seems to show that there has been considerable development of this area, the area shown on Exhibit Number Two, oh, especially back in the 1950's, and then there appears to be another spate of development in 1972, '73. I suppose if you looked at enough wells you'd find them scattered over a great deal of time. Is that a correct analysis of what's shown on here by the initial potential dates?

A. Yes, sir, it sure appears that way.

Q. And in the eastern area it appears as though there are some wells already completed in the Section 23 here are a couple of wells; Section 22 there's a well; Section 27 there is a well, and so on.

A. Yes, sir.

Q. Is it your intention that the tight sand designation apply to wells already -- well, it's not your intention that it apply to wells already completed.

A. No, sir.

Q. But only to wells drilled prospectively.

Okay, now you do have natural unstimulated tests. Is someone else going to speak --

A. Yes, sir.

Q. -- to those tests and analyze the data, and so on? Okay.

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

MR. CARR: I would call Kevin McCord.

KEVIN McCORD

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

DIRECT EXAMINATION

BY MR. CARR:

Q. Will you state your name and place of residence?

A. My name is Kevin McCord and I live in Farmington, New Mexico.

Q. By whom are you employed and in what capacity?

A. I'm a self-employed petroleum engineer and I'm acting as a consultant for Mr. Little.

Q. Have you previously testified before this Commission or one of its examiners and had your credentials accepted and made a matter of record?

A. Yes, I have.

Q. Are you familiar with the application filed on behalf of Mr. Little?

A. I am.

Q. And are you familiar with the subject area?

A. Yes.

Q. Have you prepared --

MR. CARR: Are the witness' qualifications acceptable?

MR. STAMETS: They are.

Q. Have you prepared certain exhibits for introduction in this case?

A. Yes, I have.

Q. First I think I'll ask you, have you obtained stabilized, unstimulated gas production rates in the area?

A. Yes, I have. Obtaining stabilized, unstimulated gas production rates for the Pictured Cliffs wells in the San Juan Basin is not a standard procedure used by most companies. Our past experience has shown that these wells have low permeability Pictured Cliffs and they must be stimulated to obtain commercial production.

However, in preparation for this tight gas study, three hour unstimulated gas production tests were performed on seven wells scattered throughout the tight gas area. These wells are indicated by the orange squares on Exhibit Number Two, and also Exhibit Number Nine gives the location of these test wells and indicates that the average unstimulated natural gas production rate from these wells is 13.7 Mcf of gas per day. This rate is well below the 68 Mcf of gas per day allotted for tight gas formations with a depth range of 2387 feet.

Q. Now, Mr. McCord, are these truly unstimulated gas production rates?

A. No, they are not true unstimulated production rates, in that each one of these wells was acidized with 500 gallons of 7-1/2 percent hydrochloric acid as a production aid to induce a flow channel from the wellbore to the formation through the perforations.

This acidizing cleans up the flow path so gas can move more freely to the wellbore. True unstimulated natural gas production would not have the aid of this formation clean-up procedure to assist in gas production.

Q. How would the actual unstimulated production rates compare to those which you have presented?

A. It would be expected that an actual natural unstimulated gas production would be even lower than this; therefor, both this average production rate of 13.7 Mcf of gas per day, can be considered to be a maximum average obtainable unstimulated natural gas production rate from the Pictured Cliffs formation in the area.

This does indicate that the average unstimulated natural gas production rate from the Pictured Cliffs formation is not expected to exceed 68 Mcf of gas per day, which is our limit.

Q. Have you obtained stabilized unstimulated oil production rates?

A. I do have some reported oil production

rates in the area, but no unstimulated oil production rates.

The natural gas produced from the Pictured Cliffs formation in this area is virtually dry gas. There has been very little oil and condensate reported for any of the wells now producing in the area.

Only three wells that I have found have ever reported any oil or condensate production in the Largo Canyon Area. These wells are the Foster Trust Riddle No. 1, 2703 barrels; the Kimbell Oil Company Salazar No. 2, 309 barrels; and the Kimbell Oil Company Leiberman No. 2, 336 barrels of oil and condensate, and as you know, oil and condensate is reported under one heading with our natural gas production.

Q. Have you made an analysis of this production?

A. Yes, I have. I've looked up the past production from these three wells and found out that the Foster Trust Riddle No. 1 in 1957 averaged a post-stimulation rate of 1.9 barrels of oil or condensate per day. The highest oil and condensate production reported for the other two wells is 0.3 barrels per day.

The unstimulated oil and condensate production from these three wells would be considered to be much lower than the low after frac production figures pre-

sented, which themselves are well below the five barrels of oil per day unstimulated oil production limitation given for tight gas areas.

Therefor, these dry gas production figures indicate that no well drilled in the Pictured Cliffs formation in this tight gas area is expected to produce without stimulation more than five barrels of crude oil per day.

Q. Mr. McCord, is stimulation required for commercial production from the Pictured Cliffs wells in the subject area?

A. Yes, it is.

Q. Would you now refer to your Exhibits Numbers Ten through Seventeen, which are core analyses, and review these for Mr. Stamets?

A. Exhibits Numbers Ten through Seventeen present core analysis data used to determine the average laboratory permeability to air for Pictured Cliffs formation pay zones in this area.

The exhibits contain the actual core analyses reports, plus summary tables showing analysis of cores taken from only the productive portion of the Pictured Cliffs formation for each well.

The core intervals chosen for permeability averaging were determined by log examination of the in-

terval cored for each well. Only cored intervals of sand with more than six ohms resistivity appearing on the induction resistivity log of the well, or ten percent porosity appearing on a porosity log for the well, were used for permeability averaging.

Q. What problems did you encounter in calculating the average laboratory permeability?

A. The main problem I found in calculating an average permeability for the wells in this area is that we had two wells that were in the good part of the South Blanco Pictured Cliffs trend to the northeast.

Examination of Exhibits Ten through Seventeen indicate that one of these wells, the Depco, Inc. MKL No. 17, has an abnormally high permeability average for the Pictured Cliffs formation compared to the other five wells cored, and this is, let's see, just to be able to check over those numbers I will address Exhibit Number Twenty later on, but it gives an analysis of all the wells, and that is the last one, it would be on page two.

Analysis of Exhibit Number Two shows that this MKL No. 17 Well was not completed in the Pictured Cliffs zone but was completed in the deeper Point Lookout zone of the Mesaverde formation; however, a close offset well the Depco, Inc., MKL No. 9 Well, was completed in the Pictured

Cliffs formation and has produced more than 3 Bcf of gas since 1952.

The large permeability in the MKL No. 17 Well is confirmed by this offset well's large cumulative production of natural gas, but this well is definitely not the same sort of well that could be expected in the Largo Canyon Tight Gas Area. This is mainly due to the large production in this other Pictured Cliffs trend and virtually just the small production in the trend right below it.

The MK -- this -- this MKL No. 9 Well is in the heart of the South Blanco Pictured Cliffs trend, while the wells in the Largo Canyon Tight Gas Area are between this trend and the Ballard Pictured Cliffs trend. They're different trends.

The Depco, Inc., MKL No. 1 Well is also located in the good Pictured Cliffs formation reservoir rock associated with the South Blanco Pictured Cliffs Pool. This well was also completed in the 2300 foot deeper Point Lookout zone of the Mesaverde. A nearby offset well to this MKL No. 1 is the Depco, Inc., MKL No. 2, and it was completed in the Pictured Cliffs formation and has a cumulative gas production of 956 MMCF of gas since 1952.

The large cumulative gas production of a near offset well indicates that the core data of the Depco,

Inc., MKL No. 2 Well is probably not representative of the Largo Canyon Tight Gas Area.

Q. What wells did you use --

A. The six -- I'm sorry.

Q. What wells did you use in compiling this data?

A. Okay, on Exhibit Number Two the cored wells are the circled wells and they're colored in. There are six more remaining cored wells that have somewhat poorer core permeability and/or cumulative gas production associated with them, and therefor indicate that they are located in poorer reservoir rock than that exhibited by the two wells mentioned previously; therefor, I used these six wells for permeability averaging in the Largo Canyon Tight Gas Area, and the Depco, Inc., MKL No. 17 and MKL No. 1 Wells will not be included in the average because of the -- as I stated before, they're in the somewhat better South Blanco Pictured Cliffs Pool.

Q. What permeability did you obtain?

A. The average laboratory permeability to air determined for the Largo Canyon Tight Gas Area in this manner was 0.37 millidarcy.

The actual in situ permeability of the formation is less than this laboratory determined value due

to water saturation and confining pressures found in the Pictured Cliffs reservoir.

Exhibit Number Eighteen presents a technical paper entitled The Effect of Overburden Pressure and Water Saturation on Gas Permeability of Tight Sandstone Cores, which was written by Rex D. Thomas and Don T. Ward of the U. S. Bureau of Mines.

This paper presents relationships between laboratory determined permeability in cores and actual in situ permeability found in reservoirs.

Exhibit Number Nineteen explains how in-situ permeability is calculated from the core analysis, using the technical paper presented.

Q Will you now refer to your Exhibit Number Twenty?

A. Okay. Exhibit Number Twenty is a summary of all the laboratory core analyses results for this tight gas area. An average in situ permeability value of 0.007 millidarcy was calculated from the average laboratory permeability value of 0.37 millidarcy for the Largo Canyon Area. This 0.007 millidarcy permeability value calculated from the core data is well below the 0.10 millidarcy cutoff for tight gas determination.

Q What other methods did you employ to

determine permeability in the subject area?

A. To make use of the seven natural unstimulated production tests that were taken in the area, which resulted in an unstimulated gas flow rate of 13.7 Mcf of gas per day, I used this data along with other Pictured Cliffs reservoir data for the tight gas area, and used it in Darcy's Law, fluid flow through a porous medium, to calculate a reservoir permeability.

This Darcy's Law calculation is presented as Exhibit Number Twenty-one.

Darcy's Law calculations record an average reservoir permeability value of 0.02 millidarcy for the Largo Canyon Tight Gas Area. This permeability value compares to a 0.007 millidarcy permeability value determined by core analysis methods. Both of these values are well below the 0.10 millidarcy tight gas cutoff.

Q. Which method of calculating permeability do you believe most accurately depicts the subject area?

A. I believe it's the 0.02 millidarcy determined by Darcy's Law calculations because it involves actual formation flow characteristics and reservoir parameters to determine the formation permeability; therefor, I believe the estimated average in situ gas permeability throughout the pay section is expected to be 0.1 millidarcy, or less.

in the Largo Canyon Tight Gas Area.

Q. Mr. McCord, have you reviewed existing State and Federal regulations concerning protection of fresh water?

A. Yes, I have. The existing State and Federal regulations will assure that development of the Pictured Cliffs formation will not adversely affect or impair any fresh water aquifers that are being used or are expected to be used in the foreseeable future for domestic or agricultural water supply.

Regulations require that casing programs be designed to seal off potential water-bearing formations from oil and gas producing formations. These fresh water zones exist from the surface to the base of the Ojo Alamo formation. This Ojo Alamo depth averages 1640 feet in the proposed tight gas area.

Most Pictured Cliffs wells drilled in the Largo Canyon Area are drilled with natural mud that will not contaminate fresh water zones. Normal casing designs consist of 7-inch OD surface casing being set from the surface to a depth of 120 feet. Production casing used is 2-7/8ths inch OD and is set from the surface to total depth.

The surface casing is cemented in place by circulating cement to the surface, protecting the near

surface formations from downhole contamination.

The production casing is cemented from total depth to the surface, or to a depth sufficient to cover the Ojo Alamo formation. This process protects the Pictured Cliffs and other shallow formations from contaminating the Ojo Alamo aquifer.

Therefor, all productive and fresh water zones are protected by both casing and cement.

Stimulation of the Pictured Cliffs formation involves various fracture treatments, depending on the operator. Fracture treatments usually consist of one or two percent potassium chloride water-base fluid with sand or a nitrogen water foam-base fluid with sand. Either treatment will not harm a fresh water aquifer.

Fresh water protection is assured using these fracture stimulation treatments due to zone isolation caused by cementation. A distance of over 700 feet between the Pictured Cliffs formation and the Ojo Alamo fresh water aquifer is additional insurance that no existing fresh water zone will be contaminated by stimulation of Pictured Cliffs wells in this area.

Therefor, all New Mexico and Federal regulations will protect any fresh water supply that may be affected by the drilling, completing, and producing of the

Pictured Cliffs formation in the Largo Canyon Tight Gas Area.

Q. Mr. McCord, will you summarize your conclusions concerning the qualifications of the subject area for tight sand designation?

A. Evidence presented here today substantiate the following for Curtis Little's proposed Canyon -- Largo Canyon Pictured Cliffs Formation Tight Gas Area:

One, for an average Pictured Cliffs well depth of 2387 feet the stabilized production rate at atmospheric pressure of wells completed in the Pictured Cliffs formation without stimulation is not expected to exceed the maximum allowable rate of 68 Mcf of gas per day.

Two, no well drilled into the Pictured Cliffs formation in the Largo Canyon area is expected to produce without stimulation more than 5 barrels of crude oil per day.

And three, the estimated average in situ gas permeability throughout the Pictured Cliffs pay section is expected to be 0.1 millidarcy, or less.

The proposed Largo Canyon Tight Gas Area meets all the specifications required, as stated above, and should be designated tight formation in the Pictured Cliffs formation under Section 107 of the Natural Gas Policy Act of 1978.

Q. Will you please identify what has been marked for identification as Exhibit Number Twenty-two?

A. This is a written text explaining the purpose of each one of the reports presented -- or each one of the exhibits presented here today.

Q. In your opinion will granting this application be in the best interest of conservation, the prevention of waste, and the protection of correlative rights?

A. Yes.

Q. Were Exhibits Nine through Twenty-two prepared by you or under your direction and supervision?

A. They were.

MR. CARR: At this time, Mr. Stamets, we would offer Applicant Exhibits Nine through Twenty-two.

MR. STAMETS: These exhibits will be admitted.

MR. CARR: And that concludes our direct presentation.

CROSS EXAMINATION

BY MR. STAMETS:

Q. Mr. McCord, are the results of the unstimulated tests summarized any place?

A. Yes, sir, they are. Exhibit Number Nine.

Q. Exhibit Nine.

A. It's in the folder on the righthand side.

Q. Okay. Let's take the second well listed on Exhibit Number Nine, the Kimbell Warren No. 5. It shows an unstimulated rate of 6.8.

A. Yes, sir.

Q. Now when you look back at Exhibit Number Two,that same well, there's an initial potential shown of 2,959,000. Now would those two figures have anything at all to do with one another?

A. One is an unstimulated rate taken right after perforation. The IP, of course, is perforated. The well has been fracture stimulated, and it is a 7-day build-up and a 3-hour flow test.

Q. So the figures on Exhibit Number Two are probably a figure after frac, after additional treatment.

A. That is correct. The only before frac figures that we have for production are presented in Exhibit Number Nine.

Q. Okay.

MR. STAMETS: Are there other questions of this witness? Mr. Chavez.

QUESTIONS BY MR. CHAVEZ:

Q. Mr. McCord, on the subject of these unstimulated flow tests, were they done through the pitot tube method of testing?

A. Oh, let's see, how were those -- they were crifice well tests.

Q. Okay. How did you determine the overburden pressure with a gradient of .73 psi per foot to make the corrections to the laboratory permeability?

A. In determining that, Mr. Chavez, there is an overburden pressure which you have to determine the whole composition of the formations, your overburden above you, which involves using an average porosity, which of course, is pretty hard to obtain, and you use that versus the depth of your formation. You subtract from that the buoyancy effect caused by the assumption that water is filling the pore spaces in that overburden rock, helping to support the overburden. You then subtract the average reservoir pressure you found in the formation. That gives you a net confining pressure, which is what you use into our exhibit to determine what factor is used for -- what overburden factor is used on your core analysis.

Q. Well, is the overburden gradient in this area generally quite a bit higher than that of, say, salt

saturated water?

A. Do you know the value of your salt saturated water? I don't.

Q. It's about .44 psi per foot.

A. Yes, in that we're talking a somewhat more dense rock than water. It would definitely, if you figure the pressure exerted by a head of rock of -- of that many feet versus water. I think your rock is going to exert a lot more pressure than your water would be, so I think that's a valid assumption.

Q. In looking at your permeability correction factors derived by the use of this Bureau of Mines paper, in Exhibit Eighteen, if we used the permeability derived in that correction of .007 and use your -- I'm sorry, and put that into the -- assume that as k for your Exhibit Number Twenty-one.

A. Uh-huh.

Q. And then solve for the radius of drainage, you get a very, very small amount of drainage, actually less than ten feet. Wouldn't that seem to indicate that this .007 is actually way too low a figure to use?

A. Not at all. I don't believe so. I think we're talking about a real small permeability involved here and all that -- all Darcy's Law is doing is comparing

all these factors together.

If you use such a small value for permeability, you're not going to be draining much area at all. The reason being is the formation is just too tight to -- to pass this gas through it. So because of that, no, I don't think that's -- I agree it's a small number but I don't think it's at all unreasonable.

Q. The wells in this area, according to your Exhibit Twenty-one, you assume to be draining a quarter section. Is that assumed because that's the acreage spacing for this area?

A. Yes, sir, under R_b there I've indicated that.

Q. Well, at this low a permeability wouldn't the drainage of an area that -- that large probably not take place?

A. That's correct. It will not take place without the fracturing process.

Q. Your figure for water saturation you assume to be 35 percent.

A. Yes, sir.

Q. Is this continuous throughout the Pictured Cliffs interval in this area?

A. Yes, to my knowledge it is. I got that

number from the core analysis reports taken, so those were actual laboratory determined values of water saturation.

Q. Did you cross check that with calculations and water saturations, say, estimated off of well logs?

A. No, I didn't. I'm sure you're well aware that often the porosity, et cetera, on well logs is not the same as the porosity that you would see in a core analysis; therefor, you could do those calculations. I did not, but I doubt that they would concur very closely to each other.

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

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

Do you have any further witnesses, Mr. Carr.

MR. CARR: No further witnesses, Mr. Stamets.

MR. STAMETS: Are there any statements? If not, the case will be taken under advisement.

(Hearing concluded.)

C E R T I F I C A T E

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. 7395, heard by me on 10-7, 1980.

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

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION

BRUCE KING
GOVERNOR

LARRY KEHOE
SECRETARY

April 19, 1982

POST OFFICE BOX 2088
STATE LAND OFFICE BUILDING
SANTA FE, NEW MEXICO 87501
(505) 827-2434

Mr. Howard Kilchrist
Federal Energy Regulatory Comm.
Department of Energy
825 North Capitol Street, N.E.
Washington, D. C. 20426

Re: Tight Formation Applications

Dear Mr. Kilchrist:

At the request of one of your staff members, I am enclosing a copy of the transcript of the Oil Conservation Division hearing in our Case No. 7395 on the application of Curtis J. Little for designation of a tight formation in Rio Arriba County, New Mexico. The recommendation made in this case was forwarded to you as Division Order No. R-6875 dealing with the Pictured Cliffs formation.

I am also enclosing a copy of our Order No. R-6883-A which is a Nunc Pro Tunc order amending Order No. R-6883 which was previously forwarded to you for your consideration. Mr. Leonard Gruskiewicz of your staff pointed out an error in our Order No. R-6883 and this "A" order corrects that error.

Thank you for your assistance with these matters.

Sincerely,

W. PERRY PEARCE
General Counsel

WPP/dr

enc.

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION

BRUCE KING
GOVERNOR

LARRY KEHOE
SECRETARY

POST OFFICE BOX 2088
STATE LAND OFFICE BUILDING
SANTA FE, NEW MEXICO 87501
(505) 827-2434

January 12, 1982

Re: CASE NO. 7395
ORDER NO. R-6875

Mr. William F. Carr
Campbell, Byrd & Black
Attorneys at Law
Post Office Box 2208
Santa Fe, New Mexico

Applicant:

Curtis J. Little

Dear Sir:

Enclosed herewith are two copies of the above-referenced Division order recently entered in the subject case.

Yours very truly,

JOE D. RAMEY
Director

JDR/fd

Copy of order also sent to:

Hobbs OCD x
Artesia OCD x
Aztec OCD x

Other _____

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION

IN THE MATTER OF THE HEARING
CALLED BY THE OIL CONSERVATION
DIVISION FOR THE PURPOSE OF
CONSIDERING:

CASE NO. 7395
Order No. R-6875

APPLICATION OF CURTIS J. LITTLE
FOR DESIGNATION OF A TIGHT
FORMATION, RIO ARRIBA COUNTY,
NEW MEXICO.

ORDER OF THE DIVISION

BY THE DIVISION:

This cause came on for hearing at 9 a.m. on October 21, 1981, at Santa Fe, New Mexico, before Examiner Richard L. Stamets.

NOW, on this 11th day of January, 1982, the Division Director, having considered the testimony, the record, and the recommendations of the Examiner, and being fully advised in the premises,

FINDS:

(1) That due public notice having been given as required by law, the Division has jurisdiction of this cause and the subject matter thereof.

(2) That the applicant, Curtis J. Little, requests that the Division in accordance with Section 107 of the Natural Gas Policy Act, and 18 C.F.R. §271.703 recommend to the Federal Energy Regulatory Commission that the Pictured Cliffs formation underlying the following lands situated in Rio Arriba County, New Mexico, hereinafter referred to as the Pictured Cliffs formation, be designated as tight formations in said Federal Energy Regulatory Commission's regulations:

AREA A

TOWNSHIP 25 NORTH, RANGE 6 WEST, NMPM
Sections 21 through 23: All
Sections 26 and 27: All
Section 28: NE/4
Sections 34 and 35: All
Section 36: W/2

AREA B

TOWNSHIP 25 NORTH, RANGE 7 WEST, NMPM
Section 4: All
Section 5: E/2
Section 8: NE/4
Section 9: N/2
Section 10: N/2

TOWNSHIP 26 NORTH, RANGE 6 WEST, NMPM
Section 31: All

TOWNSHIP 26 NORTH, RANGE 7 WEST, NMPM
Section 17: S/2
Section 18: All
Section 19: N/2 and SE/4
Section 20: All
Section 21: S/2
Section 22: S/2
Section 25: SW/4
Section 26: S/2
Sections 27 and 28: All
Sections 33 through 36: All

Containing a total of 14,400 acres, more or less.

(3) That the proposed Largo Canyon Tight Gas Area is divided into two non-contiguous tracts being hereinbefore described as Area A and Area B.

(4) That certain acreage between Areas A and B has been excluded from this appication at the request of the operator of that acreage.

(5) That the Pictured Cliffs formation underlies all of the above described lands; that the formation is a marine, clay-filled, siltstone, about 70 feet thick; such formation is found at an average depth of 2387 feet below the surface of the areas set out in Finding No. (2) above.

(6) That the type section for the Pictured Cliffs formation for the proposed tight formation designations is found at a depth of from approximately 2156 feet to 2231 feet on the induction electrical log from the Curtis J. Little Grevey No. 1 Well, located in Unit G of Section 19, Township 26 North, Range 7 West, Rio Arriba County, New Mexico.

(7) That the Pictured Cliffs formation underlying the above-described lands has been penetrated by a number of wells, but the areas proposed for tight formation designation are largely undeveloped exploratory areas.

(8) That the technical evidence presented in this case demonstrated that the predominant percentage of wells which may be completed in the Pictured Cliffs formation within the proposed tight formation areas may reasonably be presumed to exhibit permeability, gas productivity, or crude oil productivity not in excess of the following parameters:

(a) average in situ gas permeability throughout the pay section of 0.1 millidarcy; and

(b) stabilized production rates, without stimulation, against atmospheric pressure, as found in the table set out in 18 C.F.R. §271.703(c)(2)(B) of the regulations; and

(c) production of more than five barrels of crude oil per day.

(9) That within the proposed areas there is a recognized aquifer being the Ojo Alamo, found at an average depth of 1640 feet or approximately 750 feet above the Pictured Cliffs formation.

(10) That existing State of New Mexico and Federal Regulations relating to casing and cementing of wells will assure that development of the Pictured Cliffs formation will not adversely affect said aquifers.

(11) That the Pictured Cliffs formation within the proposed areas should be recommended to the Federal Energy Regulatory Commission for designation as a tight formation.

IT IS THEREFORE ORDERED:

(1) That it be and hereby is recommended to the Federal Energy Regulatory Commission pursuant to Section 107 of the Natural Gas Policy Act of 1978, and 18 C.F.R. §271.703 of the regulations that the Pictured Cliffs formation underlying the following described lands in Rio Arriba County, New Mexico, be designated as a tight formation:

AREA A

TOWNSHIP 25 NORTH, RANGE 6 WEST, NMPM
Sections 21 through 23: All
Sections 26 and 27: All
Section 28: NE/4
Sections 34 and 35: All
Section 36: W/2

AREA B

TOWNSHIP 25 NORTH, RANGE 7 WEST, NMPM
Section 4: All
Section 5: E/2
Section 8: NE/4
Section 9: N/2
Section 10: N/2

TOWNSHIP 26 NORTH, RANGE 6 WEST, NMPM
Section 31: All

TOWNSHIP 26 NORTH, RANGE 7 WEST, NMPM
Section 17: S/2
Section 18: All
Section 19: N/2 and SE/4
Section 20: All
Section 21: S/2
Section 22: S/2
Section 25: SW/4
Section 26: S/2
Sections 27 and 28: All
Sections 33 through 36: All

Containing a total of 14,400 acres, more or less.

(2) That jurisdiction of this cause is retained for the entry of such further orders as the Division may deem necessary.

DONE at Santa Fe, New Mexico, on the day and year hereinabove designated.

STATE OF NEW MEXICO
OIL CONSERVATION DIVISION

JOE D. RAMEY
Director

S
fd/

United States Department of the Interior

OFFICE OF THE SECRETARY

Minerals Management Service
South Central Region
P. O. Box 26124
Albuquerque, New Mexico 87125

MAR 02 1982

Mr. W. Perry Pearce
Oil Conservation Division
State of New Mexico
P. O. Box 2088
Santa Fe, New Mexico 87501

Dear Mr. Pearce:

This jurisdictional agency concurs in the recommendation of the State of New Mexico, Case No. 7395, Order No. R-6875, dated January 11, 1982, that the Pictured Cliffs formation underlying the described lands in subject order in Rio Arriba County, New Mexico, be designated as a Section 107 tight formation.

It is requested that this concurrence be included with the recommendation submitted to the Federal Energy Regulatory Commission.

Sincerely yours,

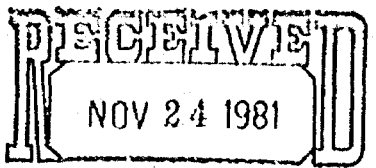
James W. Sutton
FOR Gene F. Daniel
Deputy Minerals Manager
Oil & Gas

CAMPBELL, BYRD & BLACK, P.A.
LAWYERS

JACK M. CAMPBELL
HARL D. BYRD
BRUCE D. BLACK
MICHAEL B. CAMPBELL
WILLIAM F. CARR
BRADFORD C. BERGE
WILLIAM G. WARDLE
KEMP W. GORTHEY

JEFFERSON PLACE
SUITE 1 - 110 NORTH GUADALUPE
POST OFFICE BOX 2208
SANTA FE, NEW MEXICO 87501
TELEPHONE: (505) 988-4421
TELECOPIER: (505) 983-6043

November 24, 1981



Mr. R. L. Stamets
Technical Support Chief
Oil Conservation Division
Post Office Box 2088
Santa Fe, New Mexico 87501

Re: Case 7395: Application of Curtis J. Little for Designation of a Tight Formation, Rio Arriba County, New Mexico

Dear Mr. Stamets:

Enclosed is a proposed order of the Division in the above-referenced matter.

If we may be of any further assistance to you in this case, please advise.

Very truly yours,

William F. Carr

WFC:lr

Enclosure

cc: Mr. Kevin McCord

LIST OF EXHIBITS

Exhibit Number	Exhibit Name	Purpose of Exhibit
1.	Pictured Cliffs Reservoir Map	Show location of Largo Canyon Tight Gas Area with respect to Pictured Cliffs Production.
2.	Pictured Cliffs Formation Completion and Production Map	Show production figures of completed and dry Pictured Cliffs wells in and around the tight formation area.
3.	Largo Canyon Tight Gas Area Wells	List production figures of completed and dry Pictured Cliffs wells in the tight formation area.
4.	January 1981 Cumulative Gas Production Map of Wells Completed in the Pictured Cliffs Formation	Present, by color codes, the production trends in the area surrounding the Largo Canyon Tight Gas Area.
5.	1980 Annual Gas Production Map of Wells Completed in the Pictured Cliffs Formation	Present, by color codes, the production trends in the area surrounding the Largo Canyon Tight Gas Area.
6.	Type Log	Show log characteristics and depth of Pictured Cliffs formation in the Largo Canyon Tight Gas Area.
7.	Cross Section A-A'	Show Pictured Cliff formation development in the northwest portion of the Largo Canyon Tight Gas Area.
8.	Cross Section B-B'	Show Pictured Cliff formation development in the southeast portion of the Largo Canyon Tight Gas Area.
9.	Natural Production Tests	Lists natural unstimulated production tests taken and average results.
10.	Core Analysis Skelly Oil Company Farming No. 1-E	Show average laboratory core permeability.
11.	Core Analysis Superior Oil Company Sloan Gov't. 1-11	Show average laboratory core permeability.
12.	Core Analysis Victor Salazar Campbell No. 1	Show average laboratory core permeability.
13.	Core Analysis Superior Oil Company Albuquerque Assoc. No. 1-36 State	Show average laboratory core permeability.

Exhibit Number	Exhibit Name	Purpose of Exhibit
14.	Core Analysis Pubco Development, Inc. Hughes 28-4	Show average laboratory core permeability.
15.	Core Analysis Pubco Development, Inc. Hughes 34-3	Show average laboratory core permeability.
16.	Core Analysis Kingsley-Locke Oil Co. MKL No. 1	Show average laboratory core permeability.
17.	Core Analysis Kingsley-Locke Oil Co. MKL No. 4-17	Show average laboratory core permeability.
18.	Technical Paper	Present relationship between laboratory and in situ permeability.
19.	Determination of In Situ Permeability	Show method of determining in situ permeability from laboratory core analysis.
20.	Summary of Core Permeability Data	Show summary of permeability data, average laboratory permeability and in situ permeability.
21.	Darcy's Law Calculation	Show determination of permeability from unstimulated gas production tests.

EXHIBIT NO. 3

LARGO CANYON TIGHT GAS AREA

BEFORE EXAMINER STAMETS
OIL CONSERVATION DIVISION
APPLICANTS EXHIBIT NO. 3
CASE NO. 7395
Submitted by MMCFG LIMS
Hearing Date 10/21/81

COMPANY	WELL NAME	LOCATION	PICTURED CLIFFS DEPTH	IP DATE	IP MMCFG	1980 PROD. MMCFG	CUMULATIVE 01-01-81 MMCFG
1. Minel, Inc.	Delta No. 2	SE/SW 21 25-6	2300	10/60	456	5	60
2. Kay Kimbell	Salazar Fed. 1-22	NW/SE 22 25-6	2566	6/58	1483	8	282
3. El Paso Natural Gas	Canyon Largo Unit No. 40	SE/SE 23 25-6	2597	6/57	968	5	225
4. El Paso Natural Gas	Kimbell Com. No. 1	NE/NW 23 25-6	2520	9/77	152	5	21
5. Kimbell Oil	Salazar 4/26	NW/NW 26 25-6	2670	5/80	D&A	-	-
6. Kimbell Oil	Warren Fed. 1-26	SE/NE 26 25-6	2696	12/57	1873	5	243
7. Kimbell Oil	Coral Com. No. 3	SW/SW 27 25-6	2224	6/81	189	New Well	
8. Kimbell Oil	Salazar 2-34	NW/SW 34 25-6	2182	6/55	376	8	203/309 BC
9. J. Gregory Merrion	Federal Com. No. 4	NE/SE 34 25-6	2150	10/80	2302	10	10
10. J. Gregory Merrion	Federal Com. A No. 4	SW/SW 35 25-6	2390	9/80	2131	8	8
11. Kimbell Oil	Warren No. 5	SW/SE 35 25-6	2512	5/81	2959	New Well	-
12. El Paso Natural Gas	Harvey State No. 9	NE/SW 36 25-6	2608	10/56	D&A	-	-
13. Kimbell Oil Co.	Liberman No. 2	SW/SW 4 25-7	2193	7/55	248	4	196/336 BC
14. Foster Trust	Riddle No. 1	SW/NE 4 25-7	2200	5/53	396	8	350/2703 B
15. Curtis Little	Grevey No. 2	SW/SE 4 25-7	2175	-	-	New Well	-
16. C.J. Warren	Federal No. 1	SW/SE 5 25-7	2206	11/56	D&A	-	-
17. Curtis Little	Warren No. 2	SW/SE 5 25-7	2193	-	-	New Well	-
18. Curtis Little	Salazar No. 2	SW/NE 5 25-7	2765	-	-	New Well	-

	COMPANY	WELL NAME	LOCATION	PICTURED CLIFFS DEPTH	IP DATE	IP MMCFG	1980 PROD MMCFG	CUMULATIVE 01-01-81 MMCFG
19.	El Paso Natural Gas	Largo No. 1	NW/NW 9 25-7	2150	8/59	139	11	329
20.	El Paso Natural Gas	Klein No. 1-A	NW/NE 31 26-6	2302	6/57	2635	2	242
21.	El Paso Natural Gas	Klein No. 2-A	SE/NW 31 26-6	2280	9/57	D&A	-	-
22.	El Paso Natural Gas	Turner-Fields 1-31	NW/SE 31 26-6	2825	3/56	266	P&A 4/67	24
23.	El Paso Natural Gas	Turner-Fields 2-31	NW/SW 31 26-6	2307	10/56	236	P&A 4/67	17
24.	Curtis Little	Grevey No. 1	SW/NE 19 26-7	2159	5/81	646	New Well	-
25.	Curtis Little	Salazar No. 1	SW/NW 19 26-7	2520	5/81	1006	New Well	-
26.	Curtis Little	Warren No. 1	SW/SE 19 26-7	2167	5/81	706	New Well	-
27.	J. Glen Turner	Quantius 1-22	NW/SW 22 26-7	Not Given	8/54	D&A	-	-
28.	Mesa Petroleum (Pubco)	Hughes 27-1	NW/NE 27 26-7	2298	2/53	D&A	-	-
29.	Mesa Petroleum (Pubco)	Hughes 26-4	SE/SE 28 26-7	2267	3/53	D&A	-	-
30.	Mesa Petroleum (Pubco)	Hughes 34-3	SW/SW 34 26-7	2207	2/53	355	24	561
31.	El Paso Natural Gas	Johnston-State No. 7	NE/NE 36 26-7	2614	7/58	D&A	-	-
32.	El Paso Natural Gas	Harvey State No. 5	SE/SW 36 26-7	2361	12/55	D&A	-	-
33.	Merrion and Bayless	Harvey No. 1	NE/NW 36 26-7	2892	6/67	D&A	-	-

EXHIBIT NO. 9

LARGO CANYON TIGHT GAS AREA

Unstimulated Natural Gas Production Tests
(3 hour flow test after acidizing with 500 gallons of 7½% HCL acid)

	OPERATOR	WELL	LOCATION	TOP OF PICTURED CLIFFS (ft)	UNSTIMULATED NATURAL PRODUCTION RATE (MCFGPD)
1.	Kimbell Oil Company	Coral Com. No. 3	SWSW 27 25-6	2224	1.30
2.	Kimbell Oil Company	Warren No. 5	SWSE 35 25-6	2512	6.80
3.	Curtis J. Little	Grevey No. 2	SWSE 4 25-7	2175	6.23
4.	Curtis J. Little	Warren No. 2	SWSE 5 25-7	2193	10.90
5.	Curtis J. Little	Grevey No. 1	SWNE 19 26-7	2159	34.00
6.	Curtis J. Little	Salazar No. 1	SWNW 19 26-7	2520	33.00
7.	Curtis J. Little	Warren No. 1	SWSE 19 26-7	2167	3.70
		7 WELL AVERAGE			13.70

Unstimulated Natural Gas Production Rate Limit for Tight Gas @ 2387 feet is 68 MCFGPD.

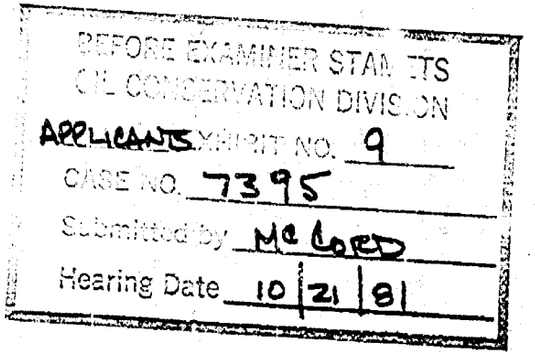


EXHIBIT NO. 10

COMPANY: Skelly Oil Company
WELL: Farming No. 1-E

Ballard Pictured Cliffs Field
NE/NE Section 2, Township 24 North, Range 6 West
Rio Arriba County, New Mexico

Pictured Cliffs Formation Core Data

Depth (ft)	Sample Footage (ft)	Horizontal Permeability (md)
2510 - 2511	1	0.16
2511 - 2512	1	0.12
2512 - 2513	1	0.45
2513 - 2514	1	0.53
2514 - 2515	1	3.00
2515 - 2516	1	1.60
2516 - 2517	1	0.12
2517 - 2518	1	1.20
2518 - 2519	1	1.60
2519 - 2520	1	0.45
2520 - 2521	1	1.20
2521 - 2522	1	0.12
2522 - 2523	1	< 0.01
2523 - 2524	1	< 0.01
2524 - 2525	1	0.29
2525 - 2526	1	0.10
2526 - 2527	1	0.20
2527 - 2528	1	0.13
2528 - 2529	1	0.04
2529 - 2530	1	0.05
2530 - 2531	1	0.02
2531 - 2532	1	0.03
2532 - 2533	1	0.08
2533 - 2534	1	0.06
2534 - 2535	1	0.02
2535 - 2536	1	0.13
2536 - 2537	1	0.04
2537 - 2538	1	0.10
2538 - 2539	1	0.08
2539 - 2540	1	0.16
2540 - 2541	1	0.05
2541 - 2542	1	0.05
2542 - 2543	1	0.04
2543 - 2544	1	0.02
2544 - 2545	1	0.08
2545 - 2546	1	0.04
2546 - 2547	1	0.01
TOTAL	37	12.39

Average Permeability = 12.39/37 = 0.33 md.

(Well not completed in Pictured Cliffs formation)

BEFORE EXAMINER STAMETS
OIL CONSERVATION DIVISION
APPLICANTS EXHIBIT NO. 10
CASE NO. 7395
Submitted by McCord
Hearing Date 10/21/81

CORE LABORATORIES, INC. *Petroleum Reservoir Engineering*

COMPANY SKELLY OIL COMPANY — DATE ON 8/14/58 — FILE NO. RP-3-815 FC

WELL FARMING NO. 1-E — DATE OFF 8/31/58 — ENGRS. WJC

FIELD WILDCAT — FORMATION AS NOTED — ELEV. 6677' DF

COUNTY RIO ARRIBA — STATE NEW MEX. — DRLG FLD. WATER BASE MUD — CORES DIAMOND

LOCATION SEC. 2-T26N-R4W — REMARKS SAMPLED BY REPRESENTATIVE OF CLIENT

TABULAR DATA and INTERPRETATION

SAMPLE NUMBER	DEPTH FEET	PERM MD	POROSITY PERCENT	RESIDUAL SATURATION % PORE SPACE OIL	RESIDUAL SATURATION % PORE SPACE TOTAL WATER	FEET
1	2510-11	0.16	14.7	0.0	87.1	
2	11-12	0.12	13.7	1.5	86.9	
3	12-13	0.45	18.7	0.0	59.4	
4	13-14	0.53	17.8	1.1	57.3	
5	14-15	3.0	20.8	0.0	55.9	
6	15-16	1.6	19.3	0.0	52.8	
7	16-17	0.12	15.0	0.0	58.0	
8	17-18	1.2	18.5	0.0	51.9	
9	18-19	1.6	21.7	0.0	55.3	
10	19-20	0.45	19.2	0.0	59.9	
11	20-21	1.2	19.4	1.0	57.3	
12	21-22	0.12	13.4	0.0	85.1	
13	22-23	<0.01	9.8	0.0	91.9	
14	23-24	<0.01	8.6	0.0	89.4	
15	24-25	0.29	17.8	0.0	70.8	
16	25-26	0.10	16.2	0.0	84.6	
17	26-27	0.20	16.6	0.0	69.3	
18	27-28	0.13	15.1	0.0	74.3	
19	28-29	0.04	15.3	0.0	83.1	
20	29-30	0.05	17.0	0.0	80.7	
21	30-31	0.02	14.4	0.0	84.6	
22	31-32	0.03	13.6	0.0	94.0	
23	32-33	0.08	15.1	0.0	89.5	
24	33-34	0.06	15.8	3.2	86.8	
25	34-35	0.02	15.2	0.0	90.2	
26	35-36	0.13	15.5	0.0	89.6	
27	36-37	0.04	12.5	0.0	94.6	
28	37-38	0.10	15.3	0.0	94.7	
29	38-39	0.08	14.0	0.0	91.0	
30	39-40	0.16	15.8	0.0	92.0	
31	40-41	0.05	15.1	0.0	93.4	
32	41-42	0.05	16.8	0.0	85.8	
33	42-43	0.04	15.8	0.0	80.6	
34	43-44	0.02	13.5	0.0	86.0	
35	44-45	0.08	15.4	0.0	83.9	
36	45-46	0.04	12.7	0.0	86.0	
37	2546-47	0.01	12.3	0.0	87.8	

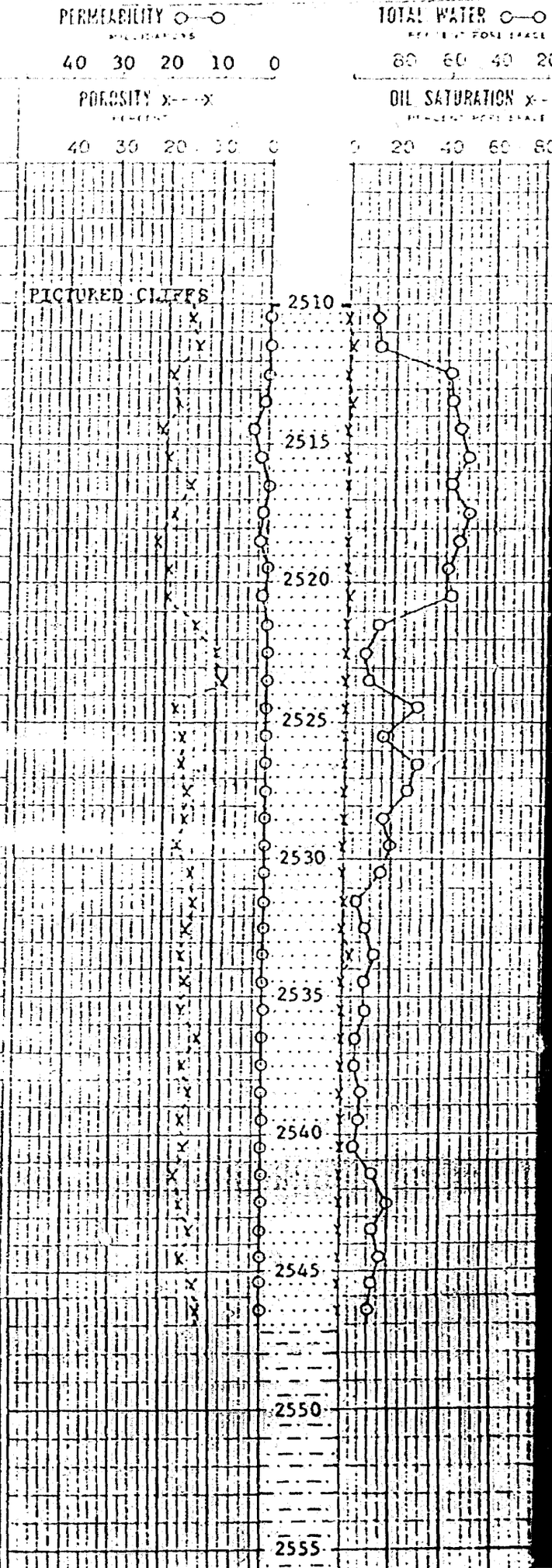


EXHIBIT NO. 11

COMPANY: Superior Oil Company
WELL: Sloan - Gov't. 1-11

Ballard Pictured Cliffs Field
NE/NW Section 11, Township 24 North, Range 6 West
Rio Arriba County, New Mexico

Pictured Cliffs Formation Core Data

Depth (ft)	Sample Footage (ft)	Horizontal Permeability (md)
2107.5 - 2108.5	1	0.00
2108.5 - 2109.5	1	0.00
2109.5 - 2110.5	1	0.00
2111.5 - 2112.5	1	0.00
2112.5 - 2113.5	1	0.00
2113.5 - 2114.5	1	0.00
2114.5 - 2115.5	1	0.00
2115.5 - 2116.5	1	0.00
2116.5 - 2117.5	1	0.00
2117.5 - 2118.5	1	0.00
2118.5 - 2119.5	1	0.00
2119.5 - 2120.5	1	0.00
2120.5 - 2121.5	1	0.00
2121.5 - 2122.5	1	0.00
2122.5 - 2123.5	1	0.00
2123.5 - 2124.5	1	0.00
2124.5 - 2125.5	1	0.00
2125.5 - 2126.5	1	0.00
2127.5 - 2128.5	1	0.00
2128.5 - 2129.5	1	0.00
2129.5 - 2130.5	1	0.00
2130.5 - 2131.5	1	0.00
2131.5 - 2132.5	1	0.00
2132.5 - 2133.5	1	0.00
2133.5 - 2134.5	1	0.00
2134.5 - 2135.5	1	0.00
2135.5 - 2136.5	1	0.00
2136.5 - 2137.5	1	0.00
2137.5 - 2138.5	1	0.00
2138.5 - 2139.5	1	0.00
2139.5 - 2140.5	1	0.00
2140.5 - 2141.5	1	0.00
2141.5 - 2142.5	1	0.00
2142.5 - 2143.5	1	0.00
2143.5 - 2144.5	1	0.00
2144.5 - 2145.5	1	0.00
2145.5 - 2146.5	1	0.00
2146.5 - 2147.5	1	0.00
2147.5 - 2148.5	1	0.00
2148.5 - 2149.5	1	0.00
2149.5 - 2150.5	1	0.00

BEFORE EXAMINER STAMETS
OIL CONSERVATION DIVISION
APPLICANTS EXHIBIT NO. 11
CASE NO. 7395
Submitted by Nebord
Hearing Date 10/24/81

COMPANY: Superior Oil Company
WELL: Sloan - Gov't. 1-11

Continued

Depth (ft)	Sample Footage (ft)	Horizontal Permeability (md)
2150.5 - 2151.5	1	0.00
2151.5 - 2152.5	1	0.00
2152.5 - 2153.5	1	0.00
2153.5 - 2154.5	1	0.00
2154.5 - 2155.5	1	0.00
2156.5 - 2157.5	1	0.04
2157.5 - 2158.5	1	0.72
2158.5 - 2159.5	1	0.81
2159.5 - 2160.5	1	0.38
2160.5 - 2161.5	1	0.13
2161.5 - 2162.5	1	0.21
2162.5 - 2163.5	1	0.04
2163.5 - 2164.5	1	0.00
2164.5 - 2165.5	1	0.72
2165.5 - 2166.5	1	1.29
2166.5 - 2167.5	1	1.63
2167.5 - 2168.5	1	0.38
2168.5 - 2169.5	1	0.38
2169.5 - 2170.5	1	0.21
2170.5 - 2171.5	1	0.81
2171.5 - 2172.5	1	1.11
2172.5 - 2173.5	1	1.63
2173.5 - 2174.5	1	1.20
2174.5 - 2175.5	1	1.11
2175.5 - 2176.5	1	1.29
TOTAL	66	14.09

Average Permeability = 14.09/66 = 0.21 md.

CORE LABORATORIES, INC.

INTERPRETATION MUST BE CONFIRMED AT ALL TIMES. RECORDED POINT BY POINT AND BY ZONES ON THIS SHEET AND REPORTED TO CLIENT

Company Superior Oil Co Elevation 6414' KB Date Report 5-28-55 FL No RP3-164-FC

Well #1-11 Sloan Gulf Well Location 1115'FN/1560'WS 11 T26N R6W Analysts WEP

Field Canyon Largo Formation Pictured Cliffs Reports to Beaty

County Rio Arriba State N. Mex. Cores Dia On or Oil Location Se #4

NO.	DEPTH	PERMEABILITY MILLIDARCYS Ka								MERKY			OBS. RETORT CORR.				WT. GM.	DENS. NAT.	BLK. VOL.	VOL. %			% POR	S_{cw} FR.	RT. SATURATION		
		M	W	C X Q X L ÷ A				A	L	BULK	WEIGHT	VOLUME	O	W	O	W				O_b	W_b	G_b			S_o	S_{cw}	S_{cw}
1	2048 S	351	0	60	0	200	2.78	0	·	1932	52.2	.08	0.0	7.2	0.0	6.3	125	2.41	52	0	12.1	0.6	12.7	1	0	85.1	95
2	49 S	✓	0	60	0	✓	✓	0	·	1847	44.3	.19	0.0	8.6	0.0	7.1	✓	2.40	52	0	13.7	1.0	14.7	1	0	93.1	93
3	50 S	✓	0	60	0	✓	✓	0	·	1531	32.3	.15	0.0	10.6	0.0	5.6	✓	2.43	52	0	10.8	1.1	11.9	1	0	90.8	90
4	2052 S	✓	0	60	0	✓	✓	0	·	1582	38.0	.17	0.0	8.6	0.0	7.0	✓	2.40	52	0	13.4	0.8	14.2	1	0	94.2	94
5	53 S	✓	0	100	0	✓	✓	0	·	1512	36.9	.06	0.0	7.1	0.0	7.5	✓	2.44	51	0	14.7	0.4	15.1	1	0	97.4	97
6	54 S	✓	0	60	0	✓	✓	0	·	1488	35.9	.10	0.0	8.1	0.0	6.7	✓	2.41	52	0	12.9	0.7	13.6	1	0	94.9	94
7	55 S	✓	0	60	0	✓	✓	0	·	1438	33.2	.13	0.0	7.7	0.0	5.8	✓	2.45	51	0	7.5	0.9	8.4	1	0	89.4	89
8	56 S	✓	0	60	0	✓	✓	0	·	1703	40.8	.21	0.0	7.8	0.0	6.8	✓	2.40	52	0	13.1	1.2	14.3	1	0	91.6	91
9	57 S	✓	0	60	0	✓	✓	0	·	1540	37.2	.20	0.0	8.0	0.0	6.4	✓	2.41	52	0	12.3	1.3	13.6	1	0	90.5	90
10	58 S	✓	0	60	0	✓	✓	0	·	1778	42.6	.23	0.0	8.2	0.0	6.5	✓	2.40	52	0	12.5	1.3	13.8	1	0	90.5	90
11	59 S	✓	0	60	0	✓	✓	0	·	1432	34.7	.14	0.0	7.6	0.0	6.0	✓	2.42	52	0	11.5	1.0	12.0	1	0	91.9	91
12	60 S	✓	0	60	0	✓	✓	0	·	818	19.5	.06	0.1	7.8	0.0	6.0	✓	2.39	52	1.0	11.5	0.7	13.2	1	76	87.1	87
13	61 S	✓	0	60	0	✓	✓	0	·	1582	37.9	.25	0.0	10.6	0.0	5.9	✓	2.39	52	0	11.3	1.6	12.9	1	0	87.6	87
14	63 S	✓	0	60	0	✓	✓	0	·	1495	35.4	.27	0.0	7.6	0.0	5.9	✓	2.37	53	0	10.9	1.8	12.7	1	0	85.9	85
15	63 S	✓	0	60	0	✓	✓	0	·	1521	37.8	.15	0.0	8.6	0.0	7.7	✓	2.42	52	0	14.2	1.0	15.2	1	0	93.4	93
16	2066 S	✓	0	60	0	✓	✓	0	·	1176	28.0	.24	0.0	8.6	0.0	6.8	✓	2.38	52	0	13.1	2.0	15.1	1	0	86.6	86
17	2073 S	✓	0	60	0	✓	✓	0	·	2176	52.1	.40	0.0	7.6	0.0	6.5	✓	2.46	52	0	12.5	1.8	14.3	1	0	87.6	87
18	74 S	✓	0	60	0	✓	✓	0	·	1462	49.2	.11	0.0	6.8	0.0	5.6	✓	2.46	51	0	11.8	0.6	11.6	1	0	94.9	94
19	75 S	✓	0	60	0	✓	✓	0	·	1640	44.3	.33	0.0	7.5	0.0	6.8	✓	2.41	52	0	13.6	1.8	14.8	1	0	87.7	87
20	76 S	✓	0	60	0	✓	✓	0	·	1510	38.3	.10	0.0	4.2	0.0	2.7	✓	2.52	50	0	5.8	0.7	6.5	1	0	89.3	89

Zone from 2048 to 2077 : Remarks Made to Client for Zone: This section is essentially non-productive

Field Interpretation Flushing

Zone from _____ to _____ : Remarks Made to Client for Zone

Field Interpretation _____

CORE LABORATORIES, INC.

INTERPRETATION MUST BE CONFIRMED AT ALL TIMES. RECORDED POINT BY POINT AND BY ZONES ON THIS SHEET AND REPORTED TO CLIENT

Company Superior Oil Co Elevation 6414' KB Date Report 5-28-55 Fl. No. CP3-164 F
Well #1-11 Sloan Govt Well Location SW NW Analysts WER
Field Canyon Largo Formation Pictured Cliffs Reports to Denv
County Rio Arriba State New Mex Cores Dia On or Off Location Sec #4

BEST AVAILABLE COPY

NO.	DEPTH	PERM. M	W	C	X	Q X L	– A	MILLIDARCYS Ka	L	MERKY BULK	WEIGHT	VOLUME	OBS RETORT O	W	CORR. O	W	WT. GM.	DENS. NAT.	BLK. VOL.	VOL. % O_b	W_b	G_b	% POR	S_{cw} FR.	PORE SATURATION S_o	S_w	S_{cw}
21	2077.5	39	0	100	0	2.00	2.75	0	.	1436	22.3	.33	0.0	6.6	0	1.8	125	2.45	.51	0	9.4	1.6	11.0	1	0	85.5	85
22	78.5	✓	0	100	0	✓	✓	0	.	1698	32.1	.22	0.0	7.6	0	6.4	–	2.38	.53	0	12.1	2.1	14.2	1	0	85.2	85
23	79.5	✓	0	60	0	✓	✓	0	.	1699	46.4	.15	0.0	6.6	0	5.8	–	2.40	.52	0	11.2	0.9	12.1	1	0	92.8	92
24	80.5	✓	0	100	0	✓	✓	0	.	1591	37.0	.25	0.0	8.0	0	1.8	–	2.34	.52	0	13.1	1.6	14.7	1	0	89.1	89
25	81.5	✓	0	60	0	✓	✓	0	.	1178	41.6	.21	0.0	7.2	0	1.5		2.41	.52	0	12.1	1.2	13.3	1	0	90.1	90
26	2082.5	✓	0	100	0	✓	✓	0	.	1147	34.1	.31	0.0	8.6	0	6.0	–	2.40	.52	0	11.5	2.1	13.6	1	0	84.5	84
27	2094.5	✓	0	60	0	✓	✓	0	.	1204	41.0	.42	0.0	9.4	0	7.4	–	2.34	.53	0	14.4	2.5	16.2	1	0	84.4	84
28	95.5	✓	0	100	0	✓	✓	0	.	1441	34.1	.32	0.0	8.0	0	7.8	–	2.37	.53	0	12.8	2.5	15.3	1	0	83.7	83
29	96.5	✓	0	60	0	✓	✓	0	.	1472	24.8	.41	0.0	7.6	0	6.4	–	2.37	.53	0	12.1	2.8	14.9	1	0	81.2	81
30	97.5	✓	0	100	0	✓	✓	0	.	1045	41.2	.25	0.0	8.6	0	6.6		2.32	.54	0	12.2	2.4	14.6	1	0	83.6	83
31	98.5	✓	0	60	0	✓	✓	0	.	1255	29.1	.28	0.0	8.2	0	7.0	–	2.32	.54	0	13.0	2.2	15.2	1	0	85.4	85
32	99.5	✓	0	60	0	✓	✓	0	.	1139	26.1	.44	0.0	8.4	0	7.5	–	2.30	.54	0	13.9	3.9	17.8	1	0	78.1	78
33	2100.5	✓	0	60	0	✓	✓	0	.	1121	25.9	.30	0.0	9.0	0	7.8	–	2.31	.54	0	14.4	2.7	17.1	1	0	84.2	84
34	02.5	✓	0	60	0	✓	✓	0	.	1901	44.4	.66	0.0	8.0	0	7.6		2.33	.54	0	14.1	3.5	17.6	1	0	80.2	80
35	03.5	✓	0	60	0	✓	✓	0	.	1148	26.8	.35	0.0	7.8	0	6.8		2.34	.53	0	12.8	3.1	15.9	1	0	80.6	80
36	04.5	✓	0	60	0	✓	✓	0	.	1285	30.3	.20	0.0	7.6	0	6.6	–	2.36	.53	0	12.5	1.6	14.1	1	0	88.6	88
37	05.5	✓	0	60	0	✓	✓	0	.	1073	24.4	.23	0.0	7.2	0	6.1	–	2.27	.53	0	11.1	2.1	13.2	1	0	84.2	84
38	06.5	✓	0	60	0	✓	✓	0	.	1361	31.6	.51	0.0	5.4	0	4.2	–	2.32	.54	0	7.8	3.7	11.5	1	0	67.8	67
39	07.5	✓	0	60	0	✓	✓	0	↓	1914	44.5	.54	0.0	5.8	0	4.6	–	2.33	.54	0	8.5	2.8	11.3	1	0	75.2	75
40	2108.5	✓	0	60	0	✓	✓	0	.	1462	33.9	.44	0.0	6.8	0	5.6		2.31	.54	0	10.4	3.0	13.4	1	0	77.7	77

Zone from 2077' to 2104' : Remarks Made to Client for Zone } This section is essentially non-productive
Field Interpretation Nothing :

Zone from ______ to ______ : Remarks Made to Client for Zone
Field Interpretation ______ :

CORE LABORATORIES, INC.

INTERPRETATION MUST BE CONFIRMED AT ALL TIMES. RECORDED POINT BY POINT AND BY ZONES ON THIS SHEET AND REPORTED TO CLIENT

Company Superior Oil Co Elevation 6414 KB Date Report 5-6-55 FL No PP-3-16-EC

Well No. 1-11 Slonn Gas Unit Well Location 1115 FNL & 760 FWL Sec 11 T 23N R 6W Analysts WEE WJC

Field ~~Ojo Encino~~ Largo Canyon Formation Pictured Cliffs Reports to Bean

County Rio Arriba State New Mex Cores Dia. On or Off Location Sec Hgt

BEST AVAILABLE COPY

NO.	DEPTH	PERMEABILITY M	W	C X Q X L = A	K MILLIDARCYS A	L	MERKY BULK	WEIGHT	VOLUME	OBS. RETORT CORR. O	W	O	W	WT. GM.	DENS. NAT.	BLK. VOL.	VOL. % O_b	W_b	G_b	% POR	S_{cw} FR.	PORE SATURATION S_o	S_{tw}	S_{cw}	I_1	I_2
41	2109	351	0	60 0 2.00 .18	0		13.70	32.7	.13	0.0	7.4	0	6.2	12.5	2.39	52	0	11.9	10	12.9	1.-	0	12.4	9.0		
42	2111	"	0	60 0 " .1	0		14.64	33.6	.66	0.0	5.6	0	4.6	"	2.29	54	0	8.5	45	13.0	1.-	0	65.4	65.		
43	2113	"	0	60 0 " .1	0		16.76	38.9	.71	0.0	6.8	0	5.9	"	2.32	54	0	10.9	42	15.1	1.-	0	72.2	72.		
44	2113	"	0	60 0 " .1	0		18.91	47.5	.21	0.0	3.7	0	2.8	"	2.51	50	0	5.9	14	6.7	1.-	0	83.6	83.	S	Pc
45	2115	"	0	60 0 " .1	0		14.44	33.6	.47	0.0	7.2	0	6.1	"	2.33	54	0	11.3	33	14.6	1.-	0	77.4	77.	"	"
46	2115	"	0	60 0 " .1	0		14.37	33.2	.44	0.0	7.3	0	6.0	"	2.31	54	0	11.1	3.1	14.2	1.-	0	78.1	78.	"	"
47	2116	"	0	60 0 " .1	0		10.75	24.7	.33	0.0	7.0	0	5.5	"	2.30	54	0	10.2	3.1	13.3	1.-	0	76.9	76.		
48	2117	"	0	60 0 " .1	0		17.82	42.2	.41	0.0	7.0	0	6.1	"	2.37	53	0	11.5	2.3	13.8	1.-	0	83.4	83.	S	Pc
49	2118	"	0	60 0 " .1	0		14.10	33.6	.29	0.0	7.0	0	6.2	"	2.39	52	0	11.9	2.1	14.0	1.-	0	85.1	85.	"	"
50	2119	"	0	60 0 " .1	0		16.13	38.2	.38	0.0	7.8	0	6.4	"	2.37	53	0	12.1	2.4	14.5	1.-	0	83.5	83.	"	"
51	2120	"	0	60 0 " .1	0		13.50	31.8	.38	0.0	6.8	0	5.4	"	2.36	53	0	10.2	2.8	13.0	1.-	0	78.4	78.		
52	2121	"	0	60 0 " .1	0		14.68	35.3	.36	0.0	7.4	0	6.2	"	2.41	52	0	11.9	2.5	14.4	1.-	0	82.6	82.		
53	2122	"	0	60 0 " .1	0		15.09	37.1	.21	0.0	6.8	0	5.6	"	2.46	51	0	11.0	1.7	12.7	1.-	0	86.6	86.		
54	2123	"	0	60 0 " .1	0		12.73	31.7	.22	0.0	4.6	0	3.5	"	2.49	50	0	7.2	1.7	8.9	1.-	0	80.5	80.		
55	2124	"	0	60 0 " .1	0		13.21	31.4	.36	0.0	7.6	0	6.1	"	2.38	53	0	11.5	2.7	14.2	1.-	0	81.0	81.		
56	2125	"	0	60 0 " .1	0		11.56	27.6	.39	0.0	7.1	0	5.6	"	2.39	52	0	10.8	3.4	14.2	1.-	0	76.1	76.	S	Pc
57	2126	"	0	60 0 " .1	0		12.62	29.8	.36	0.0	8.3	0	6.9	"	2.36	53	0	13.0	2.9	15.9	1.-	0	81.8	81.		
58	2128	"	0	60 0 " .1	0		12.51	29.3	.36	0.0	7.6	0	6.2	"	2.34	53	0	11.7	2.4	14.6	1.-	0	80.3	80.		
59	2129	"	0	60 0 " .1	0		17.98	42.3	.58	0.0	8.2	0	6.8	"	2.35	53	0	12.8	3.2	16.0	1.-	0	80.0	80.		
60	2130	"	0	60 0 " .1	0		17.18	41.0	.44	0.0	7.2	0	5.9	"	2.39	52	0	11.3	2.6	13.9	1.-	0	81.4	81.		

Zone from 2109 to 2131 : Remarks Made to Client for Zone: This section is essentially non-productive

Field Interpretation Marine :

Zone from _____ to _____ : Remarks Made to Client for Zone: _____

Field Interpretation _____ :

CORE LABORATORIES, INC.

Company Superior Oil Co. Elevation 6414' KB Date Report 1/28/[illegible] FL No. [illegible]
Well [illegible] Well Location [illegible] Analysis [illegible]
Field [illegible] Formation [illegible] Reports to [illegible]
County [illegible] State [illegible] Cores [illegible] On or Off Location [illegible]

DEPTH	PERMEABILITY M	W	C X Q X L			A	MILLIDARCYS A	L	MERKY BULK	WEIGHT	VOLUME	OBS. RETORT O	W	CORR O	W	WT. GM.	DENS. NAT.	BLK. VOL.	VOL. % O_b	W_b	G_b	% POR	S_{cw} FR.	PORE SATURATION S_o	S_w	S_{cn}
[illegible]	[illegible]	0	60	0	[illegible]	[illegible]	0	.	20.56	49.6	.40	0.0	8.2	0	6.5	1.2	2.41	52	0.	12.3	2.0	14.5	1.	0.	86.2	86
[illegible]	[illegible]	0	60	0	[illegible]	[illegible]	0	.	13.00	31.1	.40	0.0	7.5	0	6.3	[illegible]	2.31	52	0.	12.3	3.1	15.6	1.	0.	80.1	80
[illegible]	[illegible]	0	60	0	[illegible]	[illegible]	0	.	15.88	37.5	.34	0.0	7.3	0	6.2	[illegible]	2.36	53	0.	11.7	2.1	13.8	1.	0.	84.8	84
[illegible]	[illegible]	0	60	0	[illegible]	[illegible]	0	.	9.37	22.1	.29	0.0	8.6	0	7.2	[illegible]	2.36	53	0.	13.6	3.1	16.7	1.	0.	81.5	81
[illegible]	[illegible]	0	60	0	[illegible]	[illegible]	0	.	16.22	38.4	.33	0.0	8.2	0	7.2	[illegible]	2.37	53	0.	13.6	2.0	15.6	1.	0.	87.2	87
[illegible]	[illegible]	0	60	0	[illegible]	[illegible]	0	.	17.42	42.5	.26	0.0	8.2	0	6.6	[illegible]	2.44	51	0.	12.9	1.5	14.4	1.	0.	89.5	89
[illegible]	[illegible]	0	60	0	[illegible]	[illegible]	0	.	17.79	41.8	.44	0.0	8.8	0	6.8	[illegible]	2.35	52	0	12.8	2.5	15.3	1.	0.	83.6	83
[illegible]	[illegible]	0	60	0	[illegible]	[illegible]	0	.	15.94	38.4	.36	0.0	8.8	0	7.4	[illegible]	2.41	52	0	14.2	2.3	16.5	1.	0.	86.0	86
[illegible]	[illegible]	0	60	0	[illegible]	[illegible]	0	.	17.85	41.6	.46	0.0	9.6	0	8.2	[illegible]	2.33	54	0.	15.4	2.4	17.8	1.	0.	85.5	85
[illegible]	[illegible]	0	60	0	[illegible]	[illegible]	0	.	19.81	47.8	.38	0.0	8.4	0	7.0	[illegible]	2.41	52	0.	13.4	1.9	15.3	1.	0.	87.6	87
[illegible]	[illegible]	0	60	0	[illegible]	[illegible]	0	.	14.61	34.8	.30	0.0	9.4	0.	7.4	[illegible]	2.38	52	0.	14.2	2.1	16.3	1.	0.	87.1	87
[illegible]	[illegible]	0	60	0	[illegible]	[illegible]	0	.	19.39	45.8	.41	0.0	9.2	0.	8.0	[illegible]	2.37	53	0.	15.1	2.1	17.2	1.	0.	87.7	87
[illegible]	[illegible]	0	60	0	[illegible]	[illegible]	0	.	14.75	35.6	.17	0.0	8.7	0.	7.6	[illegible]	2.41	52	0.	11.6	1.2	12.8	1.	0.	92.4	92
[illegible]	[illegible]	0	60	0	[illegible]	[illegible]	0	.	14.58	35.0	.19	0.0	9.4	0	7.8	[illegible]	2.40	52	0.	15.0	1.3	16.3	1.	0.	92.1	92
[illegible]	[illegible]	0	60	0	[illegible]	[illegible]	0	.	16.16	39.7	.24	0.0	6.1	0	5.3	[illegible]	2.46	51	0.	10.4	1.5	11.9	1.	0.	87.4	87
[illegible]	[illegible]	0	60	0	[illegible]	[illegible]	0	.	15.26	36.5	.23	0.0	8.1	0.	6.0	[illegible]	2.40	52	0.	11.5	1.5	13.0	1.	0.	88.4	88
[illegible]	[illegible]	0	60	0	[illegible]	[illegible]	0	.	9.61	22.9	.22	0.0	8.3	0	7.2	[illegible]	2.38	52	0.	13.8	2.3	16.1	1.	0.	85.8	85
[illegible]	[illegible]	0	60	0	[illegible]	[illegible]	0	.	13.61	32.0	.39	0.0	9.2	0	7.8	[illegible]	2.35	53	0.	14.7	2.9	17.6	1.	0.	83.5	83
[illegible]	[illegible]	0	60	0	[illegible]	[illegible]	0	.	20.62	50.0	.29	0.0	7.2	0.	6.3	[illegible]	2.42	52	0.	12.1	1.4	13.5	1.	0.	87.8	87
[illegible]	[illegible]	0	60	0	[illegible]	[illegible]	0	.	14.14	34.1	.30	0.0	9.0	0	7.4	[illegible]	2.41	52	0.	14.2	2.1	16.3	1.	0.	87.2	87

Zone from 2131 to 2151 : Remarks Made to Client for Zone { This section is essentially non productive
Field Interpretation Nothing :

Zone from ______ to ______ : Remarks Made to Client for Zone
Field Interpretation ______ :

CORE LABORATORIES, INC.

INTERPRETATION MUST BE CONFIRMED AT ALL TIMES. RECORD POINT BY POINT AND BY ZONES ON THIS SHEET AND REPORTED TO CLIENT

Company Superior Oil Co. Elevation 6414' KB Date Report 3/26/[illegible] FL No [illegible]
Well #1-[illegible] Slane Grant Well Location [illegible] Analysis [illegible] WC
Field Carlson Lodge Formation [illegible] Reports to [illegible]
County Rio Arriba State N. Mex. Cores [illegible] On or Off Location [illegible]

NO.	DEPTH	PERMEABILITY M	W	C	× Q	× L	÷ A	K MILLIDARCYS A	L	MERKY BULK	WEIGHT	VOLUME	OBS. RETORT O	W	CORR. O	W	WT. GM.	DENS. NAT.	BLK. VOL.	VOL. % O_b	W_b	G_b	% POR	S_{cw} FR.	PORE SATURATION S_o	S_w	S_{cw}	I_1	I_2	I_3
81	2151.5	.25	0	60	.0	2.2	2.18	0		1511	33.0	.27	0.0	8.8	0	7.2	125	2.37	53	0	13.6	1.9	15.5	1.-	0	87	87			
82	52.5		0	60	.0	✓	✓	0		1701	40.9	.35	0.0	8.0	0	6.6		2.40	52	0	12.7	2.0	14.7	1.-	0	86.5	86			
83	53.5	✓	0	60	.0	✓	✓	0		1299	30.2	.98	0.0	8.0	0	6.4	✓	2.33	52	0	11.9	7.6	19.5	.90	0	61.0	55			
84	2154.5	✓	0	60	.0	✓	✓	0		1173	26.8	.48	0.0	8.2	0	6.4	✓	2.28	55	0	11.6	8.3	19.9	.87	0	58.4	51			
85	2155.5	✓	1	60	.01	✓	✓	.04		2116	50.8	1.72	0.0	7.0	0	5.6	✓	2.40	52	0	9.6	8.1	17.7	.91	0	52.2	49			
86	2157.5	✓	9	60	.017	✓	✓	.72		1297	31.0	.34	0.0	6.0	0	4.5	✓	2.39	52	0	8.7	6.5	15.2	-	0	57.2	57			
87	58.5	✓	10	60	.019	✓	✓	.81		1517	31.0	.44	0.0	7.0	0	5.5	✓	2.35	53	0	10.4	7.1	17.5	.93	0	59.4	55			
88	59.5	✓	5	60	.009	✓	✓	.38		1267	28.4	1.34	0.0	7.0	0	5.4	✓	2.35	56	0	9.1	10.6	20.3	.81	0	47.8	54			
89	60.5	✓	2	60	.003	✓	✓	.13		1305	30.8	.38	0.0	8.2	0	6.2	✓	2.36	53	0	11.7	2.9	14.6	-	0	80.1	80			
90	61.5	✓	3	60	.005	✓	✓	.21		1522	35.0	1.4-	0.0	7.4	0	5.7	✓	2.29	55	0	10.7	7.4	18.1	.92	0	59.2	54			
91	62.5	✓	1	60	.004	✓	✓	.07		1329	30.7	.95	0.0	8.3	0	6.2	✓	2.30	54	0	11.5	7.1	18.6	.91	0	61.9	56			
92	63.5	✓	0	60	.0	✓	✓	0		1887	44.7	.46	0.0	8.5	0	6.2	✓	2.37	55	0	11.7	2.4	14.1	-	0	83.0	83			
93	64.5	✓	9	60	.017	✓	✓	.72		1448	35.8	.20	0.0	5.7	0	4.0	✓	2.48	50	0	8.0	1.4	9.4	-	0	85.2	85			
94	65.5	✓	16	60	.030	✓	✓	1.29		1567	35.5	1.32	0.0	7.4	0	5.6	✓	2.27	55	0	10.2	8.4	18.6	.89	0	54.7	49			
95	66.5	✓	20	60	.038	✓	✓	1.63		1626	36.7	1.56	0.0	6.3	0	4.4	✓	2.26	55	0	8.0	9.6	17.6	.86	0	45.5	39			
96	67.5	✓	5	60	.009	✓	✓	.38		1194	27.3	1.13	0.0	6.0	0	4.-	✓	2.29	55	0	7.6	9.5	17.1	.84	0	44	40			
97	68.5	✓	5	60	.009	✓	✓	.38		1698	38.9	1.36	0.0	6.1	0	4.1	✓	2.29	55	0	8.9	8.0	16.9	.92	0	52	48			
98	69.5	✓	3	60	.005	✓	✓	.21		1440	20.8	0.45	0.0	6.3	0	4.4	✓	2.21	56	0	7.9	10.1	18.0	.85	0	43.9	37			
99	70.5	✓	10	60	.019	✓	✓	.81		1412	32.1	1.51	0.0	6.1	0	4.2	✓	2.27	55	0	7.6	8.8	16.4	.90	0	46.4	42			
100	2171.5	✓	14	60	.026	✓	✓	1.11		1285	30.5	0.76	0.0	5.4	0	3.8	✓	2.37	53	0	7.2	5.9	13.1	1.-	0	55	55			

Zone from As noted to ______ : Remarks Made to Client for Zone: 2152 - 2172 in low capacity gas production.

Field Interpretation ______ :

[illegible] with higher [illegible]

Zone from ______ to ______ : Remarks Made to Client for Zone ______

Field Interpretation ______ :

CORE LABORATORIES, INC.

…TERPRETATION …UST BE CON… …RMED AT ALL …MES. RECORD… …POINT BY …INT AND BY …NES ON THIS …LET AND RE… …ITED TO CLI…

Company Superior Oil Co. Elevation [illegible] Date Report [illegible] FL No. [illegible]

Well # 1-11 Sloan Govt (?) Well Location [illegible] Analysis [illegible]

Field [illegible] Formation Pictured Cliffs Reports to [illegible]

County [illegible] State New Mex Cores [illegible] On or Off Location [illegible]

NO.	DEPTH	PERMEABILITY M	W	C	X Q	X L	÷ A	K MILLIDARCYS A	L	MERKY BULK	WEIGHT	VOLUME	OBS. O	OBS. W	RETORT CORR. O	W	WT. GM.	DENS. NAT.	BLK. VOL.	VOL. % O_b	W_b	G_b	% POR	S_{cw} FR.	PORE SATURATION S_o	S_w	S_{cn}
1	2192.5	35	20	60	.038	[illegible]	[illegible]	1.63		1901	58.8	1.74	0.0	5.9	0.	4.1	[illegible]	2.28	55	0	7.5	10.2	17.7	.80	0.	42.4	.34
2	93.5		15	60	.028			1.20		1415	32.3	1.67	0.0	6.3	0.	4.2		2.22	56	0.	7.5	11.8	19.3	.78	0.	38.9	.30
3	[illegible]		14	60	.026			1.11		1519	33.8	1.74	0.0	6.5	0.	4.4		2.23	56	0.	8.4	11.5	19.9	.71	0.	42.3	.33
4	[illegible]		16	60	.030			1.29		1521	31.5	1.79	0.0	6.8	0.	5.0		2.21	56	0.	8.9	11.7	20.6	.78	0.	45.2	.34

…e from 2172 to 2176 : Remarks Made to Client for Zone: This shows to gas productive (?)

…d Interpretation Gas (?) :

Zone from ______ to ______ : Remarks Made to Client for Zone

Field Interpretation ______ :

EXHIBIT NO. 12

COMPANY: Victor Salazar
WELL: Campbell No. 1
(Well Now Named Kimbell Oil Co. Salazar 2-34)
Ballard Pictured Cliffs Field
NW/SW Section 34, Township 25 North, Range 6 West
Rio Arriba County, New Mexico

Pictured Cliffs Formation Core Data

Depth (ft)	Sample Footage (ft)	Horizontal Permeability (md)
2200.5 - 2201.5	1	0.00
2201.5 - 2202.5	1	0.00
2202.5 - 2203.5	1	0.00
2203.5 - 2204.5	1	0.00
2204.5 - 2205.5	1	0.00
2205.5 - 2206.5	1	0.00
2206.5 - 2207.5	1	0.00
2207.5 - 2208.5	1	0.00
2208.5 - 2209.5	1	0.00
2209.5 - 2210.5	1	0.00
2210.5 - 2211.5	1	0.00
2211.5 - 2212.5	1	0.00
2212.5 - 2213.5	1	0.00
2213.5 - 2214.5	1	0.00
2214.5 - 2215.5	1	0.00
2215.5 - 2216.5	1	0.00
2216.5 - 2217.5	1	0.00
2217.5 - 2218.5	1	0.00
2218.5 - 2219.5	1	0.00
2219.5 - 2220.5	1	0.00
2220.5 - 2221.5	1	0.00
2221.5 - 2222.5	1	0.00
2222.5 - 2223.5	1	0.00
2223.5 - 2224.5	1	0.00
2224.5 - 2225.5	1	0.00
2225.5 - 2226.5	1	0.00
2226.5 - 2227.5	1	0.00
2227.5 - 2228.5	1	1.29
2228.5 - 2229.5	1	1.11
2229.5 - 2230.5	1	2.23
2230.5 - 2231.5	1	0.55
2231.5 - 2232.5	1	0.38
2232.5 - 2233.5	1	1.11
2233.5 - 2234.5	1	1.11
2234.5 - 2235.5	1	1.20
2235.5 - 2236.5	1	1.20
2236.5 - 2237.5	1	2.49
2237.5 - 2238.5	1	3.18
2238.5 - 2239.5	1	0.00
2239.5 - 2240.5	1	
TOTAL	40	15.85

Average Permeability = 15.85/40 = 0.40 md.

BEFORE EXAMINER STAMETS
OIL CONSERVATION DIVISION
APPLICANTS EXHIBIT NO. 12
CASE NO. 7395
Submitted by MCBRD
Hearing Date 10/21/81

COMPANY [illegible] DATE ON APRIL 20, 1955 FILE NO. D-3-161(PC)
WELL NO. 1 [illegible] DATE OFF APRIL 20, 1955 ENGRS. [illegible]
FIELD [illegible] FORMATION [illegible] ELEV. 6393'GR
COUNTY [illegible] STATE N. [illegible] DRLG. FLD. [illegible] CORES [illegible]
LOCATION 1550'FSL 800'FEL 34 25N 6W REMARKS [illegible]

TABULAR DATA and INTERPRETATION

PERMEABILITY o—o (MILLIDARCYS) 5 4 3 2 1 0
TOTAL WATER o—o (PERCENT PORE SPACE) 80 60 40 20 0
POROSITY x---x (PERCENT) 40 30 20 10 0
OIL SATURATION x---x (PERCENT PORE SPACE) 0 20 40 60 80

DEPTH	PERM AIR	POROSITY	WATER	OIL	
		BEST AVAILABLE COPY			
2200.5	0.0	16.6	0.0	24.5	
01.5	0.0	15.4	0.0	89.0	
02.5	0.0	15.3	0.0	23.4	
03.5	0.0	15.3	0.0	89.2	
04.5	0.0	10.2	0.0	89.1	
05.5	0.0	20.0	0.0	72.4	
06.5	0.0	17.8	0.0	65.8	
07.5	0.0	17.7	0.0	34.2	
08.5	0.0	17.0	0.0	71.4	
09.5	0.0	14.0	0.0	72.1	
10.5	0.0	16.1	0.0	90.1	
11.5	0.0	11.1	0.0	90.1	
12.5	0.0	14.5	0.0	89.0	
13.5	0.0	15.6	0.0	88.5	
14.5	0.0	14.4	0.0	89.5	
15.5	0.0	16.7	0.0	91.6	
16.5	0.0	16.2	0.0	85.3	
17.5	0.0	16.6	0.0	86.1	
18.5	0.0	12.4	0.0	88.7	
19.5	0.0	17.2	0.0	86.6	
20.5	0.0	15.9	0.0	90.0	
21.5	0.0	16.5	0.0	91.5	
22.5	0.0	13.9	0.0	93.0	
23.5	0.0	16.9	0.0	92.9	
24.5	0.0	15.4	0.0	89.6	
25.5	0.0	16.6	0.0	77.8	
26.5	0.0	15.7	0.0	70.1	
27.5	0.0	17.5	0.0	64.0	
28.5	1.29	22.2	0.0	58.5	GAS
29.5	1.11	20.9	0.0	56.5	GAS
30.5	2.23	23.5	0.0	51.9	GAS
31.5	.55	20.4	0.0	60.2	GAS
32.5	.38	18.8	0.0	59.1	GAS
33.5	1.11	22.1	0.0	56.9	GAS
34.5	1.11	22.7	0.0	56.3	GAS
35.5	1.20	21.7	0.0	52.2	GAS
36.5	1.20	15.4	0.0	40.9	GAS
37.5	2.49	16.4	0.0	45.2	GAS
38.5	3.13	14.0	0.0	35.7	GAS
39.5	0.0	15.8	0.0	83.7	
40.5	0.0	15.2	0.0	75.0	
41.5	0.0	16.4	0.0	75.0	
42.5	0.0	14.3	0.0	84.3	
43.5	0.0	11.8	0.0	84.7	
44.5	0.0	11.8	0.0	83.1	

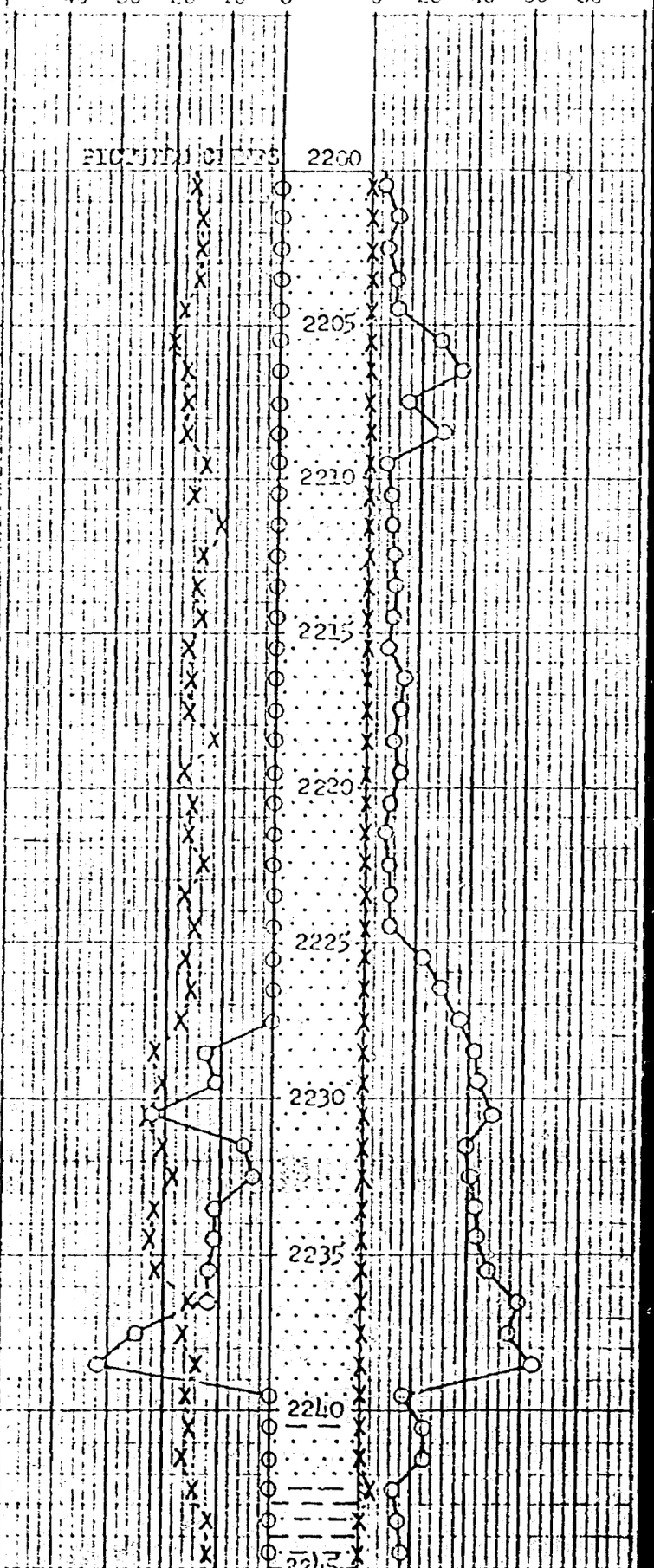


EXHIBIT NO. 13

COMPANY: Superior Oil Company
WELL: Albuquerque Assoc. #1-36 State
(Well Now Named El Paso Natural Gas Canyon Largo Unit No. 57)
Ballard Pictured Cliffs Field
SE/SE Section 36, Township 25 North, Range 7 West
Rio Arriba County, New Mexico

Pictured Cliffs Formation Core Data

Depth (ft)	Sample Footage (ft)	Horizontal Permeability (md)
2299.5 - 2300.5	1	0.00
2300.5 - 2301.5	1	0.81
2301.5 - 2302.5	1	0.00
2302.5 - 2303.5	1	0.00
2305.5 - 2306.5	1	0.00
2306.5 - 2307.5	1	0.00
2307.5 - 2308.5	1	0.00
2308.5 - 2309.5	1	0.00
2309.5 - 2310.5	1	0.00
2310.5 - 2311.5	1	0.00
2311.5 - 2312.5	1	0.00
2312.5 - 2313.5	1	0.00
2313.5 - 2314.5	1	0.00
2314.5 - 2315.5	1	0.00
2315.5 - 2316.5	1	0.00
2316.5 - 2317.5	1	1.46
2317.5 - 2318.5	1	1.63
2318.5 - 2319.5	1	0.93
2319.5 - 2320.5	1	0.81
2320.5 - 2321.5	1	0.00
2321.5 - 2322.5	1	0.64
2322.5 - 2323.5	1	0.21
2323.5 - 2324.5	1	0.47
2324.5 - 2325.5	1	0.85
2325.5 - 2326.5	1	0.93
2326.5 - 2327.5	1	0.55
2327.5 - 2328.5	1	0.30
2328.5 - 2329.5	1	0.30
2329.5 - 2330.5	1	0.13
2330.5 - 2331.5	1	0.00
2331.5 - 2332.5	1	0.00
2332.5 - 2333.5	1	0.00
2333.5 - 2334.5	1	0.00
2334.5 - 2335.5	1	0.00
2335.5 - 2336.5	1	0.00
2336.5 - 2337.5	1	0.00
2337.5 - 2338.5	1	0.00
2338.5 - 2339.5	1	0.00
2339.5 - 2340.5	1	0.00
2340.5 - 2341.5	1	0.00
2341.5 - 2342.5	1	0.00
TOTAL	41	10.02

Average Permeability = 10.02/41 = 0.24 md.

BEFORE EXAMINER STAMETS
OIL CONSERVATION DIVISION
APPLICANTS EXHIBIT NO. 13
CASE NO. 7395
Submitted by McCord
Hearing Date 10/21/81

MAY 3 1 1955

CORE LABORATORIES, INC.

INTERPRETATION MUST BE CONFIRMED AT ALL TIMES. RECORD POINT BY POINT AND BY LINES ON THIS SHEET AND REPORTED TO CLIENT

Company Superior Oil Co Elevation 6601 KB Date Report 5-30-55 FL No. RR3-1701 F
Well Albuquerque Land # 1-36 S. W. S. Well Location NWSESE S36 T25N R2W Analysis WER, WJC
Field Canyon Largo Formation Pictured Cliffs Reports to Rowl
County Rio Arriba State New Mex Cores 1 Dia On or Off Location Sec # 4

BEST AVAILABLE COPY

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NO.	DEPTH	PERM. M	W	C	X	Q	L	A	MILLIDARCYS A	L	MERKY BULK	WEIGHT	VOLUME	OBS. RETORT O	W	CORR O	W	WT. GM.	DENS. NAT.	BLK. VOL.	VOL. % O_b	W_b	G_b	% POR	S_{cn} FR.	PORE SATURATION S_o	S_w	S_{cn}	I_1	I_2	I_3
1	2269.5	.35	0	60	.0	2.0	2.78	0	·	14.62	35.0	.20	0.0	8.4	0	5.7	121	2.34	.52	0.	11.0	2.0	13.0	1.–	0.	84.7	84			
2	70.5	/	0	60	.0	/	/	0	·	14.92	35.4	.10	0.2	9.5	1.0	10.0	/	2.37	.53	1.4	11.3	0.7	13.4	1.–	13.7	81.7	81.			
3	2271.5	/	0	60	.0	/	/	0	·	9.02	24.1	.11	0.4	9.6	1.2	5.8	/	2.67	.47	2.5	12.4	1.2	16.1	1.–	15.6	77.0	77			
4	[illegible]	/	0	60	.0	/	/	0	·	17.10	40.8	.38	N	8.1	0.3	4.5	/	2.3[illegible]	.52	0.4	8.7	2.2	11.5	1.–	5.2	75.6	75.			
5	[illegible]	/	0	60	.0	/	/	0	·	14.54	35.7	.18	0.0	8.0	0.	5.4		2.45	.51	0.	11.0	1.2	12.2	1.–	0.	90.0	90			
6	90.0		0	60	.0	/	/	0	·	14.24	35.1	.33	N	5.7	0.3	4.1	/	2.46	.51	0.6	8.0	2.3	10.4	1.–	5.0	73.4	73			
7	91.5	/	0	60	.0	/	/	0	·	17.27	41.8	.24	0.0	7.2	0	5.4	/	2.43	.52	0.	10.4	1.4	11.8	1.–	0.	88.1	88			
8	92.5	/	0	60	.0	/	/	0	·	14.81	36.1	.35	0.	6.2	0.	4.1	/	2.48	.52	0.	7.9	2.4	10.3	1.–	0.	76.6	76			
9	93.0	/	0	60	.0	/	/	0	·	15.74	37.0	.54	0.	8.4	0.	6.0	/	2.32	.54	0.	11.5	3.4	14.9	1.–	0.	77.1	77			
10	94.5	/	0	60	.0	/	/	0	·	15.29	35.9	.37	N	7.2	0.3	7.6	/	2.35	.53	0.6	13.2	2.4	16.2	1.–	3.7	81.4	81.			
11	95.5	/	0	60	.0	/	/	0	·	17.08	40.3	.35	0.	7.6	0	5.6	/	2.36	.53	0.	10.6	2.0	12.6	1.–	0.	84.1	84.			
12	96.5	/	0	60	.0	/	/	0	·	15.78	37.6	.39	0.	7.3	0	[illegible]	/	2.38	.53	0.	13.6	2.5	16.1	1.–	0.	84.4	84.			
13	97.5	/	0	60	.0	/	/	0	·	15.62	36.8	.50	0.	9.8	0	7.1	/	2.35	.53	0.	14.5	3.2	17.7	1.–	0.	81.9	81.			
14	98.5	/	0	60	.0	/	/	0	·	17.53	41.1	.49	0.	16.[illegible]	0	[illegible]	/	2.34	.53	0.	15.5	2.8	18.3	1.–	0.	84.6	84.			
15	99.5	/	0	60	.0	/	/	0	·	16.36	40.0	.42	0.	6.6	0	9.1	/	2.45	.51	0.	8.6	2.6	11.2	1.–	0.	76.8	76			
16	2300.5	/	1[illegible]	60	.014	/	/	.81	v	10.93	26.4	.33	0.	11	0.	7.6	/	2.41	.52	0.	15.0	3.0	18.0	1.–	0.	83.4	83			
17	01.5	/	0	60	.0	/	/	0		17.34	41.3	.36	0.	7.1	0	[illegible]	/	2.38	.52	0.	13.5	2.1	15.6	1.–	0.	86.4	86.			
18	[illegible]	/	[illegible]	[illegible]	.0	/	/	0		15.38	36.3	.41	0.	16.[illegible]	0	[illegible]	/	[illegible]	.53	0.	15.1	2.1	17.[illegible]	1.–	0.	[illegible]	[illegible]			
[illegible]	[illegible]									[illegible]	[illegible]	[illegible]						[illegible]	.52	0.	13.0	2.3	[illegible]	1.–	0.	[illegible]	[illegible]			
										[illegible]	[illegible]	[illegible]						2.42	.52	0.	12.1	1.9	14.0	1.–	0.	86.4	86			

Zone from 2269 to 2305 : Remarks Made to Client for Zone { This section is essentially non productive
Field Interpretation Nothing :

Zone from ______ to ______ : Remarks Made to Client for Zone {
Field Interpretation ______ :

MAY 3 1 1955

CORE LABORATORIES, INC.

INTERPRETATION MUST BE CONFIRMED AT ALL TIMES. RECORDED POINT BY POINT AND BY ZONES ON THIS SHEET AND REPORTED TO CLIENT

Company The Superior Oil Co Elevation 6601' KB Date Report 5-30-55 FL No. FP-3-170KC
Well Albuquerque Assoc #1-36 Well Location S36 T25N R6W Analysts WEB WJC
Field Canyon Largo Formation Pictured Cliffs Reports to Bean
County Rio Arriba State New Mexico Cores Dia. On or Off Location Sc #4

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NO.	DEPTH	M	W	C	Q	L	A	Ka MILLIDARCYS		MERKY BULK	MERKY WEIGHT	MERKY VOLUME	OBS. RETORT O	OBS. RETORT W	CORR. O	CORR. W	WT. GM.	DENS. NAT.	BLK. VOL.	VOL. % O_b	VOL. % W_b	VOL. % G_n	% POR Φ*	S_{cw} FR.	PORE SATURATION S_o (So)	S_{w} (Sw)	S_{cw}	I₁	I₂	I₃
21	2305.5	357	0	60	0	290	2.18	0		6.39	38.7	.51	0.0	8.6	0.	7.1	105	2.37	53	0.	13.4	3.1	16.5	1.—	0.	81.2	81.			
22	06.5	/	0	60	0	—	—	0		15.74	37.2	.42	0.0	8.6	0.	6.9	—	2.36	53	0.	13.0	2.7	15.7	1.—	0.	82.8	82.			
23	07.5	/	0	60	0	—	—	0		17.29	40.0	.59	0.0	8.6	0	7.1	—	2.32	54	0.	13.1	3.4	16.5	—	0.	79.5	79.			
24	08.5	/	0	60	0	—	—	0		14.14	32.8	.49	0.0	8.9	0	7.3	—	2.32	54	0.	13.5	3.5	17.0	—	0.	79.5	79.			
25	09.5		0	60	0	—	—	0		17.17	39.9	.78	0.0	8.9	0.	7.3	—	2.33	54	0.	13.5	4.6	18.1	1.—	0.	74.6	74.			
26	10.5	—	0	60	0	—	—	0		14.44	36.8	.45	0.0	8.8	0.	7.0	—	2.35	49	0.	14.3	3.1	17.4	1.—	0.	82.3	82.			
27	11.5	—	0	60	0	—	—	0		14.19	33.1	.72	0.0	8.2	0.	6.1	—	2.34	51	0.	12.2	5.1	17.3	1.—	0.	70.5	70.			
28	12.5	/	0	60	0	—	—	0		17.07	40.0	.76	0.0	8.6	0.	7.6	—	2.35	53	0.	13.2	4.5	17.7	1.—	0.	74.6	74.			
29	13.5	/	0	60	0	—	—	0		17.71	44.9	.27	0.0	4.4	0.	3.2	—	2.53	49	0.	6.5	1.5	8.0	1.—	0.	81.4	81.			
30	14.5	/	0	60	0	—	—	0		15.74	36.7	.72	0.0	7.8	0.	6.2	—	2.33	54	0.	11.5	4.6	16.1	1.—	0.	71.5	71.			
31	15.5	/	0	60	0	—	—	0		15.70	36.1	.91	0.0	9.4	0.	7.2	—	2.30	54	0.	13.3	5.8	19.1	.93	0.	69.7	65.			
32	16.5	/	18	60	.034	—	—	1.46		8.96	20.5	.89	0.0	7.8	0.	6.0	—	2.29	55	0.	10.9	9.9	[illegible].8	.80	0	52.4	42.			
33	17.5	/	20	60	.036	—	—	1.63		16.44	37.3	1.58	0.0	8.6	0.	6.8	—	2.27	55	0.	12.4	9.6	22.0	.78	0.	56.3	44.			
34	18.5	/	12	60	.022	—	—	.93		19.99	45.0	1.93	0.0	7.6	0.	6.0	—	2.25	56	0.	10.7	9.7	20.4	.82	0.	52.5	43.			
35	19.5	/	10	60	.019	—	—	.81		12.30	30.0	1.30	0.0	8.6	0.	7.0	—	2.44	51	0.	13.7	10.6	24.3	.72	0.	56.4	41.			
36	20.5	—	0	60	0	—	—	0		16.13	40.1	.32	0.0	5.0	0.	3.8	—	2.48	50	0.	7.6	2.0	9.6	1.—	0.	79.2	79.			
37	21.5	/	8	60	.015	—	—	.64		15.93	35.7	1.49	0.0	6.9	0	5.4	—	2.24	56	0	9.6	9.4	19.0	.86	0.	50.5	43.			
38	22.5	/	3	60	.005	—	—	.21		17.58	41.7	1.09	0.0	5.4	0	3.9	—	2.37	53	0.	7.3	6.2	13.5	1.—	0.	54.1	54.			
39	23.5	/	6	60	.011	—	—	.47		22.71	51.9	2.08	0.0	6.4	0	4.9	—	2.28	55	0.	8.9	9.2	18.1	.87	0.	49.2	43.			
41	2324.5	/	11	60	.020	—	—	.85		11.25	25.1	1.38	0.0	7.1	0.	5.4	—	2.23	56	0.	9.8	12.3	22.1	.71	0.	44.4	33.			

Zone from ______ to ______ : Remarks Made to Client for Zone { 2305-16 Nothing; 2316-25 very good capacity Gas productive
Field Interpretation As noted :

* higher than normal water sat.

Zone from ______ to ______ : Remarks Made to Client for Zone {
Field Interpretation ______ :

CORE LABORATORIES, INC.

INTERPRETATION MUST BE CONFIRMED AT ALL TIMES. RECORDED POINT BY POINT AND BY ZONES ON THIS SHEET AND REPORTED TO CLIENT

Company The Superior Oil Co. Elevation 6641' KB Date Report 5-30-55 FL No RP3-170
Well Albuquerque Basin #1-36 SW¼ Location S36 T25N R6W Analysis COFP WSC
Field Canyon Largo Formation Pictured Cliffs Reports to Bean
County Rio Arriba State New Mex. Cores Dia On or Off Location Struct

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NO	DEPTH	PERMEABILITY M	W	C X Q X L = A	MILLIDARCYS	MERKY BULK	WEIGHT	VOLUME	OBS. RETORT CORR. O	W	O	W	WT. GM.	DENS. NAT.	BLK. VOL.	VOL. % O_b	W_b	G_b	% POR	S_{cw} FR.	PORE SATURATION S_o	S_w	S_{cw}	I_1	I_2	I_p	CC
41	2325.5	351	12	60 -023	2.78	.93			1.64	35.9	1.53	0.0	7.2	0.	5.7	1.25	2.24	57	0.	10.2	11.7	21.9	.76	0.	46.6	35				
42	26.5	/	7	60 .013	/	/	5		1.42	28.3	1.34	0.0	5.4	0.	4.5	/	2.27	55	0.	8.2	10.8	19.0	.81	0.	43.2	35				
43	27.5	/	4	60 .007	/	/	30		1.06	30.0	1.42	0.0	7.0	0.	6.0	/	2.25	56	0.	11.1	10.4	21.7	.71	0.	51.1	40				
44	28.5	/	4	60 .007	/	/	30		1.24	39.7	1.14	0.0	7.1	0.	6.3	/	2.30	54	0.	11.5	6.6	18.1	.95	0.	63.5	60				
45	29.5	/	2	60 .003	/	/	13		1.35	31.6	.46	0.0	7.9	0	6.2	/	2.31	53	0.	11.7	3.4	15.1	1.-	0.	77.7	73				
46	30.5	/	0	60 0	/	/	0		1.61	39.3	.69	0.0	7.4	0	5.4	/	2.36	53	0.	11.1	4.1	15.2	1.-	0.	73.0	73				
47	31.5	/	0	60 0	/	/	0		1.22	24.1	.47	0.0	6.1	0	7.0	/	2.34	53	0.	13.2	4.3	17.5	1.-	0.	75.4	75				
48	32.5	/	0	60 0	/	/	0		1.33	29.2	.44	0.0	8.6	0	7.0	/	2.37	53	0.	13.2	3.7	16.9	1.-	0.	78.1	78				
49	33.5	/	0	60 0	/	/	0		0.49	29.8	.40	0.0	8.1	0	7.2	/	2.39	52	0.	13.8	3.2	17.0	1.-	0.	81.0	81				
50	34.5	/	0	60 0	/	/	0		1.35	33.9	.39	0.0	7.6	0	7.0	/	2.36	53	0.	13.6	2.7	16.3	1.-	0.	83.5	83				
51	35.5	/	0	60 0	/	/	0		1.63	36.9	.52	0.0	8.1	0	7.2	/	2.36	53	0.	13.6	3.3	16.9	1.-	0.	80.5	80				
52	36.5	/	0	60 0	/	/	0		1.07	35.5	.55	0.0	9.5	0	7.3	/	2.36	53	0.	13.8	3.7	17.5	1.-	0.	78.9	78				
53	37.5	/	0	60 0	/	/	0		1.34	41.0	.56	0.0	9.6	0	7.4	/	2.36	53	0.	14.0	3.2	17.2	1.-	0.	81.4	81				
54	38.5	/	0	60 0	/	/	0		1.65	44.6	.59	0.0	7.1	0	6.4	/	2.39	52	0.	12.3	3.2	15.5	1.-	0.	79.4	79				
55	39.5	/	0	60 0	/	/	0		1.48	47.0	.42	0.0	8.7	0.	6.6	/	2.42	52	0.	12.7	2.2	14.9	1.-	0.	85.3	85				
56	40.5	/	0	60 0	/	/	0		1.24	44.5	.38	0.0	7.6	0.	5.7	/	2.44	51	0.	11.2	2.1	13.3	1.-	0.	84.3	84				
57	28.5	/	0	60 0	/	/	0		1.74	44.3	.20	0.0	5.1	0.	3.9	/	2.50	50	0.	7.8	1.1	8.9	1.-	0.	87.7	87				

Zone from 2325 to 2329 : Remarks Made to Client for Zone: Low capacity gas well.
Field Interpretation Gas Pictured Cliffs : 2330 – 2542 – Main productive

Zone from _____ to _____ : Remarks Made to Client for Zone: _____
Field Interpretation _____ :

EXHIBIT NO. 14

COMPANY: Pubco Development, Inc.
WELL: Hughes 28-4

Blanco Pictured Cliffs (South) Field
SE/SE Section 28, Township 26 North, Range 7 West
Rio Arriba County, New Mexico

Pictured Cliffs Formation Core Data

Depth (ft)	Sample Footage (ft)	Horizontal Permeability (md)
2288 - 2289	1	0.24
2289 - 2290	1	0.19
2290 - 2291	1	0.32
2291 - 2292	1	0.34
2292 - 2293	1	0.46
2293 - 2294	1	0.75
2294 - 2295	1	0.43
2295 - 2296	1	1.22
2296 - 2297	1	0.76
2297 - 2298	1	0.37
2298 - 2299	1	0.53
2299 - 2300	1	0.34
2300 - 2301	1	0.35
2301 - 2302	1	0.49
2302 - 2303	1	0.37
2303 - 2304	1	0.28
2304 - 2305	1	1.00
2305 - 2306	1	0.78
2306 - 2307	1	0.98
2307 - 2308	1	0.17
2308 - 2309	1	0.56
2309 - 2310	1	0.28
2310 - 2311	1	0.44
2311 - 2312	1	0.47
2312 - 2313	1	0.19
2313 - 2314	1	0.10
2314 - 2315	1	0.41
2315 - 2316	1	0.28
2316 - 2317	1	0.26
2317 - 2318	1	0.45
2318 - 2319	1	0.14
2319 - 2320	1	0.41
2320 - 2321	1	0.46
2321 - 2322	1	0.76
2322 - 2323	1	0.47
2323 - 2324	1	0.59
2324 - 2325	1	0.26
2325 - 2326	1	0.60
2326 - 2327	1	0.23
2327 - 2328	1	0.38
2328 - 2329	1	0.15
2329 - 2330	1	0.77
2330 - 2331	1	0.17
2331 - 2332	1	0.87
2332 - 2333	1	0.26
TOTAL	45	20.33

Average Permeability = 20.33/45 = 0.45 md.

BEFORE EXAMINER STAMETS
OIL CONSERVATION DIVISION
APPLICANTS EXHIBIT NO. 14
CASE NO. 7395
Submitted by MCHUGH
Hearing Date 10/21/81

Kwin

CORE LABORATORIES, INC. CORE LAB *Petroleum Reservoir Engineering*

COMPANY PUBCO DEVELOPMENT, INC. DATE ON MARCH 9, 1953 FILE NO FWL-98 (FC)
WELL HUGHES 28-4 DATE OFF MARCH 23, 1953 ENGRS WER-TBG
FIELD WILDCAT FORMATION PICTURED CLIFFS ELEV. 6287' DF
COUNTY RIO ARRIBA STATE NEW MEXICO RLG. FLD. WATER BASE MUD CORES DIAMOND
LOCATION NE SE SE SEC. 28-26N-7W REMARKS SERVICE NO. 5

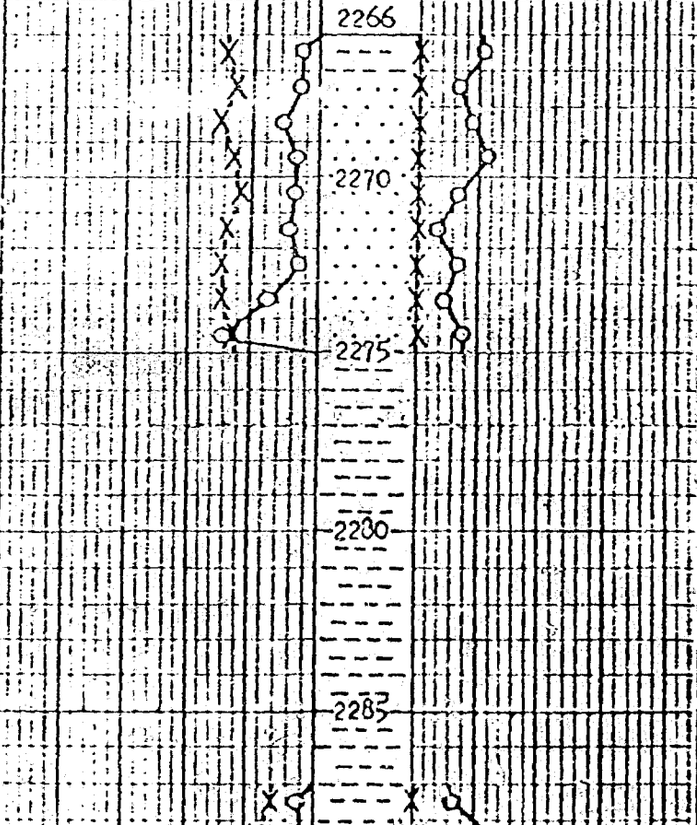
SAND ▨ LIMESTONE ▭ CONGLOMERATE ▨ CHERT ▨
SHALE ▭ DOLOMITE ▨

TABULAR DATA and INTERPRETATION

SAMPLE NUMBER	DEPTH FEET	PERM MD To Air	POROSITY %	RESIDUAL SATURATION % PORE SPACE OIL	RESIDUAL SATURATION % PORE SPACE TOTAL WATER	REMARKS
67	2267	0.29	13.7	0.0	78.9	WATER
68	68	0.29	12.9	0.0	66.9	WATER
69	69	0.57	15.3	0.0	82.3	WATER
70	70	0.35	12.9	0.0	77.6	WATER
71	71	0.37	13.0	0.0	86.6	WATER
72	72	0.43	13.8	0.0	82.3	WATER
73	73	0.33	14.4	0.0	86.8	WATER
74	74	0.75	14.5	0.0	90.4	WATER
75	75	1.12	12.8	0.0	84.2	WATER
88	2288	0.24	6.1	0.0	36.2	WATER

COMPLETION COREGRAPH

PERMEABILITY o—o MILLIDARCYS 5 4 3 2 1 0
POROSITY x---x PERCENT 40 30 20 10 0
TOTAL WATER o—o PERCENT PORE SPACE 80 60 40 20
OIL SATURATION x--- PERCENT PORE SPACE 0 20 40 60 80



14	92	0.46	13.3	0.0	75.2	WATER
15	93	0.75	12.7	0.0	84.2	WATER
16	94	0.43	12.4	0.0	76.7	WATER
17	95	1.22	13.2	0.0	84.0	WATER
18	96	0.76	13.5	0.0	77.0	WATER
19	97	0.37	12.3	0.0	81.3	WATER
20	98	0.53	14.9	0.0	67.8	WATER
21	99	0.34	14.3	0.0	53.1	WATER
22	2300	0.35	12.8	0.0	60.2	WATER
23	01	0.49	12.7	0.0	60.5	WATER
24	02	0.37	11.5	0.0	55.6	WATER
25	03	0.28	10.8	0.0	88.9	WATER
26	04	1.00	14.7	0.0	73.5	WATER
27	05	0.78	12.9	0.0	83.8	WATER
28	06	0.98	13.4	0.0	78.4	WATER
29	07	0.27	8.1	0.0	72.9	WATER
30	08	0.56	11.7	0.0	81.2	WATER
31	09	0.29	13.7	0.0	78.1	WATER
32	10	0.44	11.8	0.0	76.3	WATER
33	11	0.47	13.0	0.0	70.8	WATER
34	12	0.19	7.8	0.0	82.0	WATER
35	13	0.10	12.8	0.0	71.0	WATER
36	14	0.11	13.6	0.0	81.6	WATER
37	15	0.28	11.2	0.0	82.1	WATER
38	16	0.26	12.3	0.0	86.4	WATER
39	17	0.15	14.5	0.0	66.3	WATER
40	18	0.14	11.7	0.0	81.5	WATER
41	19	0.41	13.9	0.0	76.2	WATER
42	20	0.46	8.8	0.0	75.0	WATER
43	21	0.76	13.4	0.0	83.6	WATER
44	22	0.47	12.3	0.0	82.1	WATER
45	23	0.59	12.6	0.0	80.3	WATER
46	24	0.26	13.5	0.0	86.9	WATER
47	25	0.30	12.7	0.0	82.0	WATER
48	26	0.23	11.8	0.0	69.5	WATER
49	27	0.38	14.0	0.0	78.6	WATER
50	28	0.15	9.1	0.0	72.5	WATER
51	29	0.77	14.9	0.0	72.5	WATER
52	30	0.17	10.2	0.0	82.3	WATER
53	31	0.87	14.9	0.0	77.2	WATER
54	2332	0.26	12.7	0.0	78.0	WATER

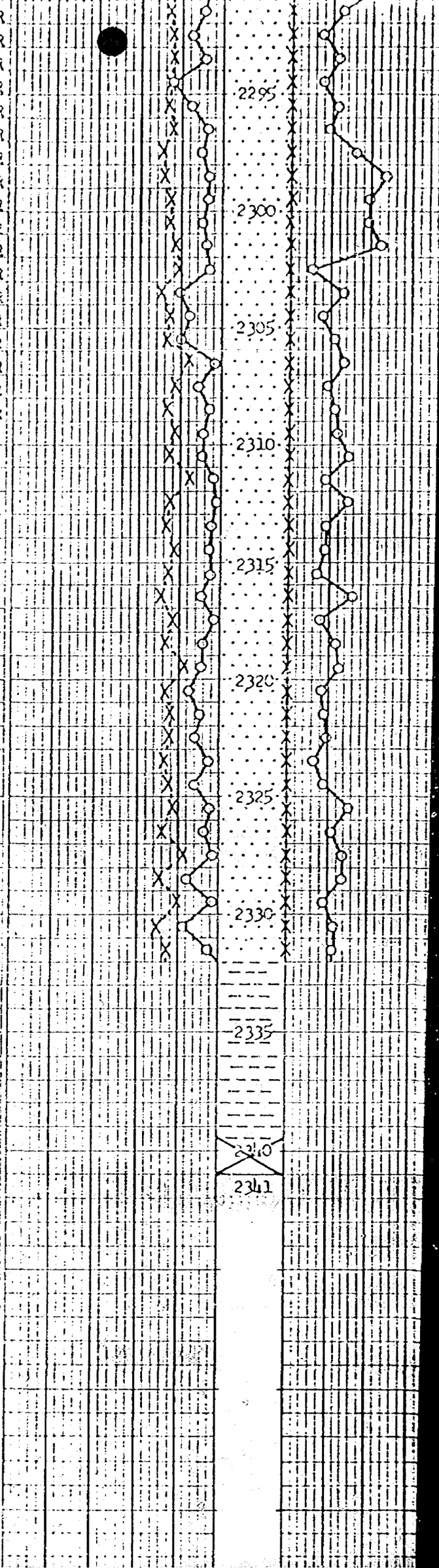


EXHIBIT NO. 15

COMPANY: Pubco Development, Inc.
WELL: Hughes 34-3
(Well Now Named Mesa Petroleum Hughes 34-3)
Ballard Pictured Cliffs Field
SW/SW Section 34, Township 26 North, Range 7 West

Pictured Cliffs Formation Core Data

Depth (ft)	Sample Footage (ft)	Horizontal Permeability (md)
2202.5 - 2203.5	1	0.10
2203.5 - 2204.5	1	0.00
2204.5 - 2205.5	1	0.00
2205.5 - 2206.5	1	0.40
2206.5 - 2207.5	1	1.00
2207.5 - 2208.5	1	1.30
2208.5 - 2209.5	1	2.60
2209.5 - 2210.5	1	1.60
2210.5 - 2211.5	1	1.90
2211.5 - 2212.5	1	2.20
2212.5 - 2213.5	1	1.40
2213.5 - 2214.5	1	2.50
2214.5 - 2215.5	1	1.00
2215.5 - 2216.5	1	1.40
2216.5 - 2217.5	1	1.30
2217.5 - 2218.5	1	0.80
2218.5 - 2219.5	1	0.60
2219.5 - 2220.5	1	0.40
2220.5 - 2221.5	1	0.00
2221.5 - 2222.5	1	0.00
2226.5 - 2227.5	1	0.00
2227.5 - 2228.5	1	0.10
2228.5 - 2229.5	1	0.10
2229.5 - 2230.5	1	0.30
2230.5 - 2231.5	1	0.40
2231.5 - 2232.5	1	0.10
2232.5 - 2233.5	1	0.60
2233.5 - 2234.5	1	0.30
2234.5 - 2235.5	1	0.00
2235.5 - 2236.5	1	0.60
2236.5 - 2237.5	1	0.40
2237.5 - 2238.5	1	0.10
2238.5 - 2239.5	1	0.00
2239.5 - 2240.5	1	0.80
2240.5 - 2241.5	1	0.10
2241.5 - 2242.5	1	0.00
2242.5 - 2243.5	1	0.10
2243.5 - 2244.5	1	0.00
2244.5 - 2245.5	1	0.40
2245.5 - 2246.5	1	0.40
2246.5 - 2247.5	1	0.60
2247.5 - 2248.5	1	0.40
2248.5 - 2249.5	1	0.60
2249.5 - 2250.5	1	0.00
2250.5 - 2251.5	1	0.70
2251.5 - 2252.5	1	0.70
TOTAL	46	28.50

Average Permeability = 28.50/46 = 0.62 md

BEFORE EXAMINER STAMETS
OIL CONSERVATION DIVISION
APPLICANTS EXHIBIT NO. 15
CASE NO. 7395
Submitted by MCCORD
Hearing Date 10/21/81

Fissures

CORE LABORATORIES, INC. CORE LAB *Petroleum Reservoir Engineering*

COMPANY PUBCO DEVELOPMENT COMPANY DATE ON JANUARY 26, 1953 FILE NO. FRML-83(FC)

WELL HUGHES 31-3 DATE OFF FEBRUARY 9,1953 ENGRS. INV,TBO.

FIELD WILDCAT FORMATION PICTURED CLIFFS ELEV. 6260' DF

COUNTY RIO ARRIBA STATE NEW MEXICO DRLG. FLD. WATER BASE MUD CORES DIAMOND

LOCATION NE SW SW SEC. 31 T26N R7W REMARKS SERVICE NO. 445

SAND LIMESTONE CONGLOMERATE CHERT

SHALE DOLOMITE

TABULAR DATA and INTERPRETATION

COMPLETION COREGRAPH

PERMEABILITY O—O MILLIDARCYS 40 30 20 10 0

TOTAL WATER O—O PERCENT PORE SPACE 80 60 40 20

POROSITY X---X PERCENT 40 30 20 10

OIL SATURATION X--- PERCENT PORE SPACE 0 20 40 60 80

SAMPLE NUMBER	DEPTH FEET	PERM MD	POROSITY %	RESIDUAL SATURATION % PORE SPACE OIL	RESIDUAL SATURATION % PORE SPACE TOTAL WATER	FACIES

2155

2160

2165

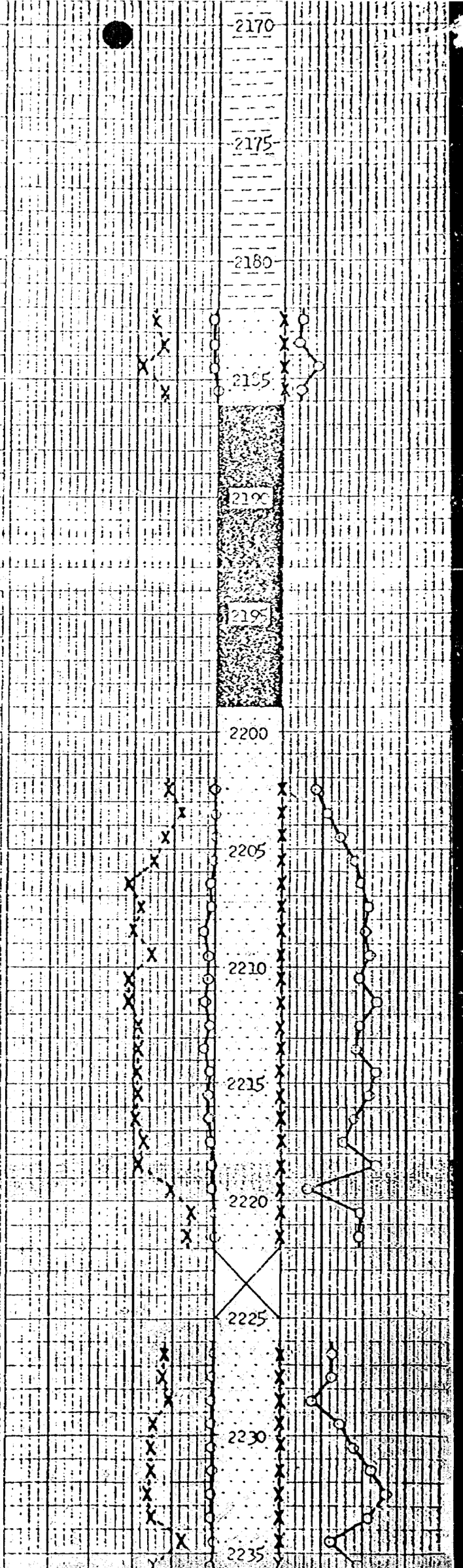
2170

2175

1	2182.5	0.8	15.4	0.0	90.3	*
2	83.5	0.6	13.2	0.0	91.6	*
3	84.5	0.7	19.1	0.0	83.2	*
4	85.5	0.0	12.8	0.0	91.4	
5						

5	2202.5	0.1	11.9	0.0	83.0	*
6	03.5	0.0	8.2	0.0	78.1	
7	04.5	0.0	12.3	0.0	72.6	
8	05.5	0.4	14.9	0.0	65.1	*
9	06.5	1.0	21.0	0.0	61.0	*
10	07.5	1.3	18.1	0.0	57.5	*
11	08.5	2.6	20.0	0.0	59.0	*
12	09.5	1.6	15.9	0.0	56.6	*
13	10.5	1.9	21.4	0.0	62.1	*
14	11.5	2.2	21.4	0.0	53.7	*
15	12.5	1.4	19.2	0.0	61.5	*
16	13.5	2.5	19.6	0.0	63.5	*
17	14.5	1.0	18.9	0.0	54.0	*
18	15.5	1.4	19.3	0.0	57.0	*
19	16.5	1.3	19.6	0.0	61.8	*
20	17.5	0.8	17.6	0.0	62.3	*
21	18.5	0.6	19.1	0.0	54.0	*
22	19.5	0.4	13.6	0.0	66.8	*
23	20.5	0.0	5.7	0.0	61.4	
24	2221.5	0.0	6.9	0.0	62.4	

25	2226.5	0.0	12.3	0.0	74.8	
26	27.5	0.1	12.7	0.0	74.8	*
27	28.5	0.1	10.9	0.0	85.2	*
28	29.5	0.3	15.0	0.0	70.6	*
29	30.5	0.4	15.6	0.0	64.7	*
30	31.5	0.1	15.8	0.0	56.3	*
31	32.5	0.6	16.2	0.0	48.7	*
32	33.5	0.5	15.7	0.0	57.3	*
33	34.5	0.0	7.4	0.0	75.6	



5	2202.5	0.1	11.9	0.0	83.0	*
6	03.5	0.0	8.2	0.0	78.1	
7	04.5	0.0	12.3	0.0	71.6	
8	05.5	0.4	14.9	0.0	65.1	*
9	06.5	1.0	21.0	0.0	61.0	*
10	07.5	1.3	18.1	0.0	57.5	*
11	08.5	2.6	20.0	0.0	59.0	*
12	09.5	1.6	15.9	0.0	56.6	*
13	10.5	1.9	21.4	0.0	62.1	*
14	11.5	2.2	21.4	0.0	53.7	*
15	12.5	1.4	19.2	0.0	61.5	*
16	13.5	2.5	18.6	0.0	63.5	*
17	14.5	1.0	18.9	0.0	58.0	*
18	15.5	1.4	19.3	0.0	57.0	*
19	16.5	1.3	19.6	0.0	6..8	*
20	17.5	0.8	17.6	0.0	62.3	*
21	18.5	0.6	19.1	0.0	58.0	*
22	19.5	0.4	19.6	0.0	66.8	*
23	20.5	0.0	5.7	0.0	61.4	
24	2221.5	0.0	6.9	0.0	62.4	

25	2226.5	0.0	12.3	0.0	74.8	
26	27.5	0.1	12.7	0.0	74.8	*
27	28.5	0.1	10.9	0.0	85.2	*
28	29.5	0.3	15.0	0.0	70.6	*
29	30.5	0.4	15.6	0.0	64.7	*
30	31.5	0.1	15.8	0.0	56.3	*
31	32.5	0.6	16.2	0.0	48.7	*
32	33.5	0.5	15.7	0.0	57.3	*
33	34.5	0.0	7.4	0.0	75.6	
34	35.5	0.6	14.5	0.0	62.1	*
35	36.5	0.4	15.3	0.0	49.6	*
36	37.5	0.1	15.8	0.0	47.4	*
37	38.5	0.0	10.0	0.0	72.0	
38	39.5	0.8	19.9	0.0	41.7	*
39	40.5	0.1	13.7	0.0	62.7	*
40	41.5	0.0	13.6	0.0	51.4	
41	42.5	0.1	16.5	0.0	52.7	*
42	43.5	0.0	13.1	0.0	72.5	
43	44.5	0.4	14.7	0.0	73.7	*
44	45.5	0.4	15.5	0.0	67.8	*
45	46.5	0.6	15.3	0.0	71.5	*
46	47.5	0.4	15.9	0.0	67.2	*
47	48.5	0.6	13.3	0.0	68.4	*
48	49.5	0.0	13.3	0.0	83.5	
49	50.5	0.7	15.3	0.0	72.8	*
50	2251.5	0.7	13.9	0.0	79.8	*

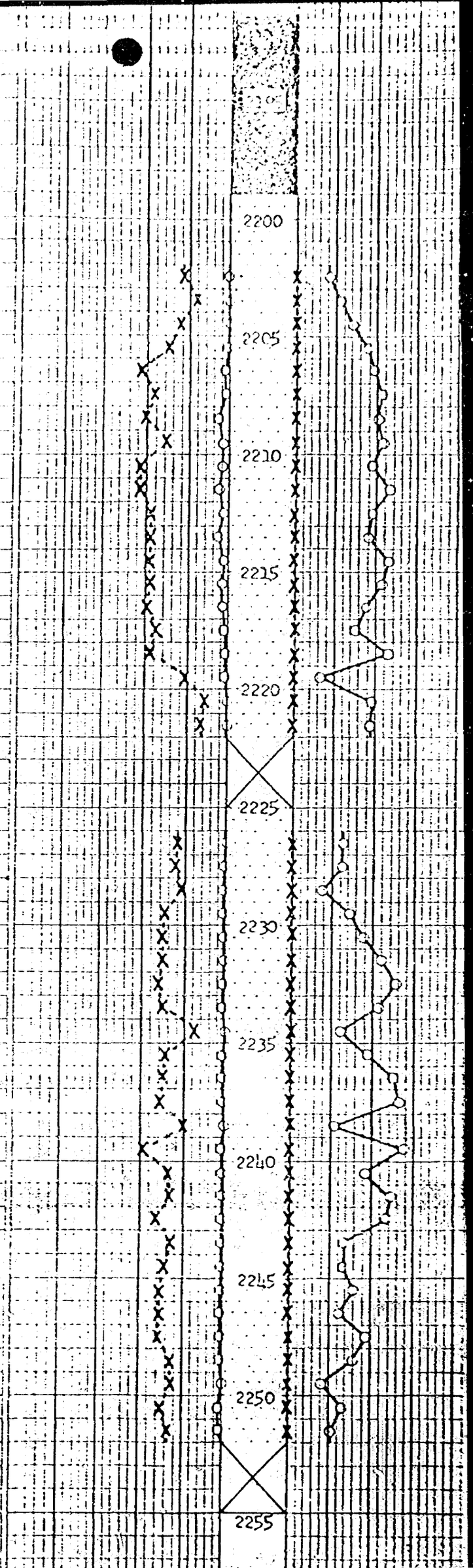


EXHIBIT NO. 16

COMPANY: Kingsley-Locke Oil Company
WELL: MKL No. 1
(Well Now Named Depco, Inc. MKL No. 1)
Blanco Pictured Cliffs (South) Field
SW/SW Section 5, Township 26 North, Range 7 West
Rio Arriba County, New Mexico

Pictured Cliffs Formation Core Data

Depth (ft)	Sample Footage	Horizontal Permeability (md)
2133 - 2134	1	0.40
2136 - 2137	1	0.10
2142 - 2143	1	1.00
2152 - 2153	1	0.00
2156 - 2157	1	0.00
2165 - 2166	1	0.40
TOTAL	6	1.90

Average Permeability = 1.90/6 = 0.32 md.

(Well not completed in Pictured Cliffs formation)

BEFORE EXAMINER STAMETS
OIL CONSERVATION DIVISION
APPLICANTS EXHIBIT NO. 16
CASE NO. 7395
Submitted by McCORD
Hearing Date 10/21/81

Sec 5 - 11N - 7W

[redacted] LOCATION CORE ANALYSIS RESULTS

Average Porosity = 9.9%

Average Permeability = 80.3 MD

NOTE: 1) REFER TO ATTACHED LETTER 1) OF 2 LOCATION ANALYZED—NO INTERPRETATION OF RESULTS

EXHIBIT No. 17

COMPANY: Kingsley Locke Oil Company
WELL: MKL No. 4-17
Well Now Named Depco, Inc. Hughes 4-17)
Blanco Pictured Cliffs (South) Field
NW/SW Section 6, Township 26 North, Range 7 West
Rio Arriba County, New Mexico

Pictured Cliffs Formation Core Data

Depth (ft)	Sample Footage (ft)	Horizontal Permeability (md)
2123.5 - 2124.5	1	0.40
2124.5 - 2125.5	1	1.90
2125.5 - 2126.5	1	2.40
2137.5 - 2138.5	1	0.00
2138.5 - 2139.5	1	0.00
2139.5 - 2140.5	1	0.70
2140.5 - 2141.5	1	1.00
2141.5 - 2142.5	1	2.20
2142.5 - 2143.5	1	24.00
2143.5 - 2144.5	1	73.00
2144.5 - 2145.5	1	2.50
2145.5 - 2146.5	1	43.00
2146.5 - 2147.5	1	60.00
2147.5 - 2148.5	1	48.00
2148.5 - 2149.5	1	40.00
2149.5 - 2150.5	1	21.00
2150.5 - 2151.5	1	21.00
2151.5 - 2152.5	1	29.00
2152.5 - 2153.5	1	7.70
2153.5 - 2154.5	1	1.30
2154.5 - 2155.5	1	15.00
TOTAL	21	394.10

Average Permeability = 394.10/21 - 18.77 md.

(Well not completed in Pictured Cliffs formation)

BEFORE EXAMINER STAMETS
OIL CONSERVATION DIVISION
APPLICANTS EXHIBIT NO. 17
CASE NO. 7395
Submitted by McCord
Hearing Date 10/24/81

CORE LABORATORIES, INC. CORE LAB *Petroleum Reservoir Engineering*

INTERNATIONAL OIL CORP

COMPANY	MESCALERO ROSWELL OIL COMPANY	DATE	10-2 - 10-4-52	FILE	FRH-64 FC
WELL	M.K.L. NO. 1 - 17	CORES	CONVENTIONAL	ANALYSTS	RLB - LHV
FIELD	JAROO CANYON AREA	FORMATION	PICTURED CLIFFS	ELEVATION	6026' GL
COUNTY	RIO ARRIBA	DRIG. FLUID	WATER BASE MUD	LOCATION	SEC. 6-26N-
STATE	NEW MEXICO	REMARKS	SERVICE NO. 4		

CORE ANALYSIS AND INTERPRETATION

SAMPLE NUMBER	DEPTH FEET	PERMEABILITY MILLIDARCYS	POROSITY %	RESIDUAL LIQUID SATURATION % PORE SPACE OIL	RESIDUAL LIQUID SATURATION % PORE SPACE TOTAL WATER	PROBABLE PROD
1	2123.5	0.4	18.4	2.2	54.3	GAS
2	24.5	1.9	17.6	0.0	45.4	GAS
3	25.5	2.4	21.0	0.0	52.4	GAS
4	2137.5	0.0	8.0	7.0	66.3	
5	38.5	0.0	9.9	0.0	62.6	
6	39.5	0.7	13.6	0.0	54.4	GAS
7	40.5	1.0	20.0	0.0	47.5	GAS
8	41.5	2.2	19.8	0.0	59.7	GAS
9	42.5	24	22.6	0.0	51.8	GAS
10	43.5	73	23.7	0.0	54.0	GAS
11	44.5	2.5	26.2	0.0	45.1	GAS
12	45.5	43	23.0	0.0	57.8	GAS
13	46.5	60	20.3	0.0	62.6	GAS
14	47.5	48	23.1	0.0	53.3	GAS
15	48.5	40	22.7	0.0	51.5	GAS
16	49.5	21	22.5	0.0	54.2	GAS
17	50.5	21	21.0	0.0	55.7	GAS
18	51.5	29	19.1	0.0	52.3	GAS
19	52.5	7.7	18.0	0.0	60.0	GAS
20	53.5	1.1	21.2	0.0	50.0	GAS
21	54.5	15	19.0	0.0	55.2	GAS

COMPLETION COREGRAPH

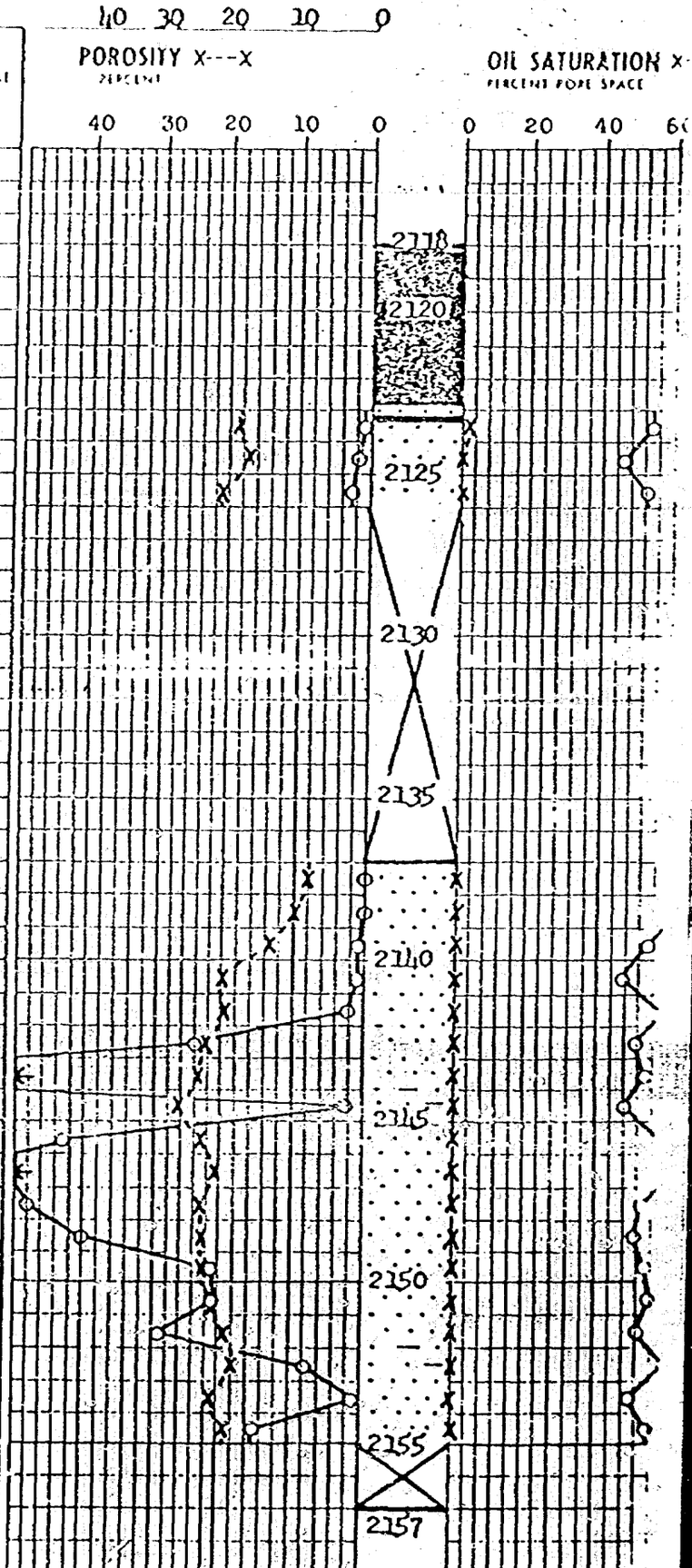


EXHIBIT 18

Effect of Overburden Pressure and Water Saturation on Gas Permeability of Tight Sandstone Cores

Rex D. Thomas, SPE-AIME, U. S. Bureau of Mines
Don C. Ward, SPE-AIME, U. S. Bureau of Mines

Introduction

Research on the potential of nuclear explosions to stimulate gas production from low-permeability (tight) sandstone reservoirs is being conducted by the U. S. Bureau of Mines in cooperation with the Atomic Energy Commission. This report describes the part of that research that was conducted to establish correlation between permeability measured on dry cores at low external pressure (routine analysis) and permeability at reservoir conditions.

Cores used in this research were obtained from two Plowshare gas-stimulation projects. Project Gasbuggy cores from the Pictured Cliffs formation, Choza Mesa field, Rio Arriba County, N. M., can be described as very fine grained, slightly calcareous, well indurated sandstone. Project Wagon Wheel cores from the Fort Union formation, Pinedale field, Sublette County, Wyo., can be described as very fine grained, slightly calcareous, very well indurated sandstone.

Underground reservoirs are under considerable compressive stress as a result of the weight of overlying rocks (offset somewhat by internal-fluid pressure). The resultant net confining pressure or effective overburden pressure is referred to in this report simply as overburden pressure. The resulting effects on the physical properties of the reservoir rock have been studied.[1-5] Overburden pressure causes only a small decrease in porosity, which can usually be ignored.[3] This was confirmed for Project Gasbuggy and Project Wagon Wheel cores. A commercial laboratory found that the porosity of these cores is reduced by about 5 percent of the original porosity. The effect of overburden pressure on permeability, however, is appreciable and varies considerably for different reservoir rocks,[3-5] causing greater reductions in permeability for low-permeability rocks.[3,4] The effect of overburden pressure on relative permeability has been found to be small[4] or nonexistent.[3]

This report presents material that confirms and extends previous research findings on the effect that overburden pressure has upon the permeability of dry cores. Also presented are the results of research on the relative gas permeability of low-permeability cores under overburden pressure.

Apparatus and Procedure

Cylindrical cores 2.0 to 7.5 cm long and 2.5 cm in diameter were cut parallel to the bedding plane. After the cores were dried overnight in a vacuum oven (4.5 psia, 70°C), the gas (N_2) permeability of each core was measured in a Hassler cell. An external pressure of 100 psi over the inlet pressure was used to maintain a good seal between the rubber sleeve and the core.[6] Permeability was measured at inlet pressures of 45, 60, and 100 psia, with atmospheric pressure at the outlet. A bubble tube and timer were used to measure gas flow rate. Initial permeability (k_i) then was calculated by the Klinkenberg technique to correct for the effect of gas slippage. All other permeabilities reported here were calculated by this method.

In the same manner, permeability was measured at

Research conducted to determine the potential of nuclear explosions to stimulate gas production verifies that the gas permeability of tight sandstone cores is markedly decreased with increasing overburden pressure. Water saturation also reduces the gas permeability by a large amount. The relative permeability, however, does not change significantly with overburden pressure.

increasing external pressures of about 500, 1,000, 2,000, 3,000, 4,000, 5,000, and 6,000 psi. External pressures actually were somewhat higher to compensate for internal pressure. The core and stainless steel end pieces were placed in a rubber sleeve (piece of bicycle innertube) 0.1 cm thick. Rubber cement was used to seal the stainless steel end pieces to the rubber sleeve. Shrinkable plastic tubing proved unsatisfactory because high pressure was required to seal the core. The jacketed core was mounted in a high-pressure cell with distilled water as the external fluid.

Cores used in relative permeability studies were first subjected to high external pressure and then allowed to recover their initial permeability. Bulk volume, dry weight, and porosity were measured by conventional gas-expansion techniques. Cores then were subjected to a vacuum (0.3 psia) for 2 hours, immersed in water, and allowed to stand under a vacuum overnight. The cores were weighed and again subjected to vacuum overnight and weighed again to assure complete saturation. Most of the cores were completely saturated after one night. Porosity values calculated on the basis of water saturation are in good agreement with those measured by conventional gas-expansion techniques.

Water in the core was allowed to evaporate at atmospheric conditions to a saturation of about 70 percent and the core was placed in the holder for 2 hours under external pressure (100 psi above inlet) only so the water saturation was uniform. Gas permeability then was measured at three inlet pressures between 30 and 100 psia with atmospheric pressure at the outlet. This procedure was repeated for decreasing water saturations at the same external pressure. After the permeability was measured the core was weighed to determine if any water was lost. In all cases the amount lost was negligible. After the core was dried in a vacuum oven, the gas permeability at this external pressure was measured. The procedure was repeated for external pressures of 3,000 and 6,000 psi.

Results and Discussion

Effect of Overburden Pressure on Permeability

Core number, length, porosity, and initial permeability of the cores used in this research are shown in Table 1. The core number refers to the depth in feet at which the core was obtained. Typical plots of the effect of simulated overburden pressure on Gasbuggy cores are shown in Fig. 1. The permeability is decreased by about 75 percent at an overburden pressure of 3,000 psi and by 90 percent at 6,000 psi. The hydrostatic loading used in these experiments does not reproduce subsurface conditions exactly; in an actual reservoir the horizontal component of stress is usually less than the vertical component. Since the actual loading is not known, this method probably is as realistic as any other. Cores that contain microfractures are affected to a greater extent, as shown in Fig. 2. In these cores the permeability is decreased by about 95 percent at a simulated overburden pressure of 3,000 psi, with most of the reduction occurring below 2,000 psi.

The data shown in Table 1 and Figs. 1 and 2 were obtained by subjecting the core to successive incre-

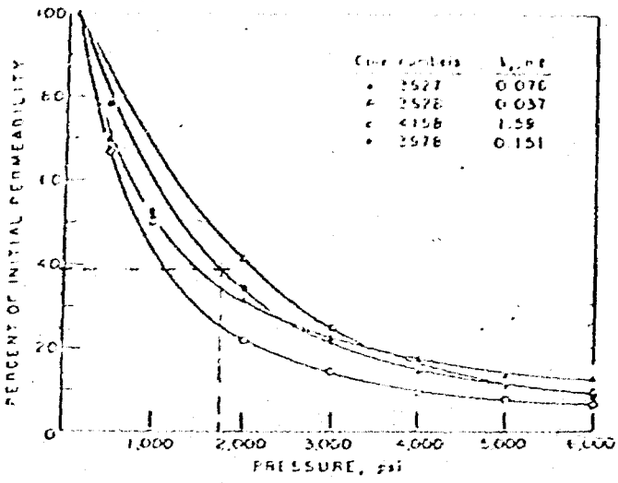


Fig. 1—Effect of overburden pressure on gas permeability of Gasbuggy cores.

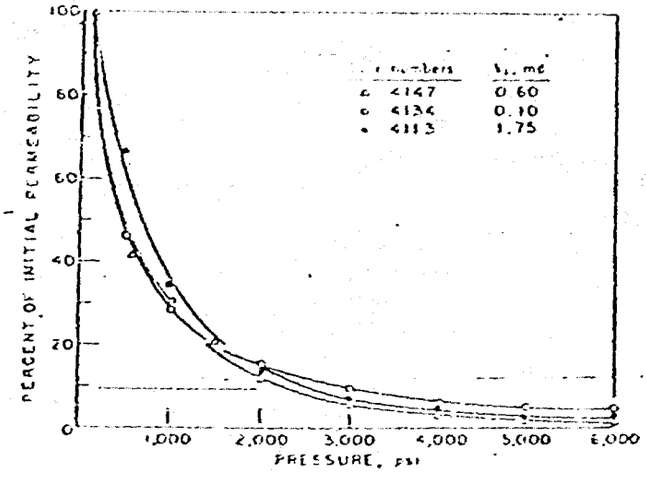


Fig. 2—Effect of overburden pressure on gas permeability of fractured Gasbuggy cores.

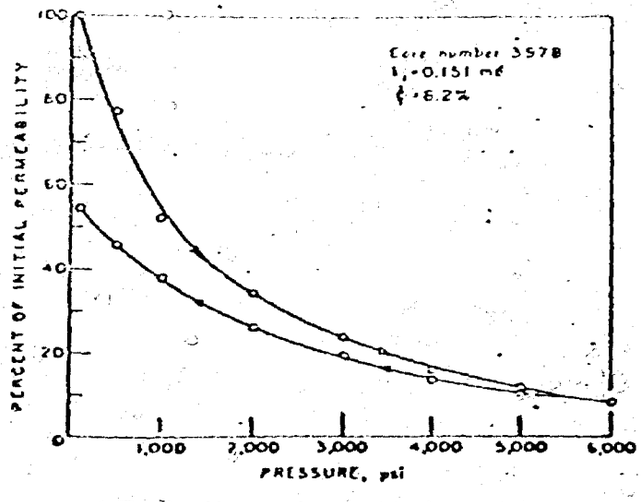


Fig. 3—Hysteresis effect at decreasing confining pressures.

TABLE 1—EFFECT OF OVERBURDEN PRESSURE ON GAS PERMEABILITY

Effective Overburden Pressure (psi):				500	1,000	2,000	3,000	4,000	5,000	6,000
Core Number*	Length (cm)	Porosity (percent)	Ki†	Permeability (md)						
Gasbuggy										
3927	2.1	8.1	0.076	0.053	0.040	0.024	0.0175	0.0132	0.0105	0.0095
3978	7.5	8.3	0.037	0.031	0.024	0.015	0.0093	0.0069	0.0048	0.0035
3978	2.1	8.2	0.151	0.118	0.078	0.052	0.036	0.024	0.0175	0.0132
4113**	2.1	10.1	1.75	1.16	0.602	0.252	0.113	0.058	0.042	0.029
4134**	2.1	11.6	0.10	0.048	0.029	0.0153	0.0095	0.0065	0.0055	0.0047
4140**	7.5	11.6	2.40	1.73	1.32	0.81	0.14	0.069	0.052	0.022
4147**	7.5	11.3	0.60	0.247	0.181	0.071	0.034	0.0186	0.0118	0.0087
4158	2.1	13.6	1.59	1.06	0.80	0.35	0.225	0.157	0.116	0.100
Wagon Wheel										
8084	3.8	7.7	0.028	0.022	0.020	0.010	0.0070	0.0047	0.0035	0.0030
8122	3.8	11.4	0.071	0.055	0.048	0.034	0.027	0.024	0.021	0.019
8570**	3.8	8.7	0.039	0.029	0.024	0.0114	0.0073	0.0048	0.0032	0.0025
10156	3.8	8.5	0.088	0.067	0.051	0.032	0.025	0.022	0.018	0.016
10990**	3.8	9.0	0.048	0.020	0.0175	0.0080	0.0050	0.0040	0.0025	0.0019

*Number denotes depth in feet.
**Slightly fractured.
†Initial permeability.

mental increases in external pressure. The core was assumed to be in equilibrium at each pressure when permeability measurements remained constant for 15 minutes, which required between 1 and 2 hours. A period of 30 minutes to an hour was required to attain equilibrium when the inlet pressure was changed. Consequently, each external pressure was maintained for a minimum of 2 hours.

The effect of decreasing external pressure was determined on a few cores, and typical results are shown in Fig. 3. Other researchers[2,3] have observed and shown that this hysteresis is mainly dependent on the stress history of the core. Cores generally recover their original permeability after 3 to 6 weeks at atmospheric conditions. This time could be shortened by storing the core in an oven at 70°C.

The effect of overburden pressure on the permeability of cores from Project Wagon Wheel is similar to that on cores from Project Gasbuggy, and typical results are shown in Fig. 6. The permeability is decreased to about 30 percent of initial permeability at an overburden pressure of 3,000 psi and to 20 percent at 6,000.

A study of the data in Table 1 indicates that the original porosity of the core and the reduction in permeability caused by overburden pressure are not related. Pore structure (fractures to uniform pores) is probably the governing factor.

Water Saturation Effects

The data in Table 2 show that the permeability decreased with increasing water saturation. The values at 20-, 40-, and 60-percent water saturation were obtained from individual relative-permeability curves for Gasbuggy and Wagon Wheel cores. Relative-permeability curves for three cores from Project Gasbuggy are shown in Fig. 5 with the data points for Core 3978. Data points were omitted for the other cores to avoid confusion. This figure shows that although gas permeability is reduced, the relative gas permeability of Gasbuggy cores is not significantly affected by increased overburden pressure. This conclusion is in agreement with the results of others.[4,5]

Extremely low values of permeability that resulted from water saturation and overburden pressure required that either long flow times or high inlet pressures (high differential across the core) be used. Since a high inlet pressure increases the end effects by changing the distribution of water in the core, long flow times were required. Although end-effect problems were encountered with the short cores (Cores 3978 and 4158), the permeability of these cores was

TABLE 2—EFFECT OF OVERBURDEN PRESSURE AND WATER SATURATION ON GAS PERMEABILITY

Water Saturation (percent):		0	20	40	60
Core Number	Pressure (psi)	Permeability (md)			
Gasbuggy					
3927	100	0.115	0.099	0.041	0.0023
3927	3,000	0.026	0.023	0.009	0.0005
3927	6,000	0.012	0.010	0.003	0.0002
3978	100	0.112	0.080	0.034	0.011
3978	3,000	0.036	0.026	0.011	0.004
3978	6,000	0.013	0.009	0.004	0.0013
4158	100	0.447	0.335	0.156	0.045
4158	3,000	0.075	0.056	0.026	0.0074
4158	6,000	0.027	0.020	0.010	0.0026
Wagon Wheel					
8084	100	0.038	0.030	0.014	0.0042
8084	3,000	0.012	0.0096	0.0043	0.0013
8084	6,000	0.0070	0.0055	0.0025	0.0008
8122	100	0.074	0.054	0.017	0.006
8122	3,000	0.027	0.020	0.008	0.002
8122	6,000	0.020	0.015	0.006	0.002
10156	100	0.100	0.074	0.029	0.003
10156	3,000	0.028	0.020	0.008	0.0008
10156	6,000	0.017	0.013	0.005	0.0005

high enough to yield reasonable results. Permeability measurements for Core 4161 (7.5 cm long, 0.053 md) required more than 2 hours per reading. These extremely long flow times can cause errors.

End effects, long flow times, and changes in permeability due to water saturation tend to decrease the accuracy of permeability measurements, especially at the higher water saturations.

The initial permeability of many of the dry cores used in this research was not reproducible following saturation and drying. The changes probably were caused by solution of material in the pores and by particle movement. These caused both increases and decreases in permeability. The variation, although sometimes large, usually was less than 5 percent; however, we feel that the relative permeability curves are essentially correct. To eliminate the effects of solution and particle movement, the permeability of the dry core following saturation, rather than the permeability initially measured, was used in calculating relative permeability.

A composite of the relative permeability curves for Gasbuggy cores is shown in Fig. 5. These curves are representative of permeabilities encountered in this formation. At a water saturation of 50 percent, the relative permeability of the cores ranges from 15 to 20 percent and is not affected by overburden pressure.

Similar results were obtained on cores from Project Wagon Wheel, as shown in Table 2 and Fig. 6 with data points for Core 8122. These cores were cut to a length of 3.8 cm to alleviate some of the long flow time and end-effect difficulties encountered with Gasbuggy cores. These curves are representative of the permeabilities encountered in the formation. At a water saturation of 50 percent, the relative permeability of these cores ranges from 12 to 21 percent. The data in these figures show, as do the data from Gasbuggy cores, that relative gas permeability is not significantly affected by increased overburden pressure.

Correlation with Nuclear Stimulation Projects

Many of the basin areas of the Rocky Mountain region consist of thick, low-permeability sandstones containing large quantities of natural gas. This type of reservoir has been the object of the AEC's Plowshare Program experiments, Projects Gasbuggy and Rulison, and proposed Projects Wagon Wheel, WASP, and Rio Blanco. Because most wells in these reservoirs have not been commercial, only limited reservoir-analysis and production-test data are available. Reservoir analysis is most difficult because low permeability requires long-term testing. Also, it is difficult to determine permeability and net pay from these tests. Knowledge of the gas permeability is necessary in predicting gas recovery, and because it is not economical to define the characteristics of different strata by well test, it is desirable to be able to relate laboratory-measured permeability to the true in-situ permeability.

Conventional analysis by a commercial laboratory (confirmed in our laboratory) of about 200 Gasbuggy cores gave an average initial gas permeability of 0.16 md on dry cores and an average water saturation of 48 percent. The effective overburden pressure of this

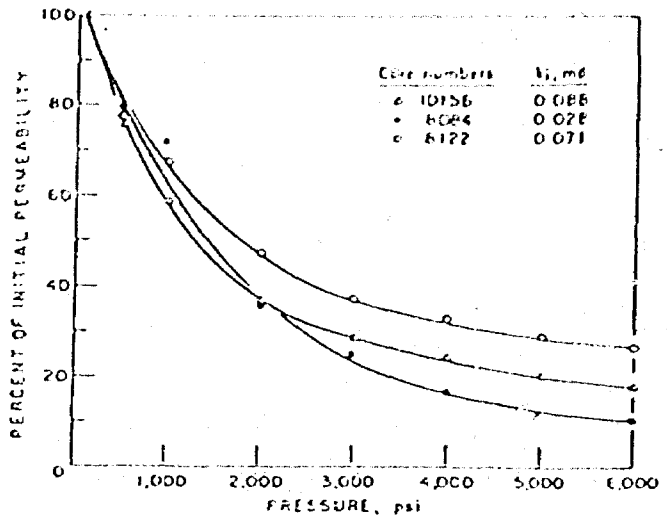


Fig. 4—Effect of overburden pressure on gas permeability of Wagon Wheel cores.

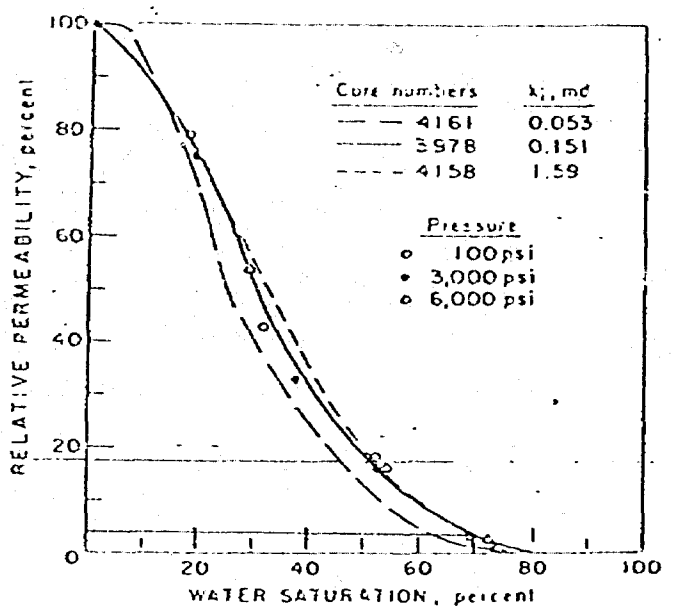


Fig. 5—Relative gas permeability of Gasbuggy cores.

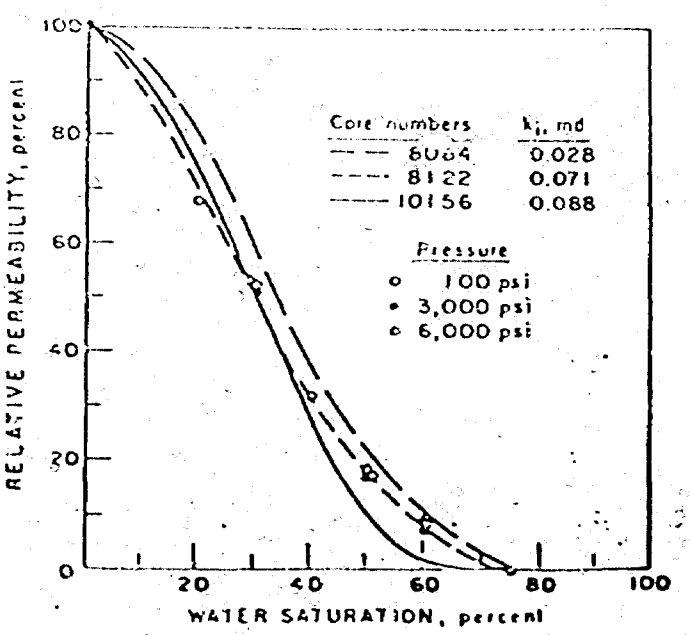


Fig. 6—Relative gas permeability of Wagon Wheel cores.

reservoir is about 3,000 psi. From Fig. 1, the reduction factor resulting from the overburden pressure is 0.25, and the reduction factor for a water saturation of 48 percent (Fig. 5) is 0.20; thus the total reduction is 5 percent of the initial permeability, or 0.008 md. This value compares favorably with permeability determinations of about 0.01 md from both preshot and postshot flow testing at Gasbuggy. The gas reservoir at Project Rulison is similar to that at Gasbuggy, having an average initial dry permeability of 0.11 md and an average water saturation of 45 percent. Simulated in-situ permeability has not yet been measured in the laboratory on Rulison cores; however, using an effective overburden pressure of 5,000 psi and curves of Gasbuggy core data (Figs. 1 and 5), the reduction factor because of overburden pressure would be 0.12 and that for water saturation 0.24. This results in a combined reduction to 3 percent of the initial permeability, or 0.003 md. Postshot production testing at Rulison is not complete, and the only preshot determination of permeability was made from tests of a 32-ft isolated zone that gave an average value of 0.008 md. No cores are available from this zone. Rulison reservoir rock is said to be less compressible than that of Gasbuggy; therefore Gasbuggy pressure-effect data would be expected to indicate a greater reduction for Rulison than actually exists.

The average initial permeability of dry Wagon Wheel cores is 0.068 md, with an average water saturation of 50 percent. An estimated effective overburden pressure of 3,000 psi gives a reduction factor of 0.28 (Fig. 4). Water saturation further reduces permeability by a factor of 0.18 (Fig. 6). Therefore, the total reduction in permeability is to approximately 5 percent of the initial permeability, or 0.0034 md. This value can be used to predict postshot gas recovery from the proposed Wagon Wheel experiment.

Cores are not yet available from Projects Rio Blanco and WASP.

Conclusions

The gas permeability of tight sandstone cores is markedly decreased with increasing overburden pressure. Most of the decrease takes place at pressures to 3,000 psi. At 3,000 psi, the permeability of unfractured samples ranges from 14 to 37 percent of the initial permeability. In fractured samples, permeability may be reduced to as low as 6 percent of initial permeability.

Water saturation also reduces the gas permeability greatly; however, the relative permeability does not change significantly with overburden pressure.

Permeability calculated from laboratory results are in good agreement with in-situ permeabilities determined from production test data. Although not confirmed, predictions for other projects appear to be reasonable.

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Original manuscript received in Society of Petroleum Engineers office June 16, 1971. Revised manuscript received Dec. 20, 1971. Paper (SPE 3634) was presented at SPE 46th Annual Fall Meeting, held in New Orleans, Oct. 3-6, 1971.

EXHIBIT NO. 19

DETERMINATION OF IN SITU FORMATION PERMEABILITY FROM LABORATORY CORE ANALYSIS DATA IN THE LARGO CANYON TIGHT GAS AREA

The relationship needed to determine in situ permeability from core analysis data is published in a technical paper by Rex D. Thomas and Don C. Ward entitled "Effect of Overburden Pressure and Water Saturation on Gas Permeability of Tight Sandstone Cores", which is presented as Exhibit No. 18. The authors' studies involved taking routine laboratory air permeability measurements at the normal 100 psi or less external pressures. To simulate the effect of in situ conditions, these permeability measurements were then made at external pressures ranging from 500 to 6000 psi. The results of these tests were then plotted on a graph of Percent of Initial Permeability (ratio of permeability at 100 psi to a permeability at a higher pressure) vs. Pressure.

Figure 1, on page 121, of Exhibit No. 18, is one such graph which presents results of tests run on cores taken from the Pictured Cliffs formation. These cores were taken from Project Gasbuggy, located in Choza Mesa Pictured Cliffs field, T28-29N, R3-4W, Rio Arriba County, New Mexico. Cores from the Pictured Cliffs formation in the Gasbuggy area and from the Pictured Cliffs formation in the Largo Canyon Tight Gas Area can be expected to have the same or very similar chacteristics.

The characteristics of core 3978, presented in Figure 1, can be used to represent the core data from the Largo Canyon Tight Gas Area. The average laboratory air permeability from the Largo Canyon Area was 0.37 millidarcy compared to an initial laboratory core permeability for core 3978 of 0.151 millidarcy. The confining pressure due to overburden at a depth of 2378 feet in the Largo Canyon Tight Gas Area is approximately 1730 psi. Entering the graph in Figure 1 at 1730 psi results in a permeability reduction factor of 0.39 resulting from the overburden pressure on the Pictured Cliffs formation.

The water present in the reservoir also causes the in situ permeability to be less than laboratory permeability as discussed in Exhibit No. 18. The 0.39 permeability reduction factor resulting from overburden pressure was determined from cores having 100% gas saturation. Figure 5 on page 123 of Exhibit 18 indicates relative permeability changes that occurred with changes in water saturation within the sample cores. For the Largo Canyon Tight Gas Area, the average core water saturation was 73%. Entering Figure 5 at 73% water saturation results in a permeability reduction factor of 0.05 for in situ water saturation.

The total permeability reduction factor used on laboratory core data to approximate reservoir conditions is obtained by multiplying the overburden reduction factor by the water saturation reduction factor. This product is 0.02 for the Pictured Cliffs formation in the Largo Canyon Tight Gas Area. Therefore, the in situ permeability for this area is 2% of the 0.37 millidarcy laboratory determined permeability or 0.007 millidarcy.

The resulting 0.007 millidarcy in situ permeability obtained for the Largo Canyon Tight Gas Area by this method compares favorably with in situ permeability values of 0.01 millidarcy determined for the Pictured Cliffs formation at Project Gasbuggy.

EXHIBIT NO. 20

SUMMARY OF CORE PERMEABILITY DATA

Well Name	Location	Total Sample Footage (ft)	Total Laboratory Permeability (md)	Average Laboratory Permeability (md)
Skelly Oil Company Farming No. 1-E (Well not completed in Pictured Cliffs formation)	NE/NE Section 2 T24N, R6W	37	12.39	0.33
Superior Oil Company Sloan Gov't. 1-11	NE/NW Section 11 T24N, R6W	66	14.09	0.21
Victor Salazar Campbell No. 1 (Well now named Kimbell Oil Co. Salazar 2-34)	NW/SW Section 34 T25N, R6W	40	15.85	0.40
Superior Oil Company Albuquerque Assoc. No. 1-36 State (Well now named El Paso Natural Gas Canyon Largo Unit No. 57)	SE/SE Section 36 T25N, R7W	41	10.02	0.24
Pubco Development, Inc. Hughes 28-4	SE/SE Section 28 T26N, R7W	45	20.33	0.45
Pubco Development, Inc. Hughes 34-3 (Well now named Mesa Petroleum Company Hughes 34-3)	SW/SW Section 34 T26N, R7W	46	28.50	0.62
Kingsley-Locke Oil Company MKL No. 1 (Well now named Depco, Inc. MKL No. 1 - Well not completed in Pictured Cliffs Formation - Well not used in permeability averaging)	SW/SW Section 5 T26N, R7W	6	1.90	0.32

BEFORE EXAMINER STAMETS
OIL CONSERVATION DIVISION
APPLICANTS EXHIBIT NO. 20
CASE NO. 7335
Submitted by Mobil
Hearing Date 10-7-81

EXHIBIT NO. 20

SUMMARY OF CORE PERMEABILITY DATA

Well Name	Location	Total Sample Footage (ft)	Total Laboratory Permeability (md)	Average Laboratory Permeability (md)
Skelly Oil Company Farming No. 1-E (Well not completed in Pictured Cliffs formation)	NE/NE Section 2 T24N, R6W	37	12.39	0.33
Superior Oil Company Sloan Gov't. 1-11	NE/NW Section 11 T24N, R6W	66	14.09	0.21
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Superior Oil Company Albuquerque Assoc. No. 1-36 State (Well now named El Paso Natural Gas Canyon Largo Unit No. 57)	SE/SE Section 36 T25N, R7W	41	10.02	0.24
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Kingsley-Locke Oil Company MKL No. 1 (Well now named Depco, Inc. MKL No. 1 - Well not completed in Pictured Cliffs Formation - Well not used in permeability averaging)	SW/SW Section 5 T26N, R7W	6	1.90	0.32

BEFORE EXAMINER STAMETS
OIL CONSERVATION DIVISION
APPLICANTS EXHIBIT NO. 20
CASE NO. 7395
Submitted by MOBIL
Hearing Date 10/21/81

SUMMARY OF CORE PERMEABILITY DATA
Page 2

Well Name	Location	Total Sample Footage (ft)	Total Laboratory Permeability (md)	Average Laboratory Permeability (md)
Kingsley- Locke Oil Company MKL No. 4-17 (Well now Named Depco, Inc. MKL No. 4 - Well not completed in Pictured Cliffs formation - Well not used in permeability averaging)	NW/SW Section 6 T26N, R7W	21	394.10	18.77
TOTAL (excluding wells 7 & 8, see report)		275	101.18	

Average laboratory permeability = 101.18/275 = 0.37 md.

Average In situ permeability (2% of laboratory permeability) = 0.007 md.

EXHIBIT NO. 21

CURTIS J. LITTLE
LARGO CANYON TIGHT GAS AREA
PICTURED CLIFF FORMATION
RIO ARRIBA COUNTY, NEW MEXICO

Calculation of Formation Permeability Using Darcy's Law

Darcy's Law: $Qg = .703\ kh \dfrac{(Pe^2 - Pwf^2)}{Ug\ T\ Z\ \ln\ (.61\ re/rw)}$

or $k = \dfrac{Qg\ Ug\ T\ Z\ \ln\ (.61\ re/rw)}{.703\ h\ (Pe^2 - Pwf^2)}$

where:

- k = permeability of formation - millidarcies
- Qg = gas flowrate, scf/day - average of 13,700 scf/day for 7 wells tested
- Ug = average gas viscosity - calculated to be 0.012 centipoise
- T = bottom hole temperature - calculated to be 90°F - 550°R
- Z = average gas compressibility factor - calculated to be 0.926
- re = drainage radius for 160 acre spacing - 1320 feet
- rw = wellbore radius - 0.10 feet
- h = net pay height - average of 85 feet for the wells in the tight gas area
- Pe = bottom hole pressure at drainage radius re - average of 757 psi for all wells in the tight gas area
- Pwf = flowing bottom hole pressure - assumed equal to atmospheric pressure for maximum flowrate - 12.2 psi surface, 12.9 psi bottomhole
- Gg = gas gravity - .7 - used for calculations of Ug and Z
- Pc = pseudo critical pressure - 668 psi used for calculation of Ug and Z
- Tc = pseudo critical temperature - 392°R used for calculation of Ug and Z

$$k = \frac{(13,700)\ (0.012)\ (550)\ (0.926)\ \ln\ (.61\ 1320/0.10)}{.703\ (85)\ (757^2 - 12.9^2)}$$

k = 0.02 millidarcy

BEFORE EXAMINER STAMETS
OIL CONSERVATION DIVISION
APPLICANTS EXHIBIT NO. 22
CASE NO. 7395
Submitted by MECHEM
Hearing Date 10 21 81

W.N.M.C.F.

APPLICATION OF

CURTIS J. LITTLE

FOR DESIGNATION OF THE LARGO CANYON AREA

OF THE PICTURED CLIFFS FORMATION

AS A TIGHT FORMATION

RIO ARRIBA COUNTY, NEW MEXICO

Case No. 7395

October 21, 1981

BEFORE EXAMINER STAMETS
OIL CONSERVATION DIVISION
LITTLE EXHIBIT NO. 22
CASE NO. 7395
Submitted by McCord
Hearing Date 10/21/81

Prepared by:

CURTIS J. LITTLE
Petroleum Geologist

KEVIN H. McCORD
Petroleum Engineer

APPLICATION OF CURTIS J. LITTLE

FOR DESIGNATION OF THE LARGO CANYON AREA OF THE

PICTURED CLIFFS FORMATION AS A TIGHT FORMATION,

RIO ARRIBA COUNTY, NEW MEXICO

Curtis J. Little is applying for portions of the Ballard Pictured Cliffs and South Blanco Pictured Cliffs gas pools to be designated as a tight formation under Section 107 of the Natural Gas Policy Act of 1978. The proposed Largo Canyon Tight Gas Area is located in the southeastern portion of the San Juan Basin. The area is located in Rio Arriba County, approximately 35 miles southeast of the town of Bloomfield in northwestern New Mexico.

Exhibit No. 1 displays the proposed Largo Canyon Tight Gas Area on a map showing the Pictured Cliffs formation wells in the San Juan Basin. The Largo Canyon Tight Gas Area includes approximately 14,400 acres, described as follows:

T25N R6W		Acreage
Section	21 all	640
	22 all	640
	23 all	640
	26 all	640
	27 all	640
	28 NE¼	160
	34 all	640
	35 all	640
	36 W½	320
T25N R7W		
Section	4 all	640
	5 E½	320
	8 NE¼	160
	9 N½	320
	10 N½	320
T26N R6W		
Section	31 all	640
T26N R7W		
Section	17 S½	320
	18 all	640
	19 N½, SE¼	480
	20 all	640
	21 S½	320
	22 S½	320
	25 SW¼	160
	26 S½	320
	27 all	640
	28 all	640
	33 all	640
	34 all	640
	35 all	640
	36 all	640

The Pictured Cliffs formation in the Largo Canyon Area meets the criteria established in Section 107 of the Natural Gas Policy Act of 1978 to be designated as a tight gas formation in that (1) the estimated average in situ gas permeability throughout the pay section is expected to be 0.1 millidarcy or less, (2) the stabilized gas production rates, without stimulation, at atmospheric pressure of these gas wells are not expected to exceed the maximum allowable production rate of 68 MCFPD for an average depth of 2387 feet to the top of the Pictured Cliffs formation in this area, and (3) no well drilled into the Pictured Cliffs formation in this area is expected to produce more than five barrels of crude oil per day prior to stimulation.

Exhibit No. 2 is a Pictured Cliffs formation completion and production map of the proposed Largo Canyon Tight Gas Area. The production figures presented for each producing well are initial potential, date of initial potention, natural gas production for 1980, and January 1, 1981 cumulative production of gas for the well. Exhibit No. 2 also presents completion and production data from wells surrounding the proposed tight gas area for comparison purposes.

The Largo Canyon Tight Gas Area contains 33 Pictured Cliffs formation gas wells, 12 of which are abandoned in the Pictured Cliffs at this time. The average depth to the top of the Pictured Cliffs formation in these wells is 2387 feet. Examination of Exhibit No. 2 indicates that the Largo Canyon Tight Gas Area is scantly developed compared to the area around it. Examination of cumulative and current gas production rates also indicate the poorer quality Pictured Cliffs reservoir rock in the Largo Canyon Tight Gas Area. A list of operator, well name and production figures for Pictured Cliffs wells in the Largo Canyon Tight Gas Area is presented as Exhibit No. 3.

Exhibit No. 4 and 5 are January 1, 1981 cumulative gas production and 1980 annual gas production maps of the Pictured Cliffs formation for the area encompassing the proposed Largo Canyon Tight Gas Area. These maps are color coded to distinguish natural gas production trends in the area. The red color in Exhibit No. 4 is used to distinguish areas with cumulative gas production greater than ½ BCF while the white indicates production less than this. In Exhibit No. 5, red is used to distinguish areas which had more than 12 MMCF of gas production in 1980. The white areas indicate areas with less than 12 MMCF of gas production in 1980.

Examination of Exhibit Nos. 4 and 5 shows that the great majority of the Largo Canyon Tight Gas Area is white, which indicates little or no gas production from the Pictured Cliffs formation in this area. This small cumulative production and sparse well locations is due to the tight nature of the reservoir rock in the area.

The Largo Canyon Tight Gas Area is bordered to the northeast by the South Blanco Pictured Cliffs field. Exhibit Nos. 4 and 5 show this area is densely drilled with good Pictured Cliffs wells, indicated by the red coloring in the area. The area to the southwest of the Largo Canyon Tight Gas Area is the Ballard Pictured Cliffs field. This field is not as fully developed as the South Blanco Pictured Cliffs field, but again, the red coloring of this area indicate much more gas production in this area than the Largo Canyon Tight Gas Area.

Geology

The Pictured Cliffs formation is a marine, clay-filled sandstone whose source was to the southwest. The formation was deposited as near-shore bars aligned northwest-southeast with each sand body becoming progressively younger from the southwest to the northeast by the regressive late Cretaceous sea.

The form of gas entrapment in the Largo Canyon Tight Gas Area is stratigraphic. Sediments within this area are seaward deposits of the Ballard Pictured Cliffs field rather than landward deposits of the South Blanco Pictured Cliffs field.

Sample examination indicates the Pictured Cliffs in this area is predominately siltstone rather than sandstone which, with clay-filling, is the contributing factor to the low permeability found in the Largo Canyon Tight Gas Area.

Exhibit No. 6 is a type log of the Pictured Cliffs formation in the Largo Canyon Tight Gas Area. This well is located in the NE¼ of Section 19, T26N, R7W. The top of the Pictured Cliffs formation on this type log is 2156 feet and is overlain by a 24 foot coal bed. The base of the Pictured Cliffs is projected to be 2231 feet and is underlain by the Lewis Shale. This log is representative of the Pictured Cliffs formation between the Ballard Pictured Cliffs pool and the South Blanco Pictured Cliff pool.

Exhibit No. 7 presents cross section A-A' which is located in the northern portion of the Largo Canyon Tight Gas Area. Exhibit No. 8 is

is log cross section B-B' located in the southern portion of the area.

The log reference datum shown on these cross sections is a bentonite which is referred to as the "Huerfanito Marker". The cross sections illustrate the Pictured Cliffs formation to be a continuous lithologic unit throughout the Largo Canyon Tight Gas Area. Both cross sections indicate better sand development in the Ballard Pictured Cliffs field and the South Blanco Pictured Cliffs field than in the Largo Canyon Tight Gas Area. This illustrates that poorer reservoir rock is present in the Largo Canyon Tight Gas Area than the two surrounding Pictured Cliffs fields.

Stabilized Unstimulated Gas Production Rate

Obtaining stabilized unstimulated gas production rates for Pictured Cliffs wells is not a standard procedure used by companies when completing their wells in the San Juan Basin. Past experience has shown that these low permeability Pictured Cliffs wells must be stimulated to obtain commercial production. However, in preparation for this Largo Canyon tight gas study, three hour unstimulated gas production tests were performed on seven wells scattered throughout the tight gas area. Exhibit No. 9 gives the location of these test wells and indicates that the average unstimulated natural gas production rate from these wells is 13.7 MCFGPD. This rate is well below the 68 MCFGPD allotted for tight formation gas wells having an average depth of 2387 feet.

The natural unstimulated production rates provided are not truly unstimulated production rates from the Pictured Cliffs formation. Each of these wells were acidized with 500 gallons of 7½% hydrochloric acid as a production aid to induce a flow channel from the wellbore to the formation through the perforations. This acidizing cleans up the flow path so gas can move more freely to the wellbore. True unstimulated natural production would not have the aid of this formation cleanup procedure to assist in gas production.

It can be expected that actual natural unstimulated gas production rates would be less than rates reported from flow tests taken after an acid treatment. Therefore, the average production rate of 13.7 MCFGPD can be considered to be the maximum average obtainable unstimulated natural production rate from the Pictured Cliffs formation in this area. This data indicates that the average unstimulated natural gas production rate from the Pictured Cliffs formation in the Largo Canyon Tight Gas Area is not expected to exceed 68 MCF of gas per day.

Stabilized Unstimulated Oil Production Rate

The natural gas produced from the Pictured Cliffs formation in the Largo Canyon Tight Gas Area is virtually dry gas. There has been very little oil and condensate reported for any of the wells now producing in the area. Only three wells have ever reported any oil and condensate production in the Largo Canyon Tight Gas Area. These wells are: (1) Foster Trust Riddle No. 1 - 2703 barrels; (2) Kimbell Oil Company Salazar No. 2 - 309 barrels and (3) Kimbell Oil Company Liberman No. 2 - 336 barrels of oil and condensate.

Analysis of early oil and condensate production from these three wells indicate the highest oil and condensate production was reported from the Foster Trust Riddle No. 1 well in 1957. This well averaged a post stimulation rate of 1.9 barrels of oil or condensate per day in 1957. The highest oil and condensate production rate reported for the other two wells was 0.3 barrels per day. The associated unstimulated oil and condensate production from these wells could be considered to be much lower than these low production figures which are well below the 5 barrels of oil per day unstimulated oil production limitation given for a tight gas area.

These dry gas production figures indicate that no well drilled in the Pictured Cliffs formation in the Largo Canyon Tight Gas Area is expected to produce, without stimulation, more than 5 barrels of crude oil per day.

Permeability

The Pictured Cliffs formation in the San Juan Basin is dependent on stimulation techniques to be commercially productive due to the low permeability of the reservoir rock.

Exhibit Nos. 10 through 17 present core analysis data used to determine the average laboratory permeability to air for Pictured Cliffs formation pay zones in this area. The exhibits contain the actual core analysis reports plus summary tables showing the analysis of cores taken from only the productive portion of the Pictured Cliffs formation for each well. The cored intervals chosen for permeability averaging were determined by log examination of the interval cored for each well. Only cored intervals of sand with more than 6 ohms resistivity appearing on the Induction Resistivity log of the well or 10% porosity appearing on a porosity log for the well were used for permeability averaging.

Calculating an average laboratory permeability for the Largo Canyon Tight Gas Area proved to be a problem. Examination of Exhibits 10 through 17 indicate that one well, the Depco, Inc. MKL No. 17, has an abnormally high permeability average for the Pictured Cliffs formation compared to the other 5 wells cored. Analysis of Exhibit No. 2 shows that the MKL No. 17 well was not completed in the Pictured Cliffs zone, but was completed in the deeper Point Lookout zone of the Mesa Verde formation. However, a close offset well, the Depco, Inc. MKL No. 9 well was completed in the Pictured Cliffs formation and has produced more than 3 BCF of gas since 1952. The large permeability in the MKL No. 17 well is confirmed by the offset well's large production of natural gas, but this well is definately not the same type of well that would be expected in the Largo Canyon Tight Gas Area. The MKL No. 9 well is in the heart of the South Blanco Pictured Cliff trend, while the wells in the Largo Canyon Tight Gas Area are between this trend and the Ballard Pictured Cliffs trend.

The Depco, Inc. MKL No. 1 well is also located in the good Pictured Cliffs formation reservoir rock associated with the South Blanco Pictured Cliffs pool. This well was also completed in the 2300 foot deeper Point Lookout zone of the Mesa Verde formation. An offset well, the Depco, Inc. MKL No. 2 was completed in the Pictured Cliffs formation and has a cumulative gas production of 956 MMCF of gas since 1952. This large cumulative gas production of a near offset well indicates that the core data of the Depco, Inc. MKL No. 2 well is probably not representative of the Largo Canyon Tight Gas Area.

The six remaining cored wells have somewhat poorer core permeability and/or cumulative gas production associated with them and therefore indicate they are located in poorer reservoir rock than that exhibited by the Depco, Inc. MKL No. 17 and MKL No. 1 wells. Therefore, these six wells will be used for permeability averaging in the Largo Canyon Tight Gas Area and the Depco, Inc. MKL No. 17 and MKL No. 1 wells will not be included in the average.

The average laboratory permeability to air determined for the Largo Canyon Tight Gas Area in this manner was 0.37 millidarcy. The actual in situ permeability of the formation is less than this laboratory determined value due to water saturation and confining pressures found in the Pictured Cliffs reservoir.

Exhibit No. 18 presents a technical paper entitled "Effect of Overburden Pressure and Water Saturation on Gas Permeability of Tight Sandstone Cores" written by Rex D. Thomas and Don C. Ward of the U.S. Bureau of Mines. This paper presents relationships between laboratory determined permeability in cores and actual in situ permeability found in reservoirs. Exhibit No. 19 explains how in situ permeability is calculated from the core analysis using the technical paper presented.

Exhibit 20 is a summary of all laboratory core analysis results for the Largo Canyon Tight Gas Area. An average in situ permeability value of 0.007 millidarcy was calculated from the average laboratory permeability value of 0.37 millidarcy for the Largo Canyon Area. This 0.007 millidarcy permeability value calculated from core data is well below the 0.10 millidarcy cutoff for tight gas determination.

Another method of determining reservoir permeability was performed in the Largo Canyon Area, making use of the 7 natural unstimulated production tests taken in the area. The average unstimulated gas flow rate of 13.7 MCFGPD along with other Pictured Cliffs reservoir data for the tight gas area can be used in Darcy's Law of fluid flow through a porous medium to calculate a reservoir permeability. This Darcy's Law calculation is presented as Exhibit No. 21.

Darcy's Law calculations report an average reservoir permeability value of 0.02 millidarcy for the Largo Canyon Tight Gas Area. This permeability value compares to a 0.007 millidarcy permeability value determined by core analysis methods. Both of these values are below the 0.10 millidarcy tight gas cutoff.

The reservoir permeability value of 0.02 millidarcy determined by Darcy's Law calculation is thought to be the best estimate of reservoir permeability for the Largo Canyon Tight Gas Area because it involves actual formation flow characteristics and reservoir parameters to determine formation permeability. Therefore, the estimated average in situ gas permeability throughout the pay section is expected to be 0.1 millidarcy or less in the Largo Canyon Tight Gas Area.

Fresh Water Protection

Existing State and Federal regulations will assure that development of the Pictured Cliffs formation will not adversely affect or impair any fresh water acquifers that are being used or are expected to be used in the foreseeable future for domestic or agricultural water supplies.

Regulations require that casing programs be designed to seal off potential water bearing formations from oil and gas producing formations. These fresh water zones exist from the surface to the base of the Ojo Alamo Formation. The Ojo Alamo depth averages 1640 feet in the proposed Largo Canyon Tight Gas Area.

Most Pictured Cliffs wells drilled in the Largo Canyon Area are drilled with natural mud that will not contaminate fresh water zones. Normal casing designs consist of 7" O.D. surface casing being set from the surface to a depth of 120 feet. Production casing used is 2 7/8" O.D. and is set from surface to total depth.

The surface casing is cemented in place by circulating cement to the surface, protecting the near surface formations from downhole contamination. The production casing is cemented from total depth to the surface or to a depth sufficient to cover the Ojo Alamo formation. This process protects the Pictured Cliffs and other shallow formations from contaminating the Ojo Alamo acquifer. Therefore, all productive and fresh water zones are protected by both casing and cement.

Stimulation of the Pictured Cliffs formation involves varied fracture treatments, depending on the operator. Fracture treatments usually consist of a one or two percent potassium chloride water base fluid with sand, or a nitrogen-water foam base fluid and sand. Either treatment will not harm a fresh water acquifer. Fresh water protection is assured during these fracture stimulation treatments due to zone isolation caused by cementation. A distance of over 700 feet between the Pictured Cliffs formation and the Ojo Alamo fresh water acquifer is additional insurance that no existing fresh water zone will be contaminated by stimulation of Pictured Cliffs wells in this area.

Therefore, New Mexico and Federal regulations will protect any fresh water supply that may be affected by drilling, completing, and producing the Pictured Cliffs formation in the Largo Canyon Tight Gas Area.

Conclusion

Evidence presented in this report substantiates the following for Curtis J. Little's proposed Largo Canyon Pictured Cliff Formation Tight Gas Area:

(1) For an average Pictured Cliff well depth of 2387 feet, the stabilized production rate at atmospheric pressure of wells completed in the Pictured Cliff formation, without stimulation, is not expected to exceed the maximum allowable rate of 68 MCF of gas per day.

(2) No well drilled into the Pictured Cliff formation in the Largo Canyon Area is expected to produce, without stimulation, more than five barrels of crude oil per day.

(3) The estimated average in situ gas permeability, throughout the Pictured Cliffs pay section, is expected to be 0.1 millidarcy or less.

The proposed Largo Canyon Tight Gas Area meets all the specifications required as stated above and should be designated a tight formation in the Pictured Cliffs formation under Section 107 of the Natural Gas Policy Act of 1978.

County,

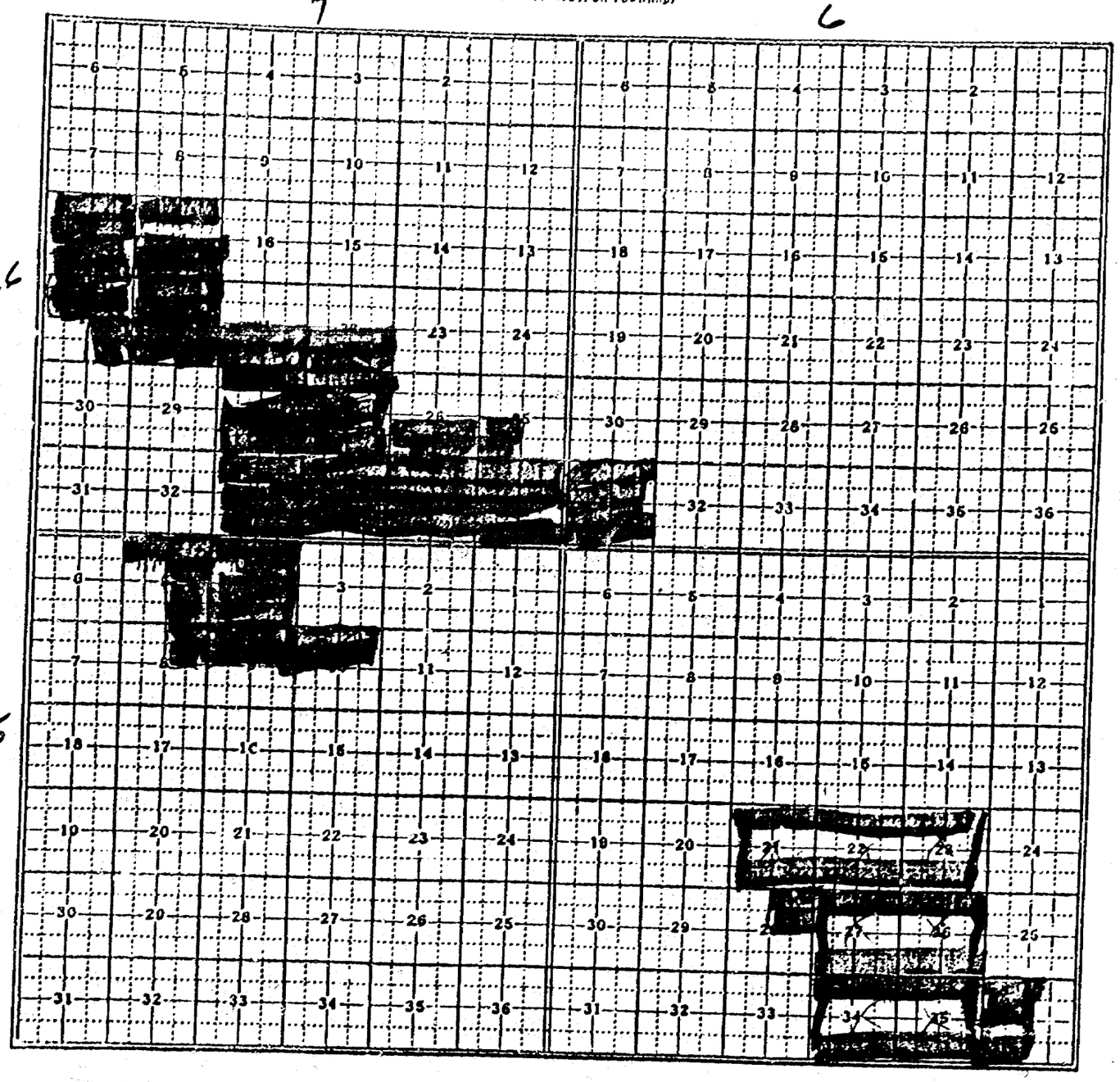
Township Range

Township Range

Township Range

Township Range

Form 104—(Sovt on Township)



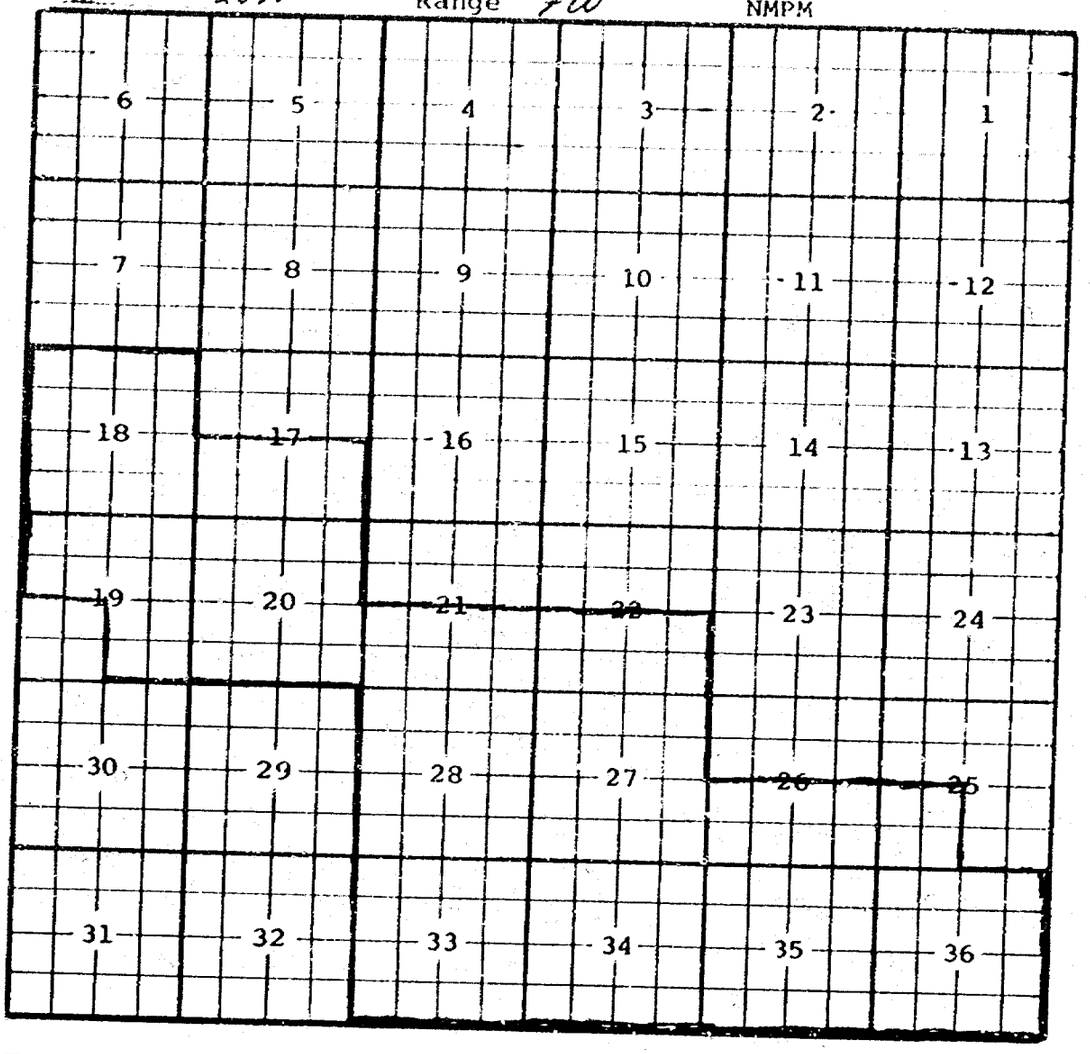
17 fence
9 ½ fence
4 ½ fence

17
4.5
1
22.5

22.5
640
14,400

County _____ Pool _____

TOWNSHIP 26 N Range 7 W NMPM



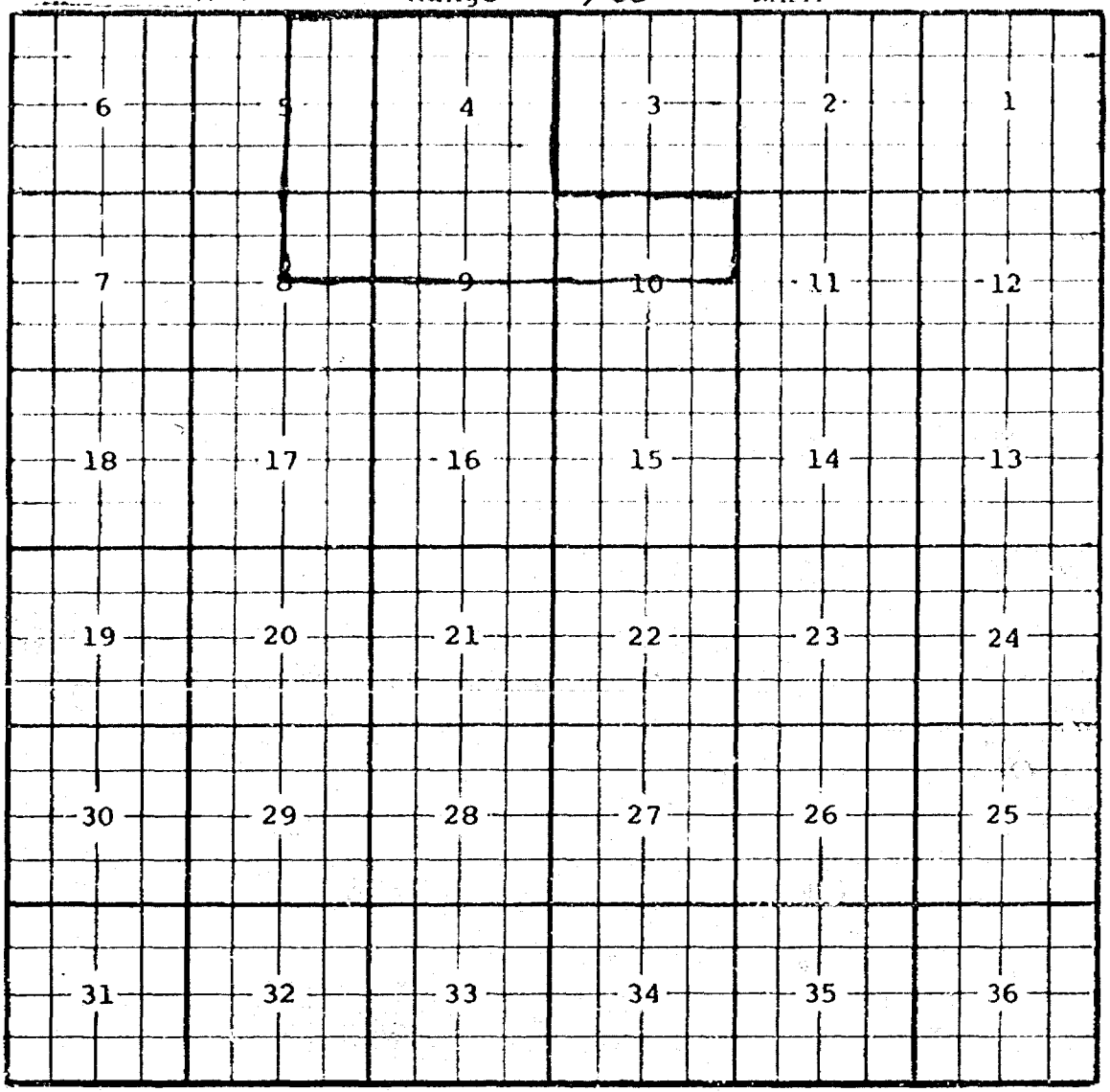
County _____ Pool _____

TOWNSHIP 26 N Range 6 W NMPM

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

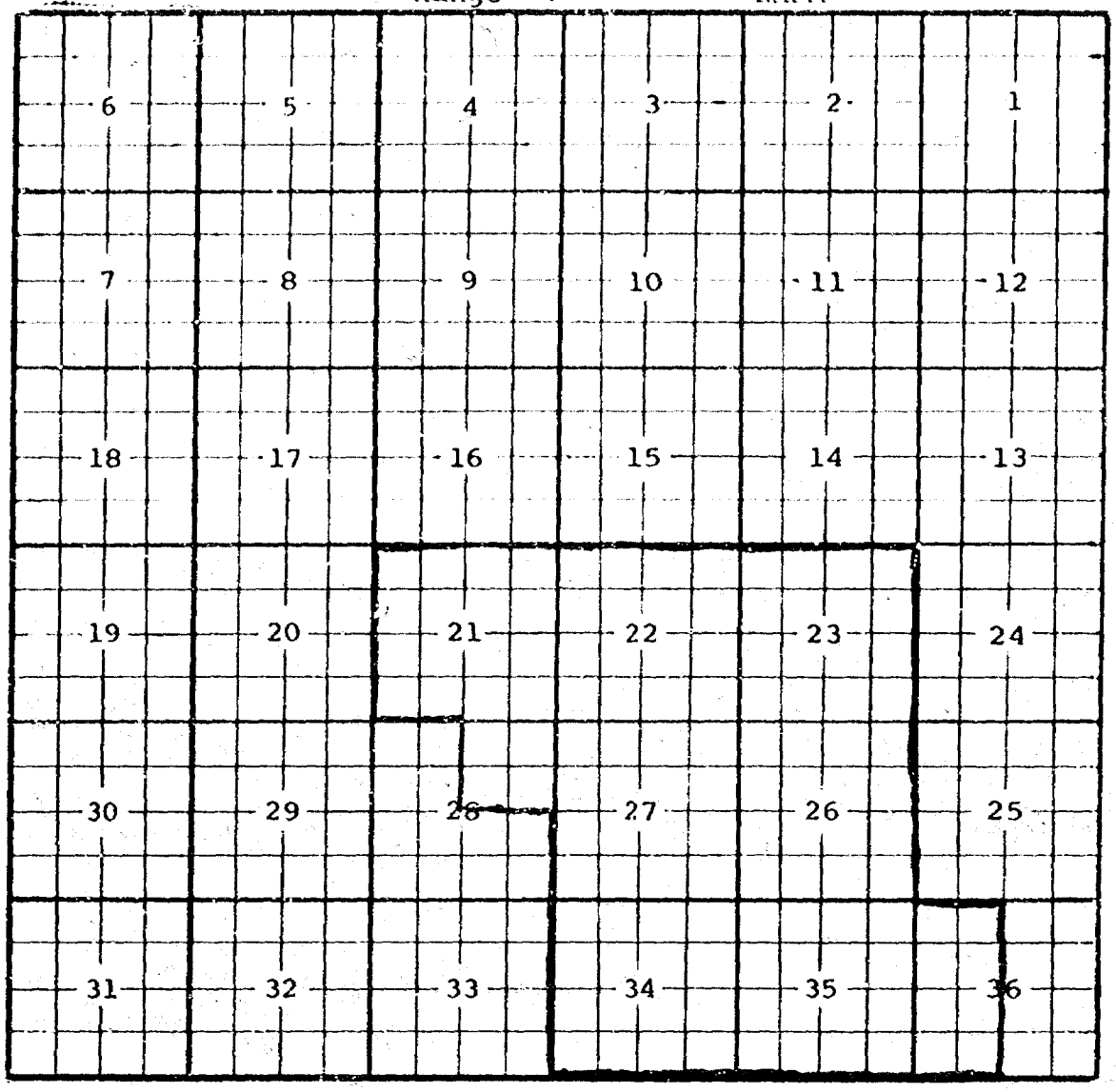
County Rio Arriba Pool Largo Canyon Area of the Pictured Cliffs

TOWNSHIP 25N Range 7W NMPM



County San Juan Pool

TOWNSHIP 25 N Range 6 W NMPM



CASE 7392: Application of Sam H. Snoddy, for an unorthodox gas well location in the Oil-Potash Area, Lea County, New Mexico. Applicant, in the above-styled cause, seeks approval for the location of a Pennsylvanian well to be drilled 660 feet from the North and East lines of Section 26, Township 20 South, Range 32 East, Oil-Potash Area, the N/2 of said Section 26 to be dedicated to the well.

CASE 7393: Application of Uriah Exploration Incorporated for compulsory pooling, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests in the Cisco, Canyon and Morrow formations underlying the W/2 of Section 13, Township 22 South, Range 24 East, to be dedicated to a well to be drilled at a standard location thereon. Also to be considered will be the cost of drilling and completing said well and the allocation of the cost thereof as well as actual operating costs and charges for supervision, designation of applicant as operator of the well, and a charge for risk involved in drilling said well.

CASE 7394: Application of Supron Energy Corporation for an unorthodox gas well location, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks approval for the unorthodox location of a Pennsylvanian well to be drilled 467 feet from the North line and 1650 feet from the West line of Section 13, Township 22 South, Range 24 East, the N/2 of said Section 13 to be dedicated to the well.

CASE 7395: Application of Curtis J. Little for Designation of a Tight formation, Rio Arriba County, New Mexico. Applicant, in the above-styled cause, seeks the designation of the Pictured Cliffs formation underlying portions of Townships 25 and 26 North, Ranges 6 and 7 West containing a total of 14,400 acres, more or less, as a tight formation pursuant to Section 107 of the Natural Gas Policy Act and 18 CFR Section 271. 701-705.

CASE 7300: (Reopened and Readvertised)

Application of Dome Petroleum Corporation for designation of a tight formation, Sandoval County, New Mexico. Applicant, in the above-styled cause, seeks the designation of the Chacra formation underlying portions of Townships 21 and 22 North, Ranges 5,6, and 7 West, containing 73,018 acres, more or less, as a tight formation pursuant to Section 107 of the Natural Gas Policy Act and 18 CFR Section 271. 701-705.

CASE 7352: (Continued from September 23, 1981, Examiner Hearing)

Application of Yates Petroleum Corporation for designation of a tight formation, Eddy County, New Mexico. Applicant, in the above-styled cause, pursuant to Section 107 of the Natural Gas Policy Act 18-CFR Section 271. 701-705, seeks the designation as a tight formation of the Permo-Penn formation underlying all of the following townships:

Township 17 South, Ranges 24 thru 26 East;

18 South, 24 and 25 East,

19 South, 23 thru 25 East;

20 South, 21 thru 24 East;

20 1/2 South, 21 and 22 East;

21 South, 21 and 22 East;

Also Sections 1 thru 12 in 22 South, 21 and 22 East,

All of the above containing a total of 315,000 acres more or less.

CASE 7384: Application of Morris R. Antweil for compulsory pooling, Lea County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests from the surface to the base of the Abo formation underlying the NE/4 SW/4 of Section 5, Township 20 South, Range 38 East, to be dedicated to a well to be drilled at a standard location thereon. Also to be considered will be the cost of drilling and completing said well and the allocation of the cost thereof as well as actual operating costs and charges for supervision, designation of applicant as operator of the well, and a charge for risk involved in drilling said well.

CASE 7385: Application of El Paso Natural Gas Company for downhole commingling, Rio Arriba County, New Mexico. Applicant, in the above-styled cause, seeks approval for the downhole commingling of Blanco-Mesaverde and Basin-Dakota production in the wellbore of its San Juan 27-5 Unit Well No. 59, located in Unit A of Section 6, Township 27 North, Range 5 West.

CASE 7386: Application of El Paso Natural Gas Company for downhole commingling, Rio Arriba County, New Mexico. Applicant, in the above-styled cause, seeks approval for the downhole commingling of South Blanco-Pictured Cliffs and Blanco-Mesaverde production in the wellbore of its San Juan 27-5 Unit Well No. 54, located in Unit L of Section 31, Township 27 North, Range 5 West.

CASE 7387: Application of Sun Oil Company for an unorthodox oil well location, Lea County, New Mexico. Applicant, in the above-styled cause, seeks approval for the unorthodox location of a well to be drilled 660 feet from the North and East lines of Section 32, Township 9 South, Range 37 East, West Sawyer-San Andres Pool, the N/2 NE/4 of said Section 32 to be dedicated to the well.

CASE 7388: Application of Sun Oil Company for an unorthodox oil well location, Lea County, New Mexico. Applicant, in the above-styled cause, seeks approval for the unorthodox location of a well to be drilled in the Northeast Lusk Yates Pool, 2500 feet from the North line and 1880 feet from the East line of Section 15, Township 19 South, Range 32 East the SW/4 NE/4 of said Section 15 to be dedicated to the well.

CASE 7389: Application of Yates Petroleum Corporation for an Amendment to Division Order No. R-4365, Eddy County, New Mexico. Applicant, in the above-styled cause seeks the amendment of Division Order No. R-4365, which promulgated special rules and regulations for the Penasco Draw San Andres-Yeso Pool, by amending Rule 5 to permit the simultaneous dedication of gas wells and oil wells and amending Rule 9 to provide for annual gas-liquid ratio tests in lieu of semi-annual tests.

CASE 7365: (Continued from October 7, 1981, Examiner Hearing)

Application of Yates Petroleum Corporation for the amendment of Order No. R-6406, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks the amendment of Order No. R-6406, to permit recompletion of its State "JM" No. 2 Well, drilled at an unorthodox Morrow location 660 feet from the South line and 660 feet from the East line of said Section 25, Township 18 South, Range 24 East, in any and all Wolfcamp and Pennsylvanian pays in said well.

CASE 7390: Application of Harvey E. Yates Company for compulsory pooling, Chaves County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests in the Mississippian formation underlying the W/2 of Section 18, Township 9 South, Range 27 East, to be dedicated to a well to be drilled at a standard location thereon. Also to be considered will be the cost of drilling and completing said well and the allocation of the cost thereof as well as actual operating costs and charges for supervision, designation of applicant as operator of the well, and a charge for risk involved in drilling said well.

CASE 7391: Application of Harvey E. Yates Company for statutory unitization, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks an order unitizing, for the purposes of a secondary recovery project, all mineral interests in the Travis Penn Unit encompassing 480 acres, more or less, underlying all or portions of Sections 12 and 13, Township 18 South, Range 28 East, Eddy County, New Mexico.

The unitized interval would be the Cisco-Canyon formation between the depths of 9815 feet and 9935 feet in Harvey E. Yates Company's Travis Deep Unit No. 2 Well. Among the matters to be considered at the hearing will be the necessity of unit operations; the designation of a unit operator; the determination of the horizontal and vertical limits of the unit area; the determination of the fair, reasonable, and equitable allocation of production and costs of production, including capital investment, to each of the various tracts in the unit area; the determination of credits and charges to be made among the various owners in the unit area for their investment in well and equipment; and such other matters as may be necessary and appropriate for carrying on efficient unit operations, including, but not necessarily limited to, unit voting procedures, selection, removal, or substitution of unit operator, and time of commencement and termination of unit operations.

CASE 7375: Application of Dugan Production Corporation for downhole commingling, San Juan County, New Mexico. Applicant, in the above-styled cause, seeks approval for the downhole commingling of Angel Peak Gallup-Basin Dakota production in the wellbore of its McAdams Well No. 2 located in Unit P of Section 34, Township 27 North, Range 10 West.

CASE 7376: Application of Dugan Production Corporation for downhole commingling, San Juan County, New Mexico. Applicant, in the above-styled cause, seeks approval for the downhole commingling of Basin-Dakota and Bisti-Lower Gallup production in the wellbore of its Big 8 Well No. 1-E, located in Unit O of Section 8, Township 24 North, Range 9 West.

CASE 7377: Application of Dugan Production Corporation for downhole commingling, San Juan County, New Mexico. Applicant, in the above-styled cause, seeks approval for the downhole commingling of undesignated Gallup and Basin-Dakota production in the wellbore of its July Jubilee Well No. 1 located in Unit G of Section 30, Township 24 North, Range 9 West.

CASE 7378: Application of Jerome P. McHugh for downhole commingling, Rio Arriba County, New Mexico. Applicant, in the above-styled cause, seeks approval for the downhole commingling of Wildhorse-Gallup and Basin-Dakota production in the wellbore of his Apache E Well No. 1, located in Unit A of Section 18, Township 26 North, Range 3 West.

CASE 7356: (Continued from September 23, 1981, Examiner Hearing)

Application of S & I Oil Company for compulsory pooling, San Juan County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests in the W/2 SW/4 of Section 12, Township 29 North, Range 15 West, Cha Cha-Gallup Oil Pool, to be dedicated to a well to be drilled at a standard location thereon. Also to be considered will be the cost of drilling and completing said well and the allocation of the cost thereof as well as actual operating costs and charges for supervision, designation of applicant as operator of the well, and a charge for risk involved in drilling said well.

CASE 7379: Application of JEM Resources, Inc., for vertical pool extension and special GOR limit, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks the vertical extension of the Cave-Grayburg Pool to include the San Andres formation, and the establishment of a special gas-oil ratio limit for said pool to 6000 to one or, in the alternative, the abolishment of the gas-oil ratio limit in said pool, all to be effective October 1, 1981.

CASE 7380: Application of Bird Oil Corporation for an unorthodox location, San Juan County, New Mexico. Applicant, in the above-styled cause, seeks approval for the unorthodox Entrada location of a well to be drilled 2310 feet from the North line and 1325 feet from the East line of Section 10, Township 22 North, Range 9 West, the SW/4 NE/4 of said Section 10 to be dedicated to the well.

CASE 7381: Application of H. L. Brown, Jr., for an unorthodox gas well location, Roosevelt County, New Mexico. Applicant, in the above-styled cause, seeks approval for the unorthodox location of a well to be drilled 330 feet from the South line and 2310 feet from the East line of Section 34, Township 7 South, Range 37 East, Bluitt-Wolfcamp Gas Pool, the E/2 of said Section 34 to be dedicated to the well.

CASE 7382: Application of TXO Production Corporation for an unorthodox gas well location, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks approval for the unorthodox location of a Morrow well to be drilled 660 feet from the South and West lines of Section 20, Township 17 South, Range 28 East, the W/2 of said Section 20 to be dedicated to the well.

CASE 7383: Application of Amoco Production Company for compulsory pooling, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests in the Upper Pennsylvanian formation underlying the NW/4 of Section 19, Township 19 South, Range 25 East, to be dedicated to a well to be drilled at a standard location thereon. Also to be considered will be the cost of drilling and completing said well and the allocation of the cost thereof as well as actual operating costs and charges for supervision, designation of applicant as operator of the well, and a charge for risk involved in drilling said well.

Docket Nos. 34-81 and 35-81 are tentatively set for October 21 and November 4, 1981. Applications for hearing must be filed at least 22 days in advance of hearing date.

DOCKET: COMMISSION HEARING - WEDNESDAY - OCTOBER 14, 1981

9 A.M. - OIL CONSERVATION COMMISSION - ROOM 205
STATE LAND OFFICE BUILDING, SANTA FE, NEW MEXICO

(The following cases are continued from the October 14, 1981, Commission hearing to October 16, 1981.)

CASE 7345: (Continued and Readvertised)

Application of Bass Enterprises Production Company for compulsory pooling, Lea County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests in the San Andres, Bone Springs and Pennsylvanian formations, Lovington Field, underlying the N/2 NE/4 of Section 13, Township 16 South, Range 36 East, to be dedicated to a well to be drilled at a standard location thereon. Also to be considered will be the cost of drilling and completing said well and the allocation of the cost thereof as well as actual operating costs and charges for supervision, designation of applicant as operator of the well, and a charge for risk involved in drilling said well.

CASE 7323: (DE NOVO)

Application of Clements Energy, Inc., for compulsory pooling, Chaves County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests underlying the E/2 of Section 32, Township 15 South, Range 27 East, to be dedicated to a well to be drilled at a standard location thereon. Also to be considered will be the cost of drilling and completing said well and the allocation of the cost thereof as well as actual operating costs and charges for supervision. Also to be considered will be the designation of applicant as operator of the well and a charge for risk involved in drilling said well.

Upon application of Southland Royalty Company, this case will be heard DE NOVO pursuant to the provisions of Rule 1220.

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Docket No. 34-81

DOCKET: EXAMINER HEARING - WEDNESDAY - OCTOBER 21, 1981

9 A.M. - OIL CONSERVATION DIVISION CONFERENCE ROOM
STATE LAND OFFICE BUILDING, SANTA FE, NEW MEXICO

The following cases will be heard before Richard L. Stamets, Examiner, or Daniel S. Nutter, Alternate Examiner:

ALLOWABLE: (1) Consideration of the allowable production of gas for November, 1981, from fifteen prorated pools in Lea, Eddy, and Chaves Counties, New Mexico.

(2) Consideration of the allowable production of gas for November, 1981, from four prorated pools in San Juan, Rio Arriba, and Sandoval Counties, New Mexico.

CASE 7373: Application of J. C. Williamson for Amendment of Division Order No. R-6738, Lea County, New Mexico. Applicant, in the above-styled cause, seeks the Amendment of Division Order No. R-6738, which approved an unorthodox location for a well 1560 feet from the North line and 1830 feet from the West line of Section 10, Township 23 South, Range 34 East. Applicant seeks the Amendment of said order to reflect the corrected location of said well at a point 1580 feet from the North line and 2614 feet from the West line of said Section 10.

CASE 7374: Application of Dugan Production Corporation for an unorthodox gas well location, San Juan County, New Mexico. Applicant, in the above-styled cause, seeks approval for the unorthodox location of a Farmington formation well located 330 feet from the South line and 990 feet from the East line of Section 9, Township 28 North, Range 11 West, the E/2 of said Section 9 to be dedicated to the well.

BEFORE THE

OIL CONSERVATION DIVISION

NEW MEXICO DEPARTMENT OF ENERGY AND MINERALS

IN THE MATTER OF THE APPLICATION
OF CURTIS J. LITTLE FOR
DESIGNATION OF TIGHT FORMATION,
RIO ARRIBA COUNTY, NEW MEXICO.

CASE 7395

CERTIFICATE OF FILING

Comes now CURTIS J. LITTLE, by and through his undersigned attorneys, and hereby certifies that a copy of the complete set of all exhibits which applicant proposes to offer or introduce at the hearing on the above-referenced application, together with a statement of the meaning and purpose of each, has been delivered to the United States Geological Survey in Albuquerque, New Mexico, on this 6th day of October, 1981, as is required by Section D of the Oil Conservation Division's Special Rules and Procedures for Tight Sand Formation Designation under Section 107 of the Natural Gas Policy Act of 1978.

CAMPBELL, BYRD & BLACK, P.A.

By William F. Carr

William F. Carr
Attorneys for Applicant
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Santa Fe, New Mexico 87501
Telephone: (505) 988-4421

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September 30, 1981

Mr. Joe D. Ramey
Division Director
Oil Conservation Division
New Mexico Department of
Energy and Minerals
Post Office Box 2088
Santa Fe, New Mexico 87501

Re: Application of Curtis J. Little for Designation of Tight Formation, Rio Arriba County, New Mexico

Dear Mr. Ramey:

Enclosed in triplicate is the application of Curtis J. Little in the above-referenced matter.

The applicant requests that this matter be included on the docket for the examiner hearing scheduled to be held on October 21, 1981.

Very truly yours,

William F. Carr

WFC:lr

Enclosures

cc: Mr. Curtis J. Little
Mr. Kevin McCord
Mr. Victor Salazar

BEFORE THE

OIL CONSERVATION DIVISION

NEW MEXICO DEPARTMENT OF ENERGY AND MINERALS

IN THE MATTER OF THE APPLICATION OF CURTIS J. LITTLE FOR DESIGNATION OF TIGHT FORMATION, RIO ARRIBA COUNTY, NEW MEXICO.

CASE 7395

APPLICATION

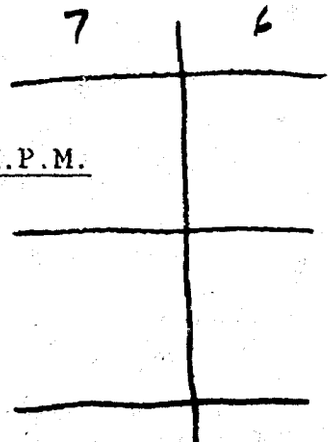
Comes now CURTIS J. LITTLE, by and through his undersigned attorneys and as provided in the Oil Conservation Division's Special Rules and Procedures for Tight Formation Designations under Section 107 of the Natural Gas Policy Act of 1978 promulgated by Oil Conservation Division Order No. R-6388 on June 30, 1980, hereby makes application for an order designating certain portions of the Pictured Cliffs formation as a tight formation under Section 107 of the Natural Gas Policy Act of 1978 and in support of its application would show the Division:

1. Applicant is the owner and operator of certain interests in the Pictured Cliffs formation underlying the following described lands situated in Rio Arriba County, New Mexico:

Township 25 North, Range 6 West, N.M.P.M.
Sections 21 through 23: All
Sections 26 and 27: All
Section 28: NE/4
Sections 34 and 35: All
Section 36: W/2

Township 25 North, Range 7 West, N.M.P.M.
Section 4: All
Section 5: E/2
Section 8: NE/4
Section 9: N/2
Section 10: N/2

Township 26 North, Range 6 West, N.M.P.M.
Section 31: All



Township 26 North, Range 7 West, N.M.P.M.
Section 17: S/2
Section 18: All
Section 19: N/2, SE/4
Section 20: All
Section 21: S/2
Section 22: S/2
Section 25: SW/4
Section 26: S/2
Sections 27 and 28: All
Sections 33 through 36: All

Containing a total of 14,400 acres, more or less.

2. The Pictured Cliffs formation is expected to have an estimated average in situ gas permeability throughout the pay section of less than 0.1 millidarcy per foot.

3. The average depth of the top of the Pictured Cliffs formation is 2387 feet and the stabilized production rate, against atmospheric pressure, of wells completed for production in said formation, without stimulation, is not expected to exceed 68 mcf of gas per day.

4. No well drilled into the Pictured Cliffs formation in the above-described area is expected to produce, without stimulation, more than five barrels of crude oil per day.

5. A complete set of Exhibits which applicant proposes to offer or introduce at the hearing on this application, together with a statement of the meaning and purpose of each exhibit will be filed with the Division and the United States Geological Survey at least 15 days prior to the hearing date as required by the Oil Conservation Division's Special Rules and Procedures for Tight Sand Formation Designation under Section 107 of the Natural Gas Policy Act of 1978.

WHEREFORE, Applicant prays that this application be set for hearing before a duly appointed examiner of the Oil Conservation Division and that after notice and hearing as required by law, the Division enter its order recommending to the Federal Energy Regulatory Commission that pursuant to 18 CFR, Section 271.701 - 705, that the Pictured Cliffs formation underlying the above-described land be designated a tight formation, and making such other and further provisions as may be proper in the premises.

Respectfully submitted,

CAMPBELL, BYRD & BLACK, P.A.

By William F. Carr

William F. Carr
Post Office Box 2208
Santa Fe, New Mexico 87501
Attorneys for Applicant

BEFORE THE

OIL CONSERVATION DIVISION

NEW MEXICO DEPARTMENT OF ENERGY AND MINERALS

IN THE MATTER OF THE HEARING CALLED BY THE OIL CONSERVATION DIVISION FOR THE PURPOSE OF CONSIDERING:

CASE NO. 7395
Order No. R-6825

APPLICATION OF CURTIS J. LITTLE FOR DESIGNATION OF A TIGHT FORMATION, RIO ARRIBA COUNTY, NEW MEXICO.

ORDER OF THE DIVISION

BY THE DIVISION:

This cause came on for hearing at 9:00 a.m. on October 21, 1981, at Santa Fe, New Mexico, before Examiner Richard L. Stamets.

NOW, on this _____ day of ~~November,~~ 1981, the Division Director, having considered the testimony, the record, and the recommendations of the Examiner, and being fully advised in the premises,

FINDS:

(1) That due public notice having been given as required by law, the Division has jurisdiction of this cause and the subject matter thereof.

(2) That the applicant Curtis J. Little, requests that the Division in accordance with Section 107 of the Natural Gas Policy Act, and 18 C.F.R. §271.703 recommend to the Federal Energy Regulatory Commission that the Pictured Cliffs formation underlying the following lands situated in Rio Arriba County, New Mexico, hereinafter referred to as the Pictured Cliffs formation, be designated as tight formations in said Federal Energy Regulatory Commission's regulations:

AREA A

Township 25 North, Range 6 West, NMPM

Sections 21 through 23: All
Sections 26 and 27: All
Section 28: NE/4
Sections 34 and 35: All
Section 36: W/2

AREA B

Township 25 North, Range 7 West, NMPM

Section 4: All
Section 5: E/2
Section 8: NE/4
Section 9: N/2
Section 10: N/2

Township 26 North, Range 6 West, NMPM

Section 31: All

Township 26 North, Range 7 West, NMPM

Section 17: S/2
Section 18: All
Section 19: N/2, SE/4
Section 20: All
Section 21: S/2
Section 22: S/2
Section 25: SW/4
Section 26: S/2
Sections 27 and 28: All
Sections 33 through 36: All

Containing a total of 14,400 acres, more or less.

(3) That the proposed Largo Canyon Tight Gas Area is divided into two non-contigious tracts being hereinbefore described as Area A and Area B.

(4) That certain acreage between Areas A and B has been excluded from this application at the request of the operator of that acreage.

(5) That the Pictured Cliffs formation underlies all the above described lands; that the formation is a marine, clay-filled, siltstone, about 70 feet thick; such formation is found at an average depth of 2387 feet below the surface of the areas set out in Finding No. (2) above.

(6) That the type section for the Pictured Cliffs formation for the proposed tight formation designations is found at a depth of from approximately 2156 feet to 2231 feet on the induction electrical log from the Curtis J. Little Grevey No. 1 Well, located in Unit G of Section 19, Township 26 North, Range 7 West, Rio Arriba County, New Mexico.

(7) That the Pictured Cliffs formation underlying the above-described lands has been penetrated by a number of wells, but the area proposed for tight formation designation are largely undeveloped exploratory areas.

(8) That the technical evidence presented in this case demonstrated that the predominant percentage of wells which may be completed in the Pictured Cliffs formation within the proposed tight formation areas may reasonably be presumed to exhibit permeability, gas productivity, or crude oil productivity not in excess of the following parameters:

(a) average in situ gas permeability throughout the pay section of 0.1 millidarcy; and

(b) stabilized production rates, without stimulation, against atmospheric pressure, as found in the table set out in 18 C.F.R. §271.703(c)(2)(B) of the regulations; and

(c) production of more than five barrels of crude oil per day.

(9) That within the proposed areas there is a recognized aquifer being the Ojo Alamo, found at an average depth of 1640 feet or approximately 750 feet above the Pictured Cliffs formation.

(10) That existing State of New Mexico and Federal Regulations relating to casing and cementing of wells will assure that development of the Pictured Cliffs formation will not adversely affect said aquifers.

(11) That the Pictured Cliffs formation within the proposed areas should be recommended to the Federal Energy Regulatory Commission for designation as a tight formation.

IT IS THEREFORE ORDERED:

(1) That it be and hereby is recommended to the Federal Energy Regulatory Commission pursuant to Section 107 of the Natural Gas Policy Act of 1978, and 18 C.F.R. §271.703 of the regulations that the Pictured Cliffs formation underlying the following described lands in Rio Arriba County, New Mexico, be designated as a tight formation:

AREA A

Township 25 North, Range 6 West, NMPM

Sections 21 through 23: All
Sections 26 and 27: All
Section 28: NE/4
Sections 34 and 35: All
Section 36: W/2

AREA B

Township 25 North, Range 7 West, NMPM

Section 4: All
Section 5: E/2
Section 8: NE/4
Section 9: N/2
Section 10: N/2

Township 26 North, Range 6 West, NMPM

Section 31: All

Township 26 North, Range 7 West, NMPM

Section 17: S/2
Section 18: All
Section 19: N/2, SE/4
Section 20: All
Section 21: S/2
Section 22: S/2
Section 25: SW/4
Section 26: S/2
Sections 27 and 28: All
Sections 33 through 36: All

Containing a total of 14,400 acres, more or less.

(2) That jurisdiction of this cause is hereby retained for the entry of such further orders as the Division may deem necessary.

DONE at Santa Fe, New Mexico, on the day and year hereinabove designated.

STATE OF NEW MEXICO
OIL CONSERVATION DIVISION

JOE D. RAMEY
Director

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