NEW MEXICO OIL CONSERVATION DIVISION

STATE OF NEW MEXICO

CASE NO. 10420

IN THE MATTER OF:

The Application of Union Oil Company of California, d/b/a UNOCAL, for designation of a tight formation, Rio Arriba County, New Mexico.

BEFORE:

MICHAEL E. STOGNER

Hearing Examiner

Bureau of Land Management Building
435 Montano Road, Northeast
Albuquerque, New Mexico
December 20, 1991

REPORTED BY:

DEBBIE VESTAL
Certified Shorthand Reporter

ORIGINAL

A P P E A R A N C E S

FOR THE NEW MEXICO OIL CONSERVATION DIVISION:

ROBERT G. STOVALL, ESQ.
General Counsel
State Land Office Building
Santa Fe, New Mexico 87504

UNITED STATES DEPARTMENT OF INTERIOR
BUREAU OF LAND MANAGEMENT
ALBUQUERQUE DISTRICT OFFICE:

ALLEN F. BUCKINGHAM, MINERALS DIVISION
ROBERT KENT, PETROLEUM ENGINEER
JANE CLANCY, GEOLOGIST

FOR THE APPLICANT:

CAMPBELL, CARR, BERGE & SHERIDAN, P.A.
Post Office Box 2208
Santa Fe, New Mexico 87504-2208
BY: WILLIAM F. CARR, ESQ.

FOR THE GAS COMPANY OF NEW MEXICO:

SARAH D. SMITH, ESQ.
Alvarado Square
Albuquerque, New Mexico 87158

I N D E X

E X H I B I T S

EXAMINER STOGNER: The hearing will come to order. Call the next case, No. 10420.

MR. STOVALL: Application of Union Oil Company of California, d/b/a UNOCAL, for designation of a tight formation, Rio Arriba County, New Mexico.

EXAMINER STOGNER: Call for appearances.

MR. CARR: May it please the Examiner, my name is William F. Carr with the law firm of Campbell, Carr, Berge & Sheridan of Santa Fe. We represent Union Oil Company of California, and I have two witnesses.

EXAMINER STOGNER: Any other appearances?

MS. SMITH: Yes. Sarah Smith on behalf of Gas Company of New Mexico and Suntera Gas Gathering Company. No witnesses.

EXAMINER STOGNER: Any other appearances?

Will the witnesses, please, stand to be sworn at this time.

(The witnesses were duly sworn.)

EXAMINER STOGNER: Mr. Carr.

REX COLE

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

EXAMINATION

BY MR. CARR:

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

A. My name is Rex Don Cole.

Q. And where do you reside?

A. My work residence is Brea, California.

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

A. Union Oil Company of California, or UNOCAL Corporation. I'm with our Science and Technology Division. I'm a Research Associate specializing in reservoir characterization work of sandstone reservoirs.

Q. Could you briefly summarize your educational background and then review your work experience.

A. I received a bachelor of science degree in geology from Colorado State University in Ft. Collins in 1970, a doctorate in geology, Ph.D., from the University of Utah in 1975. Upon completing graduate school, I was an assistant professor for two years, from 1975 to 78 -- at

least 77, early 78 -- at Southern Illinois University. I left there.

And from 1978 to 1980, I was a staff geoscientist with Bendix Field Engineering Corporation in Grand Junction, Colorado, which is mostly uranium work. I left that and became the manager of the geology program of Multi-Mineral Corporation, also in Grand Junction, Colorado, for the period of 1980 to 1982. And that was related to syn-fuels development.

In 19 -- late 82 I left Multi-Mineral, joined UNOCAL as a Research Scientist, again specializing in sandstone reservoirs. I have been there ever since.

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

A. I am.

Q. And have you conducted a geological study of the area that is involved in this application?

A. I have.

MR. CARR: We tender Dr. Cole as an expert in petroleum geology.

EXAMINER STOGNER: Are there any objections?

Dr. Cole is so qualified.

Q. (BY MR. CARR) Will you briefly state what UNOCAL seeks in this case.

A. We are seeking for an area that we call the Rincon Unit, or the application area. We are seeking approval under Section 107 of the Natural Gas Policy Act of 1978 and a portion of the Dakota formation, which is a part of the Basin Dakota Pool in the San Juan Basin, New Mexico, also in Rio Arriba County, be designated as a tight gas formation.

We would like to show through our exhibits and testimony today that we will meet the key criteria for this designation inasmuch as we'll show that the average in situ permeability is less than 0.1 millidarcies.

We'll also show that the pre-stimulation gas rates are less than 290 Mcf per day registered against an average production depth at 7,347 feet.

We will also show that a pre-stimulation oil production is less than five barrels a day. And we will document that we can protect all freshwater aquifer systems.

Q. Have you prepared exhibits for

presentation here today?

A. Yes, I have.

Q. Have UNOCAL's exhibits previously been submitted to the Oil Conservation Division and to the Bureau of Land Management with a statement of the meaning and purpose of each as required by the rules of each of these agencies?

A. We have.

Q. Would you, please, refer to what has been marked as Exhibit 1-A, the location plat, and working with this exhibit and perhaps Exhibit 1-B review the area involved in this application.

A. Certainly. Exhibit 1-A is our location map showing the Four Corners area but most of it being in New Mexico. You can note the common state boundaries of Utah, Arizona, Colorado, and New Mexico. Also shown are cultural details, such as the towns of Shiprock, Farmington, Albuquerque, and so forth.

The stipple pattern that is around more or less the margin of this illustration represents the outcrop, or the surface expression, of the Dakota formation, which is what we are applying -- or our application is

leaning toward.

As you can see, the Dakota formation is continuous around the San Juan structural basin and therefore is continuous throughout the subsurface extent. Also shown is a contour line drawn on a mappable horizon, called the Greenhorn formation, which is immediately above the Dakota interval.

And finally shown near the center of the illustration is the Rincon Unit, or the application area. These two are synonymous terms in our testimony today. Also shown are typical county lines. Our property is in Rio Arriba County.

Q. Let's go now to Exhibit 1-B.

A. Exhibit 1-B is somewhat of an enlargement. Again, the Rincon Unit is shown in the right central part of the illustration. Typical township and range designation shown along the margin. Also, the curved line is a structural contour line I referred to in Exhibit 1-A.

The large stippled area, large areas, are other areas that have been designated as tight gas formation areas in the Dakota formation

and other units as well.

Q. Let's move now to what has been marked as Exhibit No. 2, and I'd ask you to identify that and then review it for Mr. Stogner.

A. Exhibit 2 provides a lot of the details with regard to the application area and the immediate surrounding area. This will be an illustration that will be referred to in other discussions of exhibits.

Again shown in the hachured line is the area of the application, again the Rincon Unit. I'd like to call your attention to an area in the upper left-hand corner, another stippled area, or a shaded area. This is what we refer to as the window. It is not part of the Rincon Unit, but it does include the area that we're making application for.

The dots that you see scattered all the way across the map are well locations of various types. And there's a legend down in the lower right-hand corner there that people can refer to find out which well is penetrating which unit.

The squares that you see within the central or within the boundaries of the application area are those wells penetrating the

Dakota formation and, of course, are most germane to our testimony.

The large circles that are scattered across the area are wells that were cored. These are conventional cores; they're not sidewall cores. They're conventional. These are the ones that have penetrated the Dakota producing area, or Dakota formation, and there are nine of them, six of them within the unit and three outside. And these will provide a lot of key information regarding the in situ permeability that will be expressed in the engineering testimony.

I believe that's all that's on this exhibit.

Q. The boundary of the proposed area coincides with the boundary of the Rincon Unit; is that correct?

A. That's correct.

Q. This unit contains state, federal, and fee lands?

A. Yes, it does. It is approximately 85 percent federal land, 15 -- or 84 percent federal land, 15 percent state, and 1 percent fee.

Q. Within this area what is UNOCAL's ownership interest?

A. Seventy-six percent.

Q. How long has UNOCAL operated this particular unit?

A. Since 1986.

Q. And you acquired it from who at that time, El Paso?

A. El Paso Natural Gas.

Q. I think we ought to go out of order at this point and go to Exhibits 4-A and B. If you would refer to those and, using these, discuss the general nature of the geology in the application area.

A. Okay. Well, the reason I'd like to skip ahead to this is it would be nice to get some of the geologic background out of the way before we talk about things like the structure contour map that will be in Exhibit 3.

I call your attention to Exhibit 4-A, which is our type log for the Dakota interval. This is referred to, the 130 Rincon Unit well. It's located in Section 32, Township 27 North, Range 6 West.

I'd like to point out that, first of all, that what we are calling the Dakota producing interval, which again is what we're

making application for, includes two separate stratigraphic units, the lower unit designated as the Dakota formation and the upper unit, designated as the Graneros formation. And we are lumping these two together because of similar production characteristics.

Also shown on the type log are the typical geophysical log curves. The one on the left is a wireline gamma ray log, and the one on the right is a sonic log.

One of the reasons for bringing this up early too is because internally for our own reservoir description parameters and procedures for just keeping track of things, we have subdivided both the Dakota and the Graneros into subunits, and they're so designated on the right-hand side of the diagram.

The Dakota, again which is the lower unit, has been broken down into A through F units, or subintervals. The Graneros has been broken down into an upper shale interval, which does not have any production, an A-1 and A-2 interval and a B interval and plus something we call the X-Marker, which is a volcanic and ash bed that is used as a datum horizon for

subsurface mapping. The total interval shown here is roughly 300 feet thick for the combined Dakota and Graneros.

I'd also make reference to the fact that beneath the Dakota formation is the Burro Canyon, which is a sandstone unit that is nonproductive and typically is wet. And then overlying it is the Greenhorn formation, which is the unit I made reference to in Exhibit 1-A.

We also have on the basis of these nine core holes that I mentioned previously, we were not able to get direct access to a lot of the core that El Paso drilled over the years.

What we did get access to were five wells from which there were core chips available. They had taken a chip about every foot and put them in archive and reflected these and did a detailed description of them.

We also have additional information from scout tickets, service companies, and so forth.

What I've tried to illustrate in Exhibit 4-B is the combined geologic descriptive data for the Dakota producing interval based on the core chips, the scout tickets, and also log

interpretation.

I looked at approximately 168 logs in some detail to amplify our observations made from the core chips.

Again, the stratigraphic nomenclature of Dakota and Graneros is shown in the various subintervals I mentioned earlier along with the typical wireline logs.

The column labeled "Lithology" is the representation of the typical rock types found in the Dakota producing interval. It's a combination of sandstones and shales. These are cretaceous in age, approximately 92 million years old.

The depositional environment for these, there's a combination of marine and non-marine. The Graneros was deposited in an entirely marine setting and is composed of fine to very fine grain sandstones that have a fair amount of mud in them bioturbated by marine organisms. And, of course, the shales are also marine.

The upper part of the Dakota formation, what we call the A interval, is also a marine and has typical characteristics similar to that of the Graneros.

However, if we go down lower in the Dakota, what we're labeling B, C, D, E, and F, we have non-marine and sandstones and shales. The sandstones were deposited primarily by flowing water fluvial systems. And the shales are relayed over-bank deposits. And we do have some coal, very thin coals and carbonaceous shales.

Also, we have quite a lot of verbiage here reflecting the description of each one of these units. And basically we're talking about interbedded sandstones and shales. And anyone that would care to read that is more than welcome.

And again summarizing, on the far right I have the depositional environments that I've already alluded to, plus a brief statement of what reservoir quality is. This is a very qualitative -- well, qualitative and sub-quantitative estimate of what the general characteristics of these various units are.

Of course, we'll document these a lot more elaborately when we get to the engineering data. So briefly that's was was in that exhibit.

Q. Let's go back to Exhibit No. 3 now, the structure map on top of the Dakota, and I'd ask

you to review that.

A. Okay. Exhibit 3, first of all, the datum horizon that we were using for this mapping exercise is the top of the Dakota. And that again is one of the reasons I wanted to discuss Exhibits 4-A and 4-B first. As you can see from the contour lines which represent sub-sea depths, there are no major structural features.

Basically we're going from the high area in the southwest corner to a structurally deeper part of the basin to the northeast as reflected by the contour lines. They range from about minus 550 feet to minus 1,000 feet, so thus we have 450 feet of structural relief across the unit, which equates to an average structural grading of 66 feet to the mile.

I'd also make reference -- I should have pointed this out earlier -- there's a green dot on this map. And also on Exhibit 2 this is the location of the type log, which is Exhibit 4-A that I just mentioned.

Also shown on this illustration, the red dot or what's red on my illustration, the dots with the gas symbols on them are all our control points. Again, there are 50 or 60 within

the Rincon Unit and numerous other control points outside it.

MR. STOVALL: Let me interrupt you for a minute here. Looking at the exhibits we have up here, there are no green dots or red dots.

THE WITNESS: I'm sorry. What should be the green dot would be the symbol that's a hexagon.

EXAMINER STOGNER: That's in Section 32 of 27 North, 6 West?

THE WITNESS: That's correct.

EXAMINER STOGNER: Okay.

THE WITNESS: Yes, Section 32.

EXAMINER STOGNER: Where are the red dots at?

THE WITNESS: They are all the rest of them.

EXAMINER STOGNER: Okay. So anything that's a gas symbol --

THE WITNESS: Right.

MR. STOVALL: -- it's red. You just can't see it.

Q. (BY MR. CARR) From this can you tell the depth at the top of the Dakota?

A. Yes. The average -- the range, of

course, with all this subsurface control we have, the range to the top of the Dakota -- again these are expressed on the map in sub-sea values -- but the actual depth according to the drilling data, ranges from 7,008 feet to 7,586 feet. And the average depth of all of the data points within the Rincon Unit is 4,347 feet.

Q. What's the average number?

A. I'm sorry, 7,347 feet.

Q. At this depth what is the permitted pre-stimulation flow rate?

A. 290 Mcf per day.

Q. Let's move now to Exhibit No. 5, the tabular listing and the stratigraphic data. Would you review that, please.

A. Okay. This is behind the tabs for 5-A, Exhibits 5-A and 5-B. Exhibit 5-A is the tabular listing of a number of wells from the Rincon Unit. And the second page are for some wells that are immediately outside the Rincon boundary.

What's listed across the top, the headers of this table KB is the Kelly Bushing in elevation and feet. Listed as "Tops," we have two of these. One that says "Kg" should be the

top of the Graneros formation. "Kd" is the top of the Dakota. We use this data to calculate the gross thickness values for both of these two units.

If you'll scan to the bottom of the page of this first part of Exhibit 5-A, you'll see that the total range or the average thickness value for the Dakota producing interval is 265 feet based on these wells from the unit.

Then again on the second page, the headers across the top are the same. We have not listed the average values on these because these are outside of the unit.

Q. Let's move now to the Exhibit 5-B, the net sand isopach map.

A. Okay. The net sand isopach map was done almost entirely on using the existing wireline geophysical log database, but also using the core data that we had to help constrain ourselves and to calibrate our observations.

Basically what we did is using the gamma ray values, or the SP, we would identify intervals where clean sand is present. And we would sum the thickness of these clean sand intervals.

But we also made use of other types of logs that would be present, most commonly the sonic logs or resistivity logs. So we just didn't want to calculate our net sand thicknesses based solely on clean sand value, but also try to get an estimate of porosity based on one of these other log parameters, again resistivity or porosity logs, such as neutron or sonic.

Each well has to be treated as an individual case because each log oftentimes was drilled at different times using different contractors.

So to review any existing data point would require us to go and talk about each log. But we used a standard procedure for calculating that sand thickness, and that's what's represented on Exhibit 5-B.

We've taken those intervals that appear to be the most conducive to being a reservoir and we have contoured the thickness values on these. That's what the contour lines are, again showing the outline of the unit and the well control.

Basically what we found is that the net thicknesses range from approximately 60 feet, I believe, up to -- let me check my number here --

60 to 110 feet, and the average value was 80 feet. So we consider the average net thickness of the Dakota producing interval at about 80 feet.

Q. Is there any general trend to these thicknesses?

A. In a way there is. As you can see from the contour lines, there is a thickening fairly thin on the southwest corner, a thickening toward the middle and then thinning a little bit off to the northeast. But it tends to thicken to the northeast from the southwest.

Q. I'd like you now to go to your stratigraphic cross-sections. We've put them again, Mr. Stogner, on the wall and I'd ask Dr. Cole to go to the exhibit and first tell the general orientation of the cross-section and then review it.

A. Okay. First of all, I'll point out the maps that are on both cross-sections. This is the same. These lines of cross-sections for cross-section A-A prime, which is southwest to northeast, and B-B prime, which is primarily north to south, are shown on these insert maps and are also shown on Exhibit 2.

Q. Exhibit 6-A now is A-A prime, 6-B, B-B prime?

A. That's correct.

Q. All right.

A. Also on here we have the Dakota interval shown. In this case everyone can see the colors, and it's orange. Again we have the two formations that make up the producing interval Dakota and Graneros. And this green line going across on both diagrams is that boundary between these two stratigraphic units.

MR. STOVALL: Again, I'm going to have to ask that you not refer to colors since we don't have them on our exhibits.

THE WITNESS: Okay. Well, the line that separates the Dakota and Graneros is pretty much equi-distance between the top and the bottom of each of these logs and also refers to the header information on the right-hand side.

Also shown here on each cross-section, A-A prime and B-B prime, are the names of the wells, their location, section, township and range, Kelly Bushing, total depth.

And then information at the bottom includes things like completion dates, the

intervals that were perforated. And in the cases of these cross-sections, we've tried to include wells that also have the core control.

I might refer to Exhibit 6-A. You can see Rincon Unit 127, which is one of our cored wells. We have the cored intervals listed there. Another cored interval or cored well is Rincon No. 1, also on cross-section A-A prime.

And we have other -- I should also point out that we do have a cross-correlation well, which is typical for these types of exhibits. Rincon No. 1 is the tie well between both cross-sections A-A prime and B-B prime.

The most important thing that comes out from these cross-sections is the lateral continuity of the various units and subunits within the Dakota producing interval.

We've also designated the various subunits within the Graneros and the Dakota, and you can see from the darker lines going across both cross-sections that the individual intervals correlate quite well.

This has not been a problem for us in any of the correlation work. Also within each of these intervals, the sand -- there are sandstones

present in each one, and so we can also correlate those, although those individual correlation lines are not shown on this diagram.

I should make one final reference, the datum for both cross-sections is the -- this volcanic ash bed, which we referred to earlier as the X-Marker, which is in the lower Graneros formation.

Q. Dr. Cole, what conclusions have you reached from your geological study about the area that is the subject of this application?

A. Fundamentally the reservoir interval is composed of alternating sandstones and shales. Sandstones are very fine to fine grain and are either marine or non-marine and also the mud rocks that are associated with them have similar characteristics.

We've documented that the gross average thickness within the Rincon Unit for the producing interval is 265 feet. And the net thickness based on log determinations is 80 feet. And the average depth below the surface to the top of the Dakota producing interval is 7,347 feet. So that's the basic summary of the geologic data.

Q. Were Exhibits 1 through 6 and all the subparts of those exhibits, were they prepared by you or have you reviewed them, and can you testify to their accuracy?

A. That is correct.

MR. CARR: At this time, Mr. Stogner, we would move the admission of UNOCAL Exhibits 1 through 6 and all subparts thereof.

MR. STOGNER: Exhibits 1 through 6 will be admitted into evidence at this time.

MR. CARR: That concludes my direct examination of Dr. Cole.

EXAMINER STOGNER: Thank you, Mr. Carr.

Ms. Smith, your witness.

MS. SMITH: Thank you. No questions.

EXAMINATION

BY EXAMINER STOGNER:

Q. Dr. Cole, in referring to Exhibit No. 1-B, are you familiar with the other type formation areas in the San Juan Basin?

A. Yes, but maybe not as well as I should be.

Q. Do you know if the full vertical extent of those zones applicable to those areas include

the Graneros?

A. Well, the part that's been designated as Dakota, because of the typical nomenclature that's used in the basin, I have not reviewed those specific applications or cases. But just from my experience of looking at a lot of information, most geologists would include the Graneros as part of the Dakota.

Q. Do you know if that is the -- or what the vertical extent of the Basin Dakota Pool is? It sounds like you have some knowledge of that.

A. Well, within our application area, again the total interval is -- it has a range, but it's right around 285 feet thick.

I should also point out that there is, depending on individual operators, there is a lot of difference between subunits and subdesignations; that each operator has their own working nomenclature, which is certainly reflected in our exhibits.

Q. In preparing your exhibits today, I assume that there are perforated intervals that take in the Graneros formation and the Dakota formation as you indicate on your cross-sections and your information today; is that correct?

A. That is correct.

Q. And they are designated as far as production data and such as that that you know as Basin Dakota Pool?

A. That is correct.

EXAMINER STOGNER: Ms. Clancy, do you have any questions of this witness?

MS. CLANCY: No questions.

EXAMINER STOGNER: I have no further questions of Dr. Cole. You may be excused.

MR. CARR: At this time we would call Mr. Irwin.

WILLIAM L. IRWIN

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

EXAMINATION

BY MR. CARR:

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

A. William L. Irwin.

Q. And where do you reside?

A. Farmington, New Mexico.

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

A. I'm employed by the Union Oil Company

of California, UNOCAL, as the District Petroleum Engineer.

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

A. No.

Q. Could you previously summarize your educational background and then review your work experience.

A. I graduated from university with a bachelor of science degree in petroleum engineering in December 1983 from Montana College of Mineral Science & Technology. I worked four years with Quintana Petroleum Corporation in Texas, Colorado, Wyoming, and Canada in various positions in drilling, production, and reservoir engineering.

And more recently I worked for the last four years with UNOCAL at three years in Canada and transferred this year to Farmington. The last two years with UNOCAL I have been Senior Reservoir Engineer.

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

A. Yes, I am.

Q. Have you made an engineering study of

the wells in this area?

A. Yes, I have.

MR. CARR: We tender Mr. Irwin as an expert witness in petroleum engineering.

EXAMINER STOGNER: Are there any objections or questions of Mr. Irwin?

Mr. Irwin is so qualified.

Q. (BY MR. CARR) You have prepared exhibits for presentation here today?

A. Yes.

Q. Would you refer to what has been marked as UNOCAL Exhibit No. 7, the permeability map, and review that for the Examiner.

A. Exhibit 7 illustrates -- is what we call a permeability data map -- illustrates the Rincon Unit application area, the various different procedures used to calculate in situ permeability.

There's three methods illustrated here and the wells in which we derive permeability. There's core data on nine wells, as Dr. Cole had illustrated.

Q. That's indicated by a circle on this plat?

A. They are circled on Exhibit 7, six of

them within the unit and three outside the unit. There are eight wells indicated by the triangles in which we did performance analysis to determine permeability, and there are two other wells we did indicated by a square that we've done pressure buildup analysis on.

Q. Does this data confirm that the average in situ permeability for the Dakota producing interval involved in the area that is the subject of this application is less than .1 millidarcies?

A. Yes, it does.

Q. Let's go now to that data and review it. If you would go first to Exhibits 8 and 9, the original core data, and review that for the Examiner.

A. Exhibit 8 is the original core data, copied here from the core lab or the -- whatever contractor the data was generated by. It's for nine wells, six within the unit, three outside of the unit. These are illustrated as I mentioned, on Exhibit 7 and on Exhibit 2 as well.

Exhibit 9 is the same data put into a tabular form and correlated with the stratigraphic units assigned by Dr. Cole. In addition, the major difference between Exhibit 8

and Exhibit 9 is any permeability data that the contractor showed of zero permeability or less than zero permeability -- no. Excuse me.

Any permeability data that is listed as less than .01 millidarcies we included as .01 as a conservative assumption on our part.

Q. This correction would actually tend to result in a higher permeability?

A. That's correct. There are 792 values, each representing a one-foot cored section.

Q. Let's move now to Exhibit No. 10. Would you identify that and then review each of the subparts for Mr. Stogner.

A. Exhibits 10 -- Exhibit 10 includes Exhibit 10-A, B, C, and D, which takes the previous two exhibits, 8 and 9, and summarizes the data in gross and net intervals in exhibits 10-A and 10-C and by stratigraphic unit shown in Exhibits 10-B and 10-D for all the wells combined.

From there permeability measurement is listed. And going -- as you can see and we'll demonstrate further, it is very low for all the wells on any basis, gross or not.

Q. Is corrected permeability data shown on

Exhibits B and D?

A. Yes, it is.

Q. Could you explain how it was that you adjusted laboratory data to in situ figures.

A. Okay. I'd like to refer to Exhibit 10-D to explain the corrected permeability. Permeability column in Exhibit 10-D is the mean permeability, which is the second column in Exhibit 10-D.

The corrected -- the permeability listed is that conducted at ambient temperatures in laboratory conditions, which is not reflective of the in situ permeability. So to correct that, to account for overburden pressure and water saturations, we used an industry-accepted methodology known as the Jones & Owen's method. The paper referencing that method is in the appendix.

This accounts for the overburden water saturation and the Klinkenberg effect in measuring permeability. So we took the published correlation and adjusted it slightly because we found it did too great a correction. In other words, it lowered the permeability too much. So we backed off on that, and we calibrated it

against our pressure buildup analysis, which I'll get into later.

In either case, the range of permeability that we -- using this methodology on a gross basis was .0506 millidarcies, and on a net basis, as you can see illustrated in Exhibit 10-D for corrected perm, was .0303 millidarcies, all less than the .1 millidarcy cutoff.

Q. What conclusions can you reach about the formation in this subject area from this core information?

A. That it is less than .1 millidarcies and that the permeability is randomly distributed and with no significant natural fracturing.

Q. As part of your study, did you review well performance in the area?

A. Yes. It's the second methodology that we utilized to look at permeability. It's illustrated -- the wells we examined are illustrated on Exhibit 7. There were eight wells, and the average permeability that we determined for all eight was .0435 millidarcies, which agreed very well with the core data.

Q. How did you do this? Did you use Darcy's law?

A. We used a modified Darcy's law calculation. That's illustrated in the text. I would just leave it at that.

Q. Did you review the input factors that you utilized in making this calculation?

A. Yes. There's a number of input parameters. Net pay we derived from logs, of course, and it corresponds directly to Exhibit 5-B, the net pay map.

Reservoir pressure and bottomhole flowing pressure, this was derived from the annual-biannual deliverability tests and buildup tests that we've done over the years.

And flow rates also from the annual-biannual deliverability tests, as well fracture half-lengths, which we determined based on the size and the success of the fractures. We utilized a fracture model to determine those fracture half-lengths.

And yes, based on -- that's the basis for the Darcy's law, the input parameters.

Q. Now, Exhibit 11 in the exhibit book, is that a productivity report?

A. Yes. That's a report by the regulations. It shows the well locations and the

start-up productivity.

Q. Mr. Irwin, let's go to the pressure buildup analysis in this exhibit. I direct you to Exhibit No. 12, and I'd ask you to review these results with Mr. Stogner.

A. Exhibit 12-A through D illustrates buildup analysis conducted on two wells. They were seven-day buildups, Rincon 184 and Rincon 137.

And as you can see, the average drainage area -- for the average drainage area of permeability, they calculated to .043 millidarcies and .046 millidarcies using a finite-conductivity-fracture-type-curve analysis method.

This matched very well with the datum, with the core data and the performance analysis data.

Q. How much pre-stimulation flow data was available to you?

A. This pre-stimulation flow data was very limited, and this is due to the fact that tests were not generally conducted prior to stimulation as it was well-known that there was relatively little information that you could gain prior to

stimulation during the drilling of these wells.

Q. Let's go to Exhibit No. 13. I'd ask you to review that. That is the flow data map?

A. This is the limited data as illustrated. The hexagons, I guess they are, are drill stem tests that were conducted on the first wells drilled, Rincon No. 1 and the Rincon 57. And both of them illustrate flow measurements of less than 290 Mcf per day limit.

As well, there are five other wells that flow gauges that were conducted while drilling with gas, which was the early industry practice in the area. Three of them are too small to measure and two of them are very small flow rates.

Q. Now, are all of these wells indicated on the exhibits?

MR. CARR: Are they on your exhibits, Mr. Stogner?

MR. STOVALL: Yes. The only problem we have is there are no colors on them.

Q. (BY MR. CARR) All right. What is the maximum stablized production rate against atmospheric pressure allowed for wells in the subject area?

A. Two hundred and ninety.

Q. And did any wells produce at a rate in excess of this number?

A. No.

Q. Have you estimated the flow rate from the application area?

A. Yes. Based on typical average parameters that we discussed earlier, 80 feet pay, a typical average fracture half-length, et cetera, we determined that the estimated flow rate should be about 130 Mcf per day, which is what you'd expect with no -- with a zero skin.

Q. What sort of an oil rate are you experiencing in this area?

A. Based on that average flow rate, we would expect an oil rate of approximately 2.1 barrels of flow per day. This is based on the highest condensate or oil ratio that we've seen, which is about 16.5 barrels per million. So 2.1 barrels per day is what we would expect, which is less than 5.

Q. Are you familiar with the existing state and federal regulations concerning the protection of freshwater aquifers?

A. Yes.

Q. Are there freshwater aquifers in this area?

A. Yes. The Ojo Alamo is estimated at about 2500 feet depth in the area.

Q. And that results in about how much vertical depth between this water zone and the subject formation?

A. Above 4500 feet.

Q. Do these freshwater zones in your opinion exist throughout the area?

A. Yes, they're laterally continuous.

Q. Does the drilling and casing program utilized in the area ensure that freshwaters will be protected?

A. Yes, it does.

Q. Do you use -- do you have cathodic protection wells in the area to provide protection to the well?

A. We do.

Q. How are wells in this formation typically stimulated?

A. There's two methods depending on whether they isolate the Graneros and the Dakota. In the past if they were isolated in stimulating independently, approximately 40,000

pounds of 20-40 sand would be used in a hydraulic fracture.

Or if they were stimulated together as one interval, there would be approximately 75,000 pounds of 20-40 sand utilized in a gelled water hydraulic frac.

Q. Do either of these methods pose any threat to freshwater supplies in the area?

A. No, there would be no expectation to frac up to the well.

Q. This area has been approved for infill drilling, has it not?

A. Yes.

Q. By Order No. 1670-V?

A. That's correct.

Q. Have any infill wells been in fact drilled in the area?

A. One infill well has been drilled recently. That would be the 192-E drilled by UNOCAL this year. And this is discussed in the addendum to the text, page 10.

Q. And what was the purpose of this well?

A. It was to test essentially the economics of drilling within -- infill drilling within the Rincon Unit.

Q. Have you provided economic models in this packet of exhibits?

A. Yes. Attached are Exhibits 14-A and 14-B -- are economic models that indicate it is marginal rates of return without tax credits. In 14-A it's illustrated. And 14-B we've included tax credits that indicate a rate of return that may be sufficient for further infill development.

Q. In your opinion will there be further infill drilling in the area if it is not designated a tight formation and that the tax incentive is therefore not available?

A. It would be fair to say that UNOCAL would not pursue further infill drilling if a tax incentive was not available.

Q. You've already covered these points. But just by way of summary, based on your engineering study of the area, is the in situ permeability in the area which is governed by this application less than .1 millidarcies?

A. Yes.

Q. Is the stabilized production rate and atmospheric pressure calculated against atmospheric pressure from the wells completed in this formation and in the subject area less than

290 Mcf per day?

A. Yes, it is.

Q. Would you expect any well in the area to produce in excess of five barrels of crude oil per day?

A. No.

Q. And will freshwater be protected if further drilling is permitted?

A. Yes.

Q. In your opinion does the data available to you and which you've reviewed as an engineer suggest to you that this area fully qualifies for a tight gas sand designation under Section 107 of the Natural Gas Policy Act?

A. Yes.

Q. Could you identify what has been marked as Exhibit 15?

A. Exhibit 15 is a copy of the letter to Meridian, the only other operator in the application area, providing notice for the hearing.

Q. And then Exhibit No. 16, would you identify that?

A. Yes. Exhibit 16 is an affidavit of publication showing the notice of application

that has been provided pursuant to the BLM requirements.

Q. Were Exhibits 7 through 16 and all their subparts either prepared by you or compiled at your direction?

A. Yes, they were.

Q. Can you testify as to the accuracy of these exhibits?

A. Yes.

Q. In your opinion will granting this application result in the production of hydrocarbons that otherwise will not be produced?

A. Yes.

Q. And will approval of this application be in the best interests of conservation, the prevention of waste, and the protection of correlative rights?

A. Yes.

MR. CARR: At this time, Mr. Stogner, we move the admission of UNOCAL Exhibits 7 through 16.

EXAMINER STOGNER: Are there any objections?

Exhibits 7 through 16 will be -- did you say 15 or 16?

MR. CARR: 16.

EXAMINER STOGNER: -- will be admitted into evidence at this time.

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

EXAMINER STOGNER: Thank you, Mr. Carr.

Ms. Smith, your witness.

MS. SMITH: Thank you. No questions.

EXAMINATION

BY EXAMINER STOGNER:

Q. Ms. Irwin -- I'm sorry, Mr. Irwin. It's been a long day. Are you familiar with the history of the Basin Dakota Pool and its development?

A. I've done some reading, and I'm trying to get more familiar with it, yes, sir.

Q. Could you give me a brief synopsis on your understanding of the history of the beginning development back in the 50s through the 60s and the results of the infill order and how it's being developed today?

A. Within the Rincon Unit I can only speak of. The first well was drilled in 1952, subsequent development on 320. I think

originally it was 160-acre spacing. El Paso drilled on 320 acres. And the majority of the drilling was done in the 1950s and 60s on a 320-acre basis.

In 19 -- I think in the 1970s there was probably seven wells drilled. And in late -- the late 70s, about 1979, the order referred to, 1670-V, changed the spacing to 160 acres. Subsequent to that only one well was drilled in 1982 until the well we drilled in 1991. And we, of course, took over operatorship in 1986.

Q. But your understanding is that the Basin Dakota Pool within the Rincon Unit is governed by the pool rules, whatever are presently or were applicable at the time, to the Basin Dakota Pool; is that correct?

A. That's correct.

EXAMINER STOGNER: I'll take administrative notice of Order R-1670.

MR. CARR: I have a copy of it if you would like to include that in the record. We could mark that as Exhibit 17.

EXAMINER STOGNER: Okay. We can do that.

Also take -- there's been some other

past orders, and I cannot remember them at this point, but I do have them back in my office and I'll take administrative notice on any applicable Basin Dakota rule, whether they be statewide rules applicable at the time or subsequently changed and even the pool now as developed under R-8170.

But I'll take administrative notice of any applicable orders and through the historic progression of this particular pool and its development.

MR. CARR: At this time, Mr. Stogner, I would move that Exhibit 17, UNOCAL's Exhibit 17, which is a copy of Order 1670-V, be included in the record in this case.

EXAMINER STOGNER: Exhibit No. 17 will be admitted into evidence at this time.

Q. (BY MR. STOGNER) In looking at your Exhibit No. 7, you show some K values in those little boxes?

A. That's correct.

Q. Now, in your averaging, you averaged these in several different ways, didn't you? Being the core analysis, you took that as one particular data?

A. Yes, sir.
Q. And that showed to be the .0303?
A. That's correct.
Q. And that was in Exhibit 10?
A. Yes. Exhibit 10-A through D averages these, all the values, in several different ways.
Q. Okay. Now, you took whatever core analysis you had available to you; is that correct?
A. We did on a gross basis and a net basis, and this is all the core available within the wells illustrated.
Q. Okay. Now, your performance analysis is where you utilized the eight wells?
A. That's correct. Yes.
Q. And you had to utilize the perforated intervals for that particular data, didn't you?
A. No. For performance analysis?
Q. Yes.
A. No, because we didn't use perforated intervals. We used the net pay interval off of logs or as illustrated, which equates as illustrated in Exhibit 5-B, the net pay map. That's the values we utilized to calculate -- in the performance analysis to calculate

permeability.

And the reason for that, rather than using the perforated interval, is because we massive hydraulic-fractured all of these wells. Your boundaries in your hydraulic fracture in a vertical sense would be -- would be and should be the net pay interval regardless of your perforated interval.

And that's been proven through not information that I have, but general industry standards methodologies that your fractures will propagate to the boundary extents of the net intervals.

Q. Maybe we should go over the stimulation procedures that have been followed in the development of the Rincon Unit, this being originally developed in the early 50s; right?

A. Yes.

Q. How were those wells that were drilled in that era, how were they stimulated, perforated, open-hole completed, and did they change those wells that were drilled in the 60s and then finally the wells that were drilled just within the last few years?

A. Well, if they were originally completed

with some older technology, they were re-frac'd because I have a list -- I can submit it as an exhibit if you request -- of all the fracture stimulations of all the wells in the Dakota, the 60 wells.

And all of them have been hydraulically fractured with, as I gave you average values, 40,000 or 75,000 pounds. But every well has been hydraulically fractured.

EXAMINER STOGNER: Let's submit that as an exhibit, Mr. Carr.

MR. CARR: Okay. We will mark that as Exhibit 18.

THE WITNESS: It's my only copy. Can I send this?

MR. CARR: We'll get a copy.

EXAMINER STOGNER: We'll go off the record at this point while you're digging that out and Mr. Stovall is fixing to leave.

(A discussion was held off the record.)

EXAMINER STOGNER: Let's go back on the record, Mr. Irwin.

THE WITNESS: Yes, sir.

Q. (BY EXAMINER STOGNER) Prior to the formation of the Basin Dakota Pool, do you know

what pool this production was put into back in the 50s?

A. No, sir.

EXAMINER STOGNER: Okay. Regardless, there is an infill order applicable in this particular area at this time.

Mr. Kent, I'll pass the witness to you.

MR. KENT: Okay. I just have a couple of questions just for clarification here.

EXAMINATION

BY MR. KENT:

Q. In Exhibit 9 on those cores, they're just -- some of them are listed as Graneros and Dakota and then a few there's only Graneros and only Dakota. Now, all these wells that are in the unit are actually completed in both formations, but they're reported as Dakota production; is that right?

A. That's correct. Graneros is considered part of the Dakota producing interval.

Q. So then I'm still a little bit -- I don't think I really heard the answer on the net pay. The net pay that you used in your calculations was the sum of both of those

intervals, whatever the net pay was in both?

A. That's correct. The entirety of it.

MR. KENT: Okay. That's it for now.

EXAMINER STOGNER: Ms. Clancy, do you have any questions?

MS. CLANCY: No questions.

EXAMINER STOGNER: Does anybody else have any questions of this witness?

If not, he may be excused.

MR. CARR: At this time I would move the admission of UNOCAL Exhibit 18 if I did not before.

EXAMINER STOGNER: Exhibit 18 being the --

MR. CARR: That was the summary of stimulation?

THE WITNESS: Yes.

EXAMINER STOGNER: Have you provided a copy of the subsequent exhibits, 16, 17, and 18, to the BLM, or will you do that?

MR. CARR: I have not provided 17. I'll send a copy to Mr. Buckingham or to --

MS. CLANCY: Just Buck will be fine.

MR. CARR: -- whoever. To all of you.

EXAMINER STOGNER: Mr. Irwin is

dismissed.

I believe Mr. Buckingham has a statement at this point in time.

MR. BUCKINGHAM: Yes. Since this area involves infill drilling, I'd like to just put in for a matter of record what FERC's feeling on infill drilling is at this stage of the game.

The FERC issued a notice of proposed rule making on March 20, 1991. The subject was qualifying certain tight formation gas for tax credit.

Within that proposed rule making, a portion of which I quote, "was previously authorized to be developed by infill drilling if in the jurisdictional agency's judgment the formation cannot be developed without the tax credit for incentive price or the incentive price for wells spud before May 13, 1990."

I talked to FERC on December 6, 1991, after our informal meeting here with the representatives from the OCD and UNOCAL regarding economic data because this is an infill drilling area.

The reply I got from FERC was that if we were -- if you go in and use economic data

alone for any way to support your case, it will result in an automatic tolling letter from the FERC because even though we realize it, you realize it, the industry realizes it, everybody realizes it, that the tax credit is what is driving this rush to get wells drilled, but the regulation still says price incentive.

There is no price incentive, but until that regulation is changed, the FERC is bound by that regulation. They must follow that regulation to the letter.

So as a result, when we go in with the recommendation and designation of this area, I will state -- the BLM will state in there that the only reason this economic data is there is just for general information. The application, if we decide to designate it, will stand on its own merits based on permeability, crude oil production, and production according to the table listed in the FERC guidelines.

I asked -- I keep asking FERC. I've been following this since March 20, 1991. They are not in a hurry to issue a rule. I'm afraid they're waiting for a test case. Since I know they will read this transcript, this might be a

test case. But I just want to make that very clear that we cannot use economic data to prove our case.

As far as infill drilling, I also asked FERC about -- we are talking about an area here. Since the boundaries are a federal unit and there is no substantial infill drilling, all we're looking at is a federal unit. So that should stand by itself. That's all I have to say.

EXAMINER STOGNER: Thank you, Mr. Buckingham.

Does anybody else have anything further in this case?

Mr. Carr, I'm going to ask you to provide me a rough draft -- I'm sorry -- provide me and Mr. Buckingham with a rough draft order.

MR. CARR: Okay.

EXAMINER STOGNER: If there's nothing further in Case 10420, I'll take it under advisement.

(The proceedings were concluded.)

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 10420, heard by me on 20 December 1991.

, Examiner
Oil Conservation Division

CERTIFICATE OF REPORTER

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

I, Debbie Vestal, Certified Shorthand Reporter and Notary Public, HEREBY CERTIFY that the foregoing transcript of proceedings before the Oil Conservation Division was reported by me; that I caused my notes to be transcribed under my personal supervision; and that the foregoing is a true and accurate record of the proceedings.

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

WITNESS MY HAND AND SEAL DECEMBER 23, 1991.

Debbie Vestal

DEBBIE VESTAL, RPR
NEW MEXICO CSR NO. 3