CASE 6997: BENSON-MONTIN-GREER DRILLING CORPORATION FOR AMENDMENT OF POOL RULES, RIO ARRIBA COUNTY, NEW MEXICO

Case No.

6997

Application

Transcripts

Small Exhibits

ETC

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION
STATE LAND OFFICE BLDG.
SANTA FE, NEW MEXICO
6 August 1980

EXAMINER HEARING

IN THE MATTER OF:

Application of Benson-Montin-Greer Drilling Corporation for amendment of pool rules, Rio Arriba County, New Mexico.

CASE 6997

BEFORE: Daniel S. Nutter
(On 7 August 1980)

TRANSCRIPT OF HEARING

A P P E A R A N C E S

For the Oil Conservation Division: Ernest L. Padilla, Esq.
Legal Counsel to the Division
State Land Office Bldg.
Santa Fe, New Mexico 87501

For the Applicant: George L. Verity, Esq.
BAY, HAMILTON, LEES, SPEARS & VERITY
501 Northwest Thirteenth
Oklahoma City, Oklahoma

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

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

MR. NUTTER: We'll call Case Number 6997, which is the application of Benson-Montin-Greer Drilling Corporation for amendment of pool rules, Rio Arriba County, New Mexico.

Call for appearances.

MR. VERITY: Mr. George L. Verity, and Tom Kellahin for the applicant.

MR. NUTTER: Are there other appearances in Case 6997?

Mr. Verity, would you proceed?

MR. VERITY: Yes, Your Honor. I think that a brief opening statement might be helpful and I would like to make a few remarks and comments in this regard.

In the first place, I'd like to say that after several years it is a pleasure to be back in New Mexico generally and before this Commission in particular. I spent several very pleasureable years out here and a lot of my fond memories are of this Commission.

Today I'm back again on Puerto Chiquito. Puerto Chiquito first came before this Commission prior to 1963 when the -- when Benson-Montin-Greer requested the Commission to approve the Canada Ojitos Unit.

Then in 1963, after a well was drilled, and possibly two, they came before the Commission and we requested 160-acre temporary spacing. At that time both East

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

and West Puerto Chiquito were thought to be one pool. Shortly after that, or a few years after that, it was realized that there was a barrier between East and West Puerto Chiquito, and it was -- an order was entered to establish it as two pools.

In -- after 1963, when five wells had been drilled in a cluster with approximately -- yes, approximately two miles distance between two of them, Benson-Montin-Greer had the courage and it takes quite a bit, to interrupt all of the production from all five of those wells for a period of sixty days so that they could conduct one of the most remarkable interference tests that I've had the privilege of having anything to do with or having heard of in many years of oil and gas practice in Texas, New Mexico, and Oklahoma.

This interference test was conducted in 1965 and in 1966 the results of it were presented to this Commission in Cause Number 3455, which the 1963 hearing was the same number.

At that time it was established that there was -- that the pool was definitely a Niobrara with three sections in it; that it was a low grade reservoir; that there was wide drainage; that everyone of these five wells were affected by anything that happened in any one of them; and 320-acre temporary spacing was requested.

B-M-G expressed complete opinions with

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

regard to the pool and how it should be developed at that time and today, after seventeen years of history of the West Puerto Chiquito - Mancos Oil Pool, all of the theories and opinions that were expressed to the Commission back at that time have been established and are now a matter of history.

It isn't always the case in any oil field that management will permit the remarkable engineering that has been achieved in this pool. Pools like the Boulder Pool, immediately to the north, just a few miles to the north of West Puerto Chiquito, was the same type of pool, the same structure, the same relative circumstances, and as these wells do in fractured -- in a fractured zone, as we have here, they frequently come in large, that happened in the Boulder Pool just as it's happened in Puerto Chiquito, but up there they didn't fully appreciate the nature of the pool and what it was. They hurriedly got an 80-acre spacing and drilled it up on 80 acres. They didn't realize that pressure maintenance was necessary, and after a period of five years the wells were pretty well all gone, and they left a great amount of reserves in the formation that could have,with the type of engineering that has been practiced in the Canada Ojitos Unit and West Puerto Chiquito,recovered a much greater percentage of the oil in place.

Shortly thereafter the 320-acre spacing and the dramatic interference test that I referred to earlier,

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

B-M-G and the management of Canada Ojitos established a pressure maintenance by injecting gas in the upper edge of the pool. Without this pressure maintenance and controlled development of the pool on a scientific petroleum engineering basis, we would only have been able to recover approximately 5-1/2 percent of the oil in place under Puerto Chiquito; whereas, as it has been developed we expect to recover between 50 and 60 percent of the oil in the high capacity system and up to 50 percent of the oil in the low capacity system, which Mr. Greer will explain to you during his testimony.

MR. NUTTER: What's your estimate of the recoveries up there in Boulder-Mancos?

MR. VERITY: In -- up in Boulder-Mancos I don't know exactly what those recoveries were, but they had a 70 percent decline per year of their recoveries.

Our evidence will show you that even on the low capacity wells, that we have been able to maintain the initial production of those wells over a period of years so that we will show that not only the high capacity but the low capacity wells, also, drain a wide area.

We have two wells which we will be talking about along with the others, one, the well in Section 10, had produced 2-million barrels of oil and we will show that this has drained an area of approximately 6000 acres. The L-11 Well in Section 11 has produced a million barrels of oil

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

and that has drained an area far in excess of 640 acres.

The initial five well interference test enabled us to establish that the oil in place in this area was between 1500 and 2500 barrels. Then after that interference test B-M-G took one of those wells and never put it back on production and used it, and it is still being used, as an observation test well.

Then when they started injecting gas in the upper side of the pool, they were able to run additional interference tests, and by those interference tests at that juncture, they could more particularly refine their knowledge with regard to the amount of oil in place and they knew then that it was between 1600 and 2000 barrels. They think actually that it's probably towards the lower bracket of those two figures.

This brings us to the problem which is before us today, which is the zone or the area on the west edge of West Puerto Chiquito, which has not to this time been developed. It is most probably underlain by oil. We don't know yet whether that is positive or not and we don't know for sure whether it will have high capacity or just low capacity system. But it requires planning and today we think requires action of this committee.

If that area is to recover more than merely a 5-1/2 percent of the oil in place, then there is going to

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

have to be pressure maintenance over there. We are not today in a position to request pressure maintenance, which must be preceded by a unit, but it is in B-M-G's plans that a unit be formed in that area, but today, and as a preliminary step to that, we request 640-acre spacing.

If that area is developed, as Boulder was, they would have approximately 8000 barrels of recovery to an 80-acre spacing and would not be able on 320-acre spacing to obtain a profitable well. It would not be economically feasible.

So as a first step there we today request, and will prove, we feel, that we are entitled to have the spacing changed from 320 acres to 640 acres.

I am pleased that I believe all of the working interest owners in that area, at least all who have responded to the Commission, have supported 640-acre spacing. And I believe there have been four operators that have responded and supported our application.

One of them, Koch, has requested that the spacing provide for a distance of well being drilled 330 feet from any -- center of any quarter/quarter section, whereas our application just picked up the 165-foot distance that was in the previous orders.

We actually concur with Koch's position on this and think that it would be better to have 330 acres --

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

330 feet from the center of the quarter/quarter section rather than the 165 feet that is expressed in our application.

We will have one exhibit with comprehensive parts to it, and it is of its nature based on previous studies that have been presented to this Commission in the 1963, 1966, and 1969 hearings in Cause 3455. For that reason, in order to -- that we may be more brief and not have to go through all the details of our calculations which are in those records, we would like to incorporate the record of those three hearings in that cause number into this record.

MR. NUTTER: Okay, it's three hearings in Case Number --

MR. VERITY: In Case Number 3455. That was the 1963, 1966, and 1969 hearings in that cause.

MR. NUTTER: The record in Case Number 3455, the hearings held in 1963, 1966, and 1969 will be incorporated by reference in this case.

MR. VERITY: Good. With that, I'd like to call Mr. Al Greer to the stand.

(Witness sworn.)

ALBERT R. GREER

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

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

DIRECT EXAMINATION

BY MR. VERITY:

Q. Will you please state your name?

A. Albert R. Greer.

Q. Mr. Greer, what is your occupation?

A. I'm a petroleum engineer and officer for Benson-Montin-Greer Drilling Corp.

Q. You're a graduate petroleum engineer?

A. Yes, sir.

Q. You have testified before this Commission on numerous occasions as an expert petroleum engineer?

A. Yes, sir.

Q. I believe that Benson-Montin-Greer is the operator of the Canada Ojitos Unit.

A. That's correct.

Q. And you have been the engineer that has designed and carried out the program of development and production of that unit?

A. Yes, sir.

Q. Have you -- having done that, you have, of course, more than made a study, you've progressed with all the development of the unit and are intimately familiar with all of the scientific and engineering mechanics that have gone into the development of the pool?

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Rt. 1 Box 193-B
Santa Fe, New Mexico 87501
Phone (505) 455-7409

Q. Are you also familiar with the development of the Boulder Pool to the north of Puerto Chiquito?

A. Yes, sir. Of course we don't have as much information on Boulder as our own operation, but I'm familiar with what's been published.

Q. I direct your attention to what the reporter has marked as Exhibit Number One. Did you prepare this exhibit?

A. Yes, sir.

Q. Mr. Greer, I notice that it is made up in sections A through Section I, with several parts in each section.

A. Yes, sir.

Q. And will our testimony develop its way through that exhibit from A to I?

A. Yes, sir.

Q. Was this exhibit prepared by you and under your supervision?

A. Yes, sir.

Q. I notice that there is an index to the exhibit prior to Section 1. Turning on past that exhibit -- I said Section 1. I mean Section A, turning on past that to Section A, will you please address yourself to the first part of Section A, which I notice is a map, and tell us about it.

A. Yes, sir. Well, first we might should point out in regard to the index and some of the exhibits, be-

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

fore we pass on.

Q. Yes.

A. A number of the exhibits are -- are reproductions from exhibits of earlier hearings, and where that is the case, we've noted that in the index and we've identified the case number and the exhibit and as we come to those, I'll try to identify them and in order to save time I'll just refer to the '66 hearing or '69 hearing exhibit, such as that.

Under Section A the first plat is a new plat at this hearing, and it shows the East and West Puerto Chiquito Pools outlined, with the East Puerto Chiquito being on the right; the West Puerto Chiquito being on the left, and it has -- the West Puerto Chiquito is outlined in orange.

Within the West Puerto Chiquito Pool is the Canada Ojitos Unit, which is identified with a green boundary. In the north part a proposed North Canada Ojitos Unit with a purple boundary, and to the west, a proposed West Canada Ojitos Unit, and that's shown in a pink color.

Also is shown in a grey shading the exception tracts, which are irregular tracts required to meet the 640-acre spacing proration unit without -- or where we could not meet it because of the boundaries or the irregular sections themselves having less than 640 acres in them.

Q. Mr. Greer, that -- each of these units is 640 acres where it's possible to make it so, is that correct?

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Rt. 1 Box 193-B
Santa Fe, New Mexico 87501
Phone (505) 455-7409

A. Approximately. There are a couple of exceptions to that.

Q. Across the south boundary of 27 North, 1 West, there are some small ones, and the nonstandard one in Section 1, 24 North, 1 West.

A. Yes, sir.

Q. I notice, Mr. Greer, that -- that there is only one well in any one section, except for Section 11 of 25 North, 1 West. Do you have any remarks to make about that?

A. Yes, sir. Those two wells are actually about 4000 feet apart, about 4/5ths of a mile, and are actually farther apart than some wells will be where there's just one well to a section. But in a sense, the spirit of our application is that there be only one well to a section and in that because of that we will plan on just producing one of those two wells in that section. We'll leave the other one shut-in as an observation well.

So we do not need an exception for Section 11.

Q. Which well do you plan to have -- to make the unit well?

A. We would probably produce the down dip well, which would be the one to the west, the L-11.

Q. Now, then, do you plan any other units

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

in the West Puerto Chiquito?

A. Yes, sir. Before we go to that I suppose we should talk about the spacing unit in Section 1, that 320-acre tract.

Q. All right, yes, Section 1 of 24 North, 1 West. Go ahead.

A. That's the only irregular unit less than 640 acres and the reason for that is there's an injection well on that north half of Section 1, and in the south half of Section 1 there is a small window of fee land that is not committed to the unit agreement, and if we were to include that in the whole spacing unit, we'd have to force pool or something, and the owners preferred not to be worried with that kind of an action and the gascap acreage doesn't have a large equity, so there's not much at stake to the royalty interest, and they just preferred not to mess with it. So --

Q. So we ask an exception there to the 640 acres in the north half of Section 1 being it.

A. Yes, sir.

Q. Now then, turning to possibility of other units.

A. Yes, sir. We hope to form a unit in the north part of the pool, the North Canada Ojitos Unit. That's all Indian land. We've had some time. It seems to take an awful long time working with the Indians to form units. We

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

were several years in getting their approval of the East Puerto Chiquito Mancos Unit, which is also shown on this plat in the north part of the East Puerto Chiquito Pool.

And as a preliminary step to reaching unitization up there, we plan on a working interest unit initially and commingling the oil and gas and installing a gas lift system in order that we can be in shape the instant we get their approval to have the gas gathered and -- and so that we can drill an injection well and inject gas, and in a sense we would have the same kind of an operation on a smaller scale in this unit as we have in Canada Ojitos to the south. We weould not expand the Canada Ojitos Unit to the north because of the Indians have always objected to putting their land in with others, particularly where they are a minority share of the unit.

But we see no problem there in the two units meeting and both injecting gas.

Then to the west we propose the West Canada Ojitos Unit and here we have a more complicated problem in a sense, in several senses, we have a more complicated problem. The first and most logical plan to develop this acreage would be simply to expand Canada Ojitos to the west, but we have a problem there in that the Federal regulations regarding pricing of oil and windfall profits tax. Oil presently within the unit is receiving a price of about $6.25 a

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

barrel plus, depending on where the production for any one month falls with respect to its base period control level. The same oil produced just across the line would receive $39.00 a barrel. If we expand the unit and drill wells in the new area to the west, then we'd be under the same situation of $6.00 oil plus whatever increases we get being above our base grade production level.

Now the price of oil, of course, is supposed to be equalized in this phased de-regulation of oil prices by October of 1981. That could eliminate the difference in prices in that problem as of that time, but still we have a difference of a windfall profits tax being higher on the acreage -- or the lands inside the unit, the wells inside the unit, as compared to those outside, or if we formed a new unit.

MR. NUTTER: Well, Mr. Greer, is the oil over in this west side better than the oil to the east?

A. That's a good question. That's a good question. Unfortunately, the laboratory analysis, I'm sure, if the wells are drilled, will show it to be exactly the same; same character, same quality.

Just one of those unfortunate things that makes a problem in developing our oil properties.

The other difficulty is and we propose this new unit, and then that's the only reason, of course, so that we can receive a fair price for the oil, is that we can-

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

not inject gas in that area itself. I think that it will -- from what we know now, there's no rational or reasonable plan that we can devise that would let us do that. The character of the formation is such that I just don't believe it would work.

The dip of the formation is too shallow and if it has the permeability, the transmissability that I think it will have, injection wells there would result in gas just channeling within a matter of days, if not hours, to the producing wells, and it just would not work.

But we believe that we can maintain pressure in that area from the main unit to the east, and I see no problem mechanically in doing that. The problem that we have is a boundary agreement between the two units, and this, of course, will be one of the most complicated features of the development plan. But once we've -- have overcome that, and we've made some initial steps in solving that, I see it as a practical approach, and hopefully within ten years set out in the law, the windfall profits tax will phase out and at that time hopefully we could join the two units into one. The timing necessary to do it would be when we would be marketing gas from the west area. Up until that time, as long as we're gathering gas, saving it and storing it, I see no problem.

Q. Very well. I meant to say at the start,

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

and I want to say now, that I hope Your Honor will interrupt for questioning any time there's something that you don't quite understand or you would like to explore more fully, and as a matter of fact, I also would like to invite Mr. Friend, I believe it is, and Ms. Umshler, who are here from Koch and from USGS, to interrupt with questions as we proceed with this testimony, because I want everybody to understand it and I think that that would save time and be the best way to do it, Your Honor, and we invite that.

All right, Mr. Greer, now directing your attention to the second part of Section A of Exhibit One. Will you explain that exhibit to us?

A. Yes, sir. Here we'd like to go a little bit beyond, or outside the scope of engineering, perhaps, to talk a little bit about the reasons why this pool might be where it is, and some of the geological concepts as to why we find oil in these places, and as a result, then, where the probable boundaries of the pool, the reservoir, are, and then from that to draw some conclusions about the expansion of the area with additional development.

And I might say at the outset that just as all the engineering features have been interesting in this pool, one of the most interesting ones I've ever studied, so are some of the geological concepts.

The theory that I like best, the one to

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

which I subscribe, as to why this oil reservoir exists where it is, has to do with the fracturing of the formation and creating of reservoir void space by fracturing, and this is brought about by flexing of the formation.

Since our 1969 hearing one of the geologists who work for us made a study based on the fracturing characteristics of dolomite and calcite and he came up with the theory that where you have a high percent of dolomite, that the formation is more brittle, more apt to fracture than if it's calcite, and he found a high percent of dolomite in wells in this area and when we add those two things together, it makes sense to me.

Now there are some other theories, one of which we have the old "creekology" theory that, we've had some of the geologists come to us and say, well, we can trace the canyons here and where the good wells are and it's old "creekology", and of course, the answer to that is that where this pool lies in Santa Fe National Forest, a really beautiful forest, topography is rugged. Differences in elevation of 1000 or 1500 feet in just a short horizontal distance, the net result of it all being that from a standpoint of not destrying the forest, doing our best to operate here and to protect it, and also drill wells at minimum cost, we just keep them in the canyons where it's easy to get to them.

So that kind of answers the "creekology"

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

theory, but pursuing the "creekology" theory, we've had some of the geologists that subscribe to the fault theory, that here are faults and where you have faults is where the production is, and they give us an east/west fault down through some of the better wells, and of course that sounded fine until we -- until we drilled a well 3 or 4 miles north of their fault system and got another good well, and then we drilled 3 or 4 miles south and we got another one, and then they have to go back to their areal photo maps and try to find some more lines they didn't see at first.

So the end result of all of it is that the one theory or concept that seems to best fit this reservoir is the one where the formation flexes, you have fracturing, and where you have fracturing you have, over a fairly wide area, reservoir with enough porosity and permeability to give production, allow production.

And when we ran an interference test that pretty well confirmed it, in that there's just no way that we have a high concentration of oil in any one area. It has to be small volume of oil per acre over a large area.

Briefly, the flexing features that we recognize here, first I might say that the boundaries of the pool on this map, the more or less north/south orange colored line is one that separates the East and West Puerto Chiquito Pools. The north boundary is the north part of the map. The

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

west boundary of the pool is the west part of the map, and the south part of the pool is the south part of the map.

We can look about the center of the map on the east side near the C-5 injection well, and the color coding and symbols of these wells, the triangular ones are injection wells; the blue are wells -- are shut-in observation wells; those colored in red are the ones that are currently producing.

Near the C-5 Well in the blue shaded area is the first flex from the outcrop, and moving a couple miles to the east, the dashed line is the outcrop of the formation that produces here. And the dip of the formation from the outcrop into the blue shaded area runs from like 2 to 3000 feet per mile. It's a steep dip, fairly uniform dip, and in areas, not here, but on the west side of the basin, where we cored wells in this part of the formation, we'd always find a hard, tight, compact, no transmissibility.

MR. NUTTER: As I understand it, Mr. Greer, now you've got 200 foot contours, right, like right there where the C-5 is?

A. Right, and to the --

MR. NUTTER: And to the east those are all 1000 foot contours.

A. Those are 1000 foot, right, and at that point at the blue coloring to the west, we start with 200 foot

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

contours. And there in the blue shaded area in Section 5, why, instead of 2-to-3000 feet per mile, we're down to about 1000 feet per mile, so there's the first real flex.

Then the green shaded area, we're looking in round numbers at 4-to-500 feet per mile, so there's another flex.

Then in the brown shaded area we drop down to about 200 feet a mile.

And then when we get over into the grey shaded area, why, it's less than 200 feet a mile, maybe 100 feet a mile, and on farther west within the pool, we're looking then at a fairly flat dip of less than 100 feet per mile.

The best wells have been those right up and down the center in and near the brown and green shaded areas. To the north there's a deterioration of -- of the production, and the zones;we can see a little bit on some of the cross sections we'll look at later, the four wells clustered at the end of the coloring, the brown coloring to the north of those four, two of the wells have capacities like 30 to maybe 50 barrels a day. Two of them have capacities less than 10 barrels a day.

Then on the very south part of the pool, in that blue shaded area, the contours spread again and we feel that not only is there a shallow dip there, that probably will be unproductive, but also this is sort of a re-

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

entrance. We can see that the, moving from right to left across the blue colored area, you're just moving up a little valley, in a sense. Where we've had the same kind of a re-entrance in East Puerto Chiquito on the very north part of the pool, we've also had low capacity or nonproductive wells.

Now we don't know that the south part of the pool south of the unit will be nonproductive and we think it should not be taken out of the pool until somebody wants to drill a well there and determine for certain, but our feeling is it probably will not produce.

On the east boundary we believe we've pretty well defined that by the change in the flexing of the formation as it falls generally, that east side of the blue shaded area and our orange boundary between the two pools.

To the north, between the orange colored boundary and the green and blue shading, where we have no coloring at all, is an area of fairly uniform dip, and my feeling is that it probably will be a very low capacity wells, if any at all, in there, and the only value we can see of that probably would be for location of an injection well or two to take care of the wells in the proposed North Canada Ojitos Unit.

MR. NUTTER: Mr. Greer, is this change in dip and flexing evident from the surface or is it too mountainous to see it?

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

A. It's pretty hard to see. Right at the outcrop you can get a good dip of the formation there.

MR. NUTTER: At that point.

A. At that point, and that then fits pretty well the subsurface control in that area. And from there on we're limited pretty much to the -- to the subsurface work.

Q. Mr. Greer, would you explain briefly for us the plan of your Canada Ojitos Unit?

A. Yes, sir. After we ran the interference test in 1965, and it confirmed some of our earlier suspicions, you might say, of the character of the formation, we concluded a couple of things.

One was that we had to have wide spacing. We had to have control rates of production in order to try to achieve gravity drainage efficiency, and this was an instance where pressure maintenance could have a most dramatic effect. Most pressure maintenance projects, we look at increases in production of something comparable to primary production. If, for instance, the primary production from a field is like a million barrels, why, in round numbers and rule of thumb, you ordinarily can say, well, by waterflooding we might get another million barrels, and by tertiary methods, perhaps, you can get up to that amount again.

But you're looking at only, ordinarily, something like doubling what you might otherwise get.

SALLY W. BOYD, C.S.R.
Rt. 1 Box 193-B
Santa Fe, New Mexico 87501
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In this instance where we can achieve gravity drainage recovery, as compared to the solution gas drive recovery, which is what you're going to get if you don't take special measures, we're looking at like ten times as much recovery, and -- and the way to achieve the gravity drainage recovery is -- is to keep the production rate low enough so that it's within the gravity drainage potential of the reservoir. And two things are required to do that. One is keep the production rate low. The other thing is do whatever you can so to keep the reservoir's capability of giving a high gravity drainage rate up. And how do you keep that capability up? Well, the answer is to keep the pressure up. We've found, first by just general information from other pools that produce in this formation, that wells seem to have an exceptionally high rate of dropping in productivity with dropping pressure, and it could not be explained with relative permeabilities or any of the customary engineering features of production.

We hypothesized that maybe it's the fractures squeezing together as the pressure drops off. We found in our wells here, varying from well to well, ratios of like 3 to 10 to 1, and by that I mean if the reservoir pressure drops 1 percent, the productivity might drop 3 to 10 percent. Or if the reservoir pressure drops 5 percent, the productivity can drop 50 percent. And this, under condi-

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

tions of pressures above the bubble point, which are not influenced by gas/oil ratios, relative permeability, or anything else.

So we concluded we needed to maintain the pressure. We investigated how that might be done, whether by waterflooding or gas injection. And we, in that study we coined a phrase of channeling potential, which we described in our -- in the 1969 hearing, and we concluded that we could maintain pressure with injection of gas, as compared to injection of water, with roughly 1/50th to 1/100th times as many wells. In other words, we could maintain pressure, we estimated at that time, say, with one or two wells in the gas-cap, that would take 100 to 200 wells of water injection wells to maintain the same pressure, and yet inject at a low enough rate in each well to not have the water channeled to the producers.

MR. NUTTER: Mr. Greer, have you had any experience, you mentioned that if you dropped the pressure there's a possibility of fractures squeezed together and you lose the permeability and productivity. Have you had the experience anywhere where you've restored injection and increased the pressure and had those fractures open back up again?

A. Yes, sir, as near as we can tell, and unfortunately I've misplaced the statistics of that, but we did

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

check it. When we get to one of the exhibits later where we show where we injected gas and the pressure was increased, not because of the volume but simply the interference effect, we had very close control on one of our -- the one well that I was watching for that purpose, and we did restore not only the productivity but the productivity index, and it was admittedly a fairly small increase in pressure, but it was measurable and it was there.

And how far back we could go with that, of course, no one knows, but it did happen in this one well that we had the control on.

Q. The next exhibit, Mr. Greer, of Section A, is a log. Will you tell us about it?

A. Yes, sir. This just shows generally the three zones that we found to be productive that's in the Niobrara member of the Mancos shale, which is the source of the production in the West Puerto Chiquito Pool.

The top zone we call A and the second one B, and the bottom zone C. The little shading within the colored zones are parts of the formation where we have found either productivity natural or zones that have responded to frac treatment.

In the south part of the unit most of the production comes from Zone C, the bottom zone. In the north part of the unit most of the production is from Zones A and B.

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

Q. The next part of Section A I see is a cross section. Will you go over the details of that?

A. Yes, sir. We wanted to show this cross section essentially to bring out the fact that the producing interval in the entire area has roughly the same thickness in any one of these zones throughout the area.

We have a large difference in production, productivity, cumulative production, such as that, between the wells, or among the wells, and this has come about because of wide drainage, not because in one well, for instance, the zone is 10-times as thick as in another one. It just is not there.

Also, we can see that Zone C, the lower zone, has sort of deterioration, both to the north and to the south; also slight deterioration of the A and B Zones to the south.

That's about all we need to show with this.

Q. Then turning to Section B of Exhibit One, the first part is in four divisions. Will you go over that with us?

A. Yes, sir. Now this is a -- we go over here in a summary fashion the 1965 interference test, and this particular plat, the first plat under Section B, is a repeat of Section J-1 of the Exhibit Three in the 1966 hearing. At

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

that time there were only five wells in the West Puerto Chiquito Pool. We conducted this interference test in four phases. The first phase we show in the upper lefthand corner. We had all five wells shut-in.

In phase two we started producing the well colored in red, the P-11, and we produced it for awhile.

Then in phase three we continued producing the P-11 Well and put the L-11 Well on production.

And in phase four we put the A-14 on production and had three of them on production and two wells shut-in.

Now the wells that were shut-in, three of those were used as observation wells. That's the three south wells, the A-14, the K-13, and A-23. And the distances between the wells are shown on these plats. For instance, in phase two, when we started the test, the maximum distance from the producing well to an observation is about 7000 feet. In phase three, when we put the L-11 on production, the maximum distance was up to about 9000 feet.

Q. Mr. Greer, this was -- these tests were the first time that you actually proved your wide drainage?

A. Yes, sir. When we drilled the last well to be drilled, I believe, on this -- at this time, of these five wells, I believe it was the L-11, and in the course of completing that well and measuring fluid levels on it following

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

the frac treatment, which is something we've always done, I began to suspect that the behavior of the fluid level, which is a reflection of the pressure in the well, was being affected by production from the other wells, like a mile away, and that well was completed in the fall of 1964, and so because of that thing, we devised this interference test run in 1965 to confirm what appeared to be just the most unusual communication among wells.

Q. And that was the last time that you drilled two wells in one section --

A. Yes, sir.

Q. -- was in Section 11?

A. Right.

Q. Turning now to the second part of Section B, will you explain this plat to us? Or graph.

A. Yes, sir, this graph shows the production rate during and before and after the interference test, and it shows the fluid levels in the observation well during the test, and this also is a repeat of part of this 1966 hearing, Exhibit Three, Section 7 -- or Section J, Part 7.

The production rate is shown on the bottom of the graph with the shaded area. The scale is on the left-hand side. We were producing in the range of 1500 barrels a day until April. We shut all but a couple of the wells in and reduced the rate to about 500 barrels a day. During that

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

period of time the fluid level in the A-14 -- and these fluid levels, now, are measured with a wooden float on a wire line, on a Halliburton wire line, and we found that we could measure pressure differences very accurately that way. It has a high sensitivity. Our men got to where they could measure the fluid level within a half a foot, and the oil weighs about .3 of a pound per square inch per foot, so that means that they could measure pressure differences like 15/100ths of a pound.

We'd take fluid levels at least once a day, sometimes twice a day in these observation wells, and we'd see, in the month of May, for instance, the fluid levels on the A-14 appeared to be dropping and we thought, well, that could possibly be the result of the wells that were producing.

We shut all the wells in early in June and the fluid levels built up, and let them build up for a couple of months, and which incidentally, was a delay in production for this entire test of about 60,000 barrels there and for the other two periods of time a total of, oh, 70 or 80,000 barrels of production, delayed production, which even at that time represented several hundred thousand dollars cost of the test. To run a test like that today would be to delay three or four million dollars worth of production, and it's just unlikely that one would ever run another test like this.

Q. Did you have any trouble getting your management to go along with that at that time?

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

A. We fortunately have a lot of good partners. They realized the importance of the test like this and they went along with it. It was so dramatic and so important, we felt, that we were going to be developing a pool in a fashion heretofore not heard of; we would be asking for large participating areas from the USGS; we would be asking the Oil Conservation Commission at that time for spacing wider than normally approved for oil wells, and because of that, we, although I knew we would later on present this information, of course, under oath and I knew the people would believe me, nevertheless we thought it would be good to have witnesses. And so we asked the Conservation Commission and the USGS to send engineers out and help us witness this test.

And where we have the little solid color square flags are points which were -- we had witnesses of either the Oil Conservation Commission or the USGS, or both. So we had not only a good interference test, we had a well documented and observed test.

Q. Both the USGS and the Commission were not present at each and every one, but one of them or both of them.

A. At wherever there's a flag.

Q. Now I notice on this exhibit you have little inserted plats. Does that demonstrate the --

A. Those are the phases.

Q. -- phases of your interference test?

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

A. Right.

Q. So in the first one of those, which appears in June and July, you have no black well indicated, so all of them are shut-in during that 60 days.

A. That is correct.

Q. And then the next one shows one, and three, and the last one four?

A. Right. And I might point out, about mid-July -- no, it was about the 23rd or 24th of July, we produced the P-11 for a couple of days, and you can see the immediate effect on the fluid levels of the observation wells when we put that well on production. We produced it that way for a purpose. The purpose was to draw the fluid level down in the annulus so that we'd have a solid column of gas from the surface to the pump. That way -- and then we pumped all of the oil and the gas up through the pump, rather than the customary method of bringing gas out the annulus. The reason for that, being that with a solid column of gas from the surface to the pump we could, then, by taking dead weight pressures on the surface, have a very accurate measurement of the working pressure of that pump. And so we could determine the operation pressure very accurately by doing that.

Then we started our test --

Q. And you got an immediate effect in the other three wells?

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

A. Well, just conditioning the well to get ready to --

Q. Yeah.

A. -- take the test showed up on -- we hadn't planned that, but that's the way it turned out.

Because of that, then, we had in mind starting our test within a day or two after -- after we conditioned it, but in view of the fact of the reaction we got, we thought we'd best wait a few more days until it took on the character that they had before.

Then on about the 4th of August, we started producing one well, the P-11, we can see these first flags, or the second set of flags, we witnessed the fluid level before we started the well up and then approximately 24 hours later, and it's interesting that at distances up to 9000 feet, not quite 2 miles, from the producing well, we could measure the pressure interference on the observation well, the A-23.

We produced that well, then, for about a month and we conditioned the L-11 and put it on and started the L-11 test, then, about the end of September.

MR. NUTTER: I think you stated that that was a distance of about 9000 feet. That was about 7000 on that one, Mr. Greer.

A. Oh, right.

MR. NUTTER: From the P-11 to the --

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

A. Right, right you are. I'm mistaken. It's about 9000 when we started the L-11.

Q. 6950 from the P-11 to the A-23.

A. Right; right. I was wrong.

Then at the end of September we started the L-11 is when we had the 9000 foot distance, and it, too, showed up in 24 hours.

MR. NUTTER: Now the P-11 was on production while -- it remained on production, and then you started the L-11.

A. Right, in addition. You can see the increase in production there at the end of September where we went from roughly 500 barrels a day to roughly 1000.

Q. That's on the bottom of the chart.

A. On the bottom of the chart, uh-huh.

MR. NUTTER: And the dip in the pressure decline, or the fluid level decline, steepens.

A. Steepens.

MR. NUTTER: Where the other wells --

A. Then the A-23 Well, that one that's the upper observation well on this graph, is the one that has been an observation well all its life. I think we produced it about a month or two. It had a capacity of about 150 barrels a day. When we ran this interference test we decided that we just didn't need that well. We could produce all the oil out of the

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

others and it could far better serve our needs by just being an interference -- or an observation well. And so it has never produced since that time. We've used it always as an observation well.

Q. Turning now to the next exhibit of Section B, which I believe is a portion of the first part, will you explain that to us?

A. Yes, sir. This is the third part of Section B and it's a reproduction of Section M-2 out of Exhibit Three of the '66 hearing.

Q. Excuse me, you said the third part of Section B. You mean the second part of Section B.

A. Right, Section B, second part.

Q. Being --

A. No, I believe it's the third part.

Q. Well, I beg your pardon. I beg your pardon, the third part, let me get that straight. Thank you, it is the third part of Section B. Go ahead.

A. Here we show the interference effect, the amount that we or I judged would be the interference effect on the L-11. We projected the interference effect caused by the P-11 and where the fluid level would -- probably would have been had we not put the L-11 on production.

Then from that interference effect we can calculate then oil in place per acre, and I might say that

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

this is about the only way in a fractured formation like this that you can calculate oil in place correct. There's no way to core the wells or to try to determine from logs or any other way. We didn't know how accurate this would be when we first ran this test, but all the indications were that it was a good and a reliable test, and I had a considerable amount of confidence in it, in the test within the limits at which we believed -- or how accurate we thought we thought we were with the test.

Q. Then turning to the next sheet, the next part of Section B.

A. This is a repeat of Section N-1 out of Exhibit Three of the '66 hearing, and in that 1966 hearing we show in detail the -- just exactly how we calculated the oil in place per acre, all of the details of the calculation taking the formula from the beginning to the end. The formula we used was the exponential integral solution of the diffusivity equation, and that I felt was the best -- the best relation to use. It depends on -- it's based on a point source, which of course we don't have a point source. We have a well, not only a well, but it has been fracd and there have been other solutions to that equation, particularly taking into account the length of fractures, or presumed fracture following a frac treatment.

But in this instance we found that the --

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

this formation comprises a system of tight blocks and high capacity fracture system. This well drilled in a tight block, its interference effect, then, when it reaches the high capacity system then will not be -- or the influence of the fracture within that tight block will not be carried beyond the high capacity system. And so from that point on -- and from that point on it's a large part of the reservoir compared to the area, the tight block around the well that then the point source formula with its application to distances beyond the well, I think is a very accurate way to determine this. So, using this formula and the other information of which we had a pretty good control, and by pretty good control I mean the viscosity of the oil, the compressibility of the oil from bottom hole samples, all the factors that it takes to make an accurate calculation with one exception, and that exception was the compressibility of the rock itself, of the fractured shale.

I could find in the literature compressibilities for sandstone, limestone, but there was nothing on fractured shale. So we made an estimate, a fairly broad -- covered a fairly broad range, and for minimum compressibility of the formation and the connate water, I came up with 20×10^{-6} for an effective compressibility to oil.

The maximum, I felt, would be not over 50. By using those two extremes and making calculations for the 14 day period at each day, I come up with a maximum of

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

about 2500 barrels an acre in place, or a minimum of about 1000.

And as part of the test that we look at to determine whether it's a reliable test, is that the fact that we get roughly the same result whether we take information one day or five days or ten days. In other words, that did not change.

Q. Actually, if I understand what you're saying, if your information was absolutely precise and if your theory was 100 percent correct, these -- each of these numbers in columns two and three would be the same from one day to fourteen days.

A. Yes, sir.

Q. But actually there is very little variance, which does confirm your theory?

A. Yes. So at that point we felt like, we're looking at oil in place per acre - now this is not per acre foot - this is per acre, that's just all the oil there is, from 1000 to 2500 barrels.

Then if we narrow that down, I felt these were the extremes, that probably we're looking at 1500 to 2000 barrels per acre.

So this was information we had as of the 1966 hearing, and this is the way we analyzed it and presented it to the Commission.

Q. It has proven correct but has been more

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

refined.

A. That's what I read from the next test that we ran.

Q. Turning now to Section C, will you explain the first part of that?

A. Yes, sir. This is a section of another graph similar to the one that we looked at before, except that this is for the period of August and September of 1968, and covers the time when we commenced gas injection. And this is a repeat of Exhibit Two, Appendix 1, Figure 1-8 of the 1969 hearing.

When we injected gas it was at a rate which would displace a fairly large volume of oil, like 1000 or 1500 barrels a day, and this displacement of reservoir volume, then, would create an interference effect on the injection side, just the same as when we had wells shut in and started production, but that sent a pressure pulse through the reservoir by the same token we send one through the reservoir when we inject in them. And a well 2 or 3000 feet away can feel the effect of injection of fluids in the reservoir, and of course it doesn't know whether it's gas or oil. It doesn't make any difference, once you have the reservoir volume that's being displaced you create this pressure pulse and you have an interference effect.

Well, the fluid level was dropping at a

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

rate -- and again I might say that we had excellent control on the rate at which the pressure was dropping in our observation well. This is now three years following the 1965 test. The A-23 observation well had been shut in all that time, fluid levels measured every day, and in addition to fluid levels we had from time to time measured bottom hole pressures, too, to confirm the trend of pressure decline. So we can see that we started injection, I believe it was August 8.

MR. NUTTER: Which was the injection well, Mr. Greer?

A. The injection well was K-13.

MR. NUTTER: K-13.

A. Yes, sir.

MR. NUTTER: And A-23 is your observation well, then.

A. A-23 is observation, uh-huh.

The gas injection rate is shown at the top of the graph. The oil production rate is to the lower part of the graph. The fluid level and the way that it increased the little circles.

Then from that --

Q. But sometimes I notice on this you were again taking two tests a day.

A. Yes, sir.

Q. Occasionally have two tests, and yet one

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

test every day; sometimes two.

A. Yes, uh-huh. Sometimes, particularly when it rained in that area, it's hard to get to the well and if there's a blank spot that's usually the case why they didn't take it.

A. I think you got a test every day.

MR. NUTTER: No, he didn't get one on --

A. It looks like August 10th or 11th.

MR. NUTTER: -- August 10th or 11th.

A. I'm sure that was a rainstorm that interrupted that one.

Q. Anything more with regard to that exhibit?

A. No, sir.

Q. Turning to the second part of Section C.

A. This shows some of our -- the results of some of our calculations, results from that test. At this point now we have a little different situation than we did earlier. I used the same formula but the oil now is, the pressure of it is below the bubble point. It has a high compressibility as compared to earlier. The 1965 test, it was conducted at a time when the reservoir pressure was higher than the bubble point and the oil was very incompressible. In fact it was just about like water. Now that the pressure is below the bubble point, at least in the area near the observation and injection wells, the compressibility is much higher, and

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

that results in a couple of things. Because of the boundary effects and such, I couldn't make a direct calculation like I did earlier. I had to calculate different examples and pick out what seemed to best fit the data.

You can see here I show transmissibility running from 1 Darcy foot to 4 Darcy feet and the one that seemed to best fit this early part of the curve is a transmissibility of about 1.8 Darcy feet, and this for 1600 barrels of oil in place per acre.

Now I varied also the volume of oil, and to see its results, and we have roughly the same degree of accuracy there. By changing 2 or 300 barrels per acre, you would get a fairly wide separation from the observed information.

From this it looked to me like the transmissibility was probably about 1.8 Darcy feet, 1600 barrels per acre in place.

Then to continue --

Q You're now turning to the third part of this section?

A Yes, sir. And this is a repeat of Figure 1-10 out of Appendix 1 in Exhibit Two from the 1969 hearing.

And here we continue by imposing a boundary conditions as to what might -- and we can calculate what might be the curves under certain boundary conditions.

Curve 1 we have for infinite conditions,

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

as though the reservoir continued forever.

Curve 2 is the assumption that somewhere within about a mile west of the -- of this area we would have an increased transmissibility, which we think is the case. That would change it to the curve 2. Then if in addition there is a gas cap about 3500 feet east of the injection well, and you impose that on the other two conditions, you'd come up with Curve 3. Now we don't know if that's exactly the situation, but it's pretty reasonable to believe that that's why the pressure behaved as it did. It seems to pretty well fit those conditions.

And that's all for 1600 barrels of stock tank oil in place per acre, which seems to pretty well confirm the test that we'd run earlier under an entirely different set of conditions; namely high compressibility in the last test, and in this test because of the higher compressibility of the oil, then the effect of the unknown value of the compressibility of the formation becomes more insignificant because it's a minor factor now.

So we have those two things. We have two interference tests, one in which we have an indefinite value of the compressibility of the formation, which adds to the error.

We eliminate that in the second test because it's not even present, and yet in the second test we

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

come up with a number which fits fairly close to what we had the first time. So it tends to confirm what we earlier thought.

Q. Now directing your attention to the fourth part of this section.

A. Well this is a repeat of Figure 1-16 out of Appendix 1 of Exhibit Two of the 1969 hearing, and this shows kind of a summary of the transmissibility, which we calculated for the area around the wells which were in the initial interference test.

The blue shaded area is an area which I feel was probably covered and as an average would be represented by the 1965 test, the information on it. This test we ran in 1968 because of the higher compressibility and the other factors would cover a smaller area, and the area that I think that it covered would be the northeast to southwest shaded area around the K-13.

Then we ran another test, which we reported in the '69 hearing, of just transimissibility in the area covering the -- covered by the northwest to southeast shading involving the E-10 well, and it's a little different area.

The first one that we ran, the blue shaded area, we felt like the transmissibility was in the range of 5 to 10 Darcy feet. I estimated 6.3 to 6.8 would be my best estimate for that.

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

Then the one we just ran, or just discussed in 1968, we came up with 1.8 Darcy feet, but that was at a time when we had some free gas saturation and the transmissibility would have been less because of that, because of the relative permeability to oil being dropped off, and I felt like that that area probably would have been in the range of 2-1/2 to 3-1/2 Darcy feet.

Then the west part of the area is like 10 to 12, and so if we add the -- take an average of the two individual tests, the one on the west shaded area, the one on the east shaded area, and average those, we come up with something fairly close to what we felt was the average of the entire area to begin with.

So this tends to confirm our initial calculations of oil in place and transmissibility and we felt like we had sampled a fairly sizeable part of the reservoir, like ten or twelve sections.

MR. NUTTER: Mr. Greer, you've also got a change in dip right there where those transmissibilities change.

A. Yes, sir.

MR. NUTTER: Would that also enter into it?

A. Well, it's my feeling that that could be the reason why it's there. We can measure -- we can actually

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

measure that it is there from the test, and my feeling is that that's probably why it's there. And in a way it's fortunate, because in round numbers we have twice as high a transmissibility in the west area with about 200 feet per mile dip, and in the east area, then, with half that transmissibility but twice the dip, gives us an average, then, in terms of gravity drainage -- those two factors work together in gravity drainage, so then we have the same gravity drainage potential for those two parts of the reservoir.

Q. At the time that you drilled these wells did you anticipate this matter of flex, at this point?

A. When we drilled the first wells? No, sir.

Q. Anything further on that exhibit?

A. No, sir.

Q. Were there other interference tests that occurred just incidentally because you had that observation well open?

A. Oh, yes, sir. Nearly every well that we drilled we found interference of some kind or another. After the pressure dropped 2 or 300 pounds and we'd drill a well like 3 or 4 miles away from the other, we'd find that the pressure was down. One time we fracd a well 2-1/2 miles away from the observation well and we could see the increase in the effect in the pressure in the observation well just from a frac treatment.

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

Q. How long did it take to make that observation?

A. Just a few days.

Q. Practically like a pipe, isn't it?

A. Yes, sir.

Q. Turning to Section D.

A. Section D, we'd like to talk a little bit about the comparison of oil in place of the sandstone reservoir and the fractured reservoir for the same transmissibility. The colored graph, one with yellow and brown coloring, the first part of Section D, is a repeat of Figure 9 of Exhibit One from the 1966 hearing, and the thing that I'd like to show here, the brown shaded area represents a relation of porosity to permeability, which was taken from the literature from, as I recall, thousands of wells reported by Bulnes and Fitting years ago in the technical literature.

The area colored in yellow shows the relation of porosity to permeability for a fracture system of horizontal fractures of equal width, and the width in this instance is shown in inches by the little circles along the sloping lines.

And the significant thing here is like for instance, a permeability of 10 millidarcies, you might have -- expect something, if that's in a sandstone, a porosity of like 10 to 20 percent. In a system of horizontal fractures

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

you're looking at like 1/10th percent porosity, something like 1/100th of the volume, and then the significance here is that if you drill a well in the sandstone reservoir and make like 100 barrels a day, ordinarily you feel like you've got some kind of reserve, perhaps, to back it up, and if it's in a sand the chances are that you do have. But you can drill the same kind of a well, come up with the same kind of a well in a fracture system with just a minimal amount of oil in place, perhaps 1/10th or 1/100th as much as if you were in a sandstone.

To pursue that further, then, in the '69 hearing in Figure 3-4 of Appendix 3 of Exhibit Two at that hearing, we presented this graph, which is the grey shaded graph, the second part of this Section D, in which we have begun to approximate what we might expect in terms of barrels per acre, as compared to transmissibility or for given transmissibility, and here we just doubled the porosity for any given permeability and this is just a judgment decision as to how one might arrive at some kind of a number that would give us an estimate of what we might actually be looking at.

By doing that and taking the upper part of the yellow shaded area from the first graph, we come up with the grey shaded area on this second graph.

Again, the lines, the upper one a designation of A, the center one B, and the lower one C. For that

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

relation, then, we can calculate oil in place per acre as a function of transmissibility, and that we've shown on the next graph, the third part of Section D, and this was the Exhibit Two in the 1969 hearing, Figure 3-5 of Appendix 3.

And on this we have chosen like 17 feet of formation with characteristics of A from the previous graph. That would have a volume of oil in place the same as 50 feet of character B or 150 feet of character C.

Then going up to the next line we had 33 feet of A, which is equivalent of 100 of B, 300 feet of C, and so on. My feeling was that we could cover the waterfront with -- with that range of pay thicknesses for the zones that we were looking at in this reservoir.

The result of our 1965 test, we show by the little blue shaded mark a little over 6 Darcy feet and 1500 to 2000 barrels per acre.

Then the pink shaded mark is the result of the 1968 interference test at 1600 barrels an acres and running from 2-1/2 to 3-1/2 Darcy feet.

And then the green circle shows approximately what Boulder might have been, somewhere from 2000 to 4000 barrels an acre in place and like 10 to 20 Darcy feet. And incidentally, in Boulder, perhaps I should mention it now, I believe the question was earlier asked, what percent recovery did Boulder have. I feel like it was in the range of 15 to 30

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

percent.

The thing that concerned me about Boulder, how it was produced and the situation we had in Canada Ojitos was that Boulder had an ideal situation for gravity drainage, a pool like 3-1/2 to 4 miles long along the strike, a short distance, like a mile, down dip, a high rate of dip, a small amount of gas in solution, all of the factors which would give you a good gravity drainage. And so in Boulder I know that they had some gravity drainage, a substantial amount of gravity drainage. There's no way they could drill and produce the wells without getting some just by happenstance.

Our situation was entirely different. There's no way -- instead of having the one mile down dip to drain the oil, we had about four miles down dip, and instead of a small amount of gas in solution, we had a comparatively large amount of gas in solution, all of which worked for poor solution gas-drive performance and against good gravity drainage.

Q. So our unpressured production here would have been a lot less than it was in Boulder.

A. Right. So even if they got 15 to 30 percent in Boulder, there's no way we could have gotten over 5 or 6 percent in Canada Ojitos if we produced it the same way.

MR. NUTTER: Now did you say the blue there on that last exhibit was the 1965 test?

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

A. Yes, sir, uh-huh.

MR. NUTTER: And the pink was the '68 test?

A. Yes, sir.

Q. Then your next page of this section is what I'd call a schematic drawing. Will you explain that to us?

A. Yes, sir. This represents what I believe the reservoir comprises, and namely, a high capacity fracture system with tight blocks. And of course we don't know just the shape of those tight blocks. I've drawn them here sort of rounded. We know it's a fracture system. Some theories regarding fractured reservoirs are that, of course, they would be systems of sort of parallel fractures, maybe parallelograms or squares, or whatever. This we don't know.

But what we do know is that the individual wells behave just as though they were in their own little reservoir of 20 acres, 40 acres, 100 acres, surrounded by a high capacity system. Between our interference tests and the tests of individual wells, we can determine this without question. There is no other way that we can -- or that the pressures and the production of any of the wells can be described by anything other than individual little reservoirs surrounded by high capacity system.

MR. NUTTER: Well now, these segmented worms you've got crawling all over here, these are those pipe-

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

lines Verity was referring to before, aren't they?

A. Those are the pipelines; the oil just moves through almost instantaneously.

One of the -- one of the interesting features of this is that -- that if you can get a well producing in good communication with that high capacity system, that well can drain its block; the high capacity system can drain the other blocks, better than wells within the blocks themselves.

And this is a very significant, important feature in our concept of producing this reservoir.

MR. NUTTER: Now when you complete these wells you frac them, right?

A. Yes, sir.

MR. NUTTER: So you might have a well that's completed in one of these tight blocks and then you'd frac over into one of the pipelines.

A. You try to get into the pipeline. Whether you get into the pipeline is -- I know, I felt like we have in at least one well, but at least you get close to the pipeline, or a good enough communication that if not a direct tie into it, at least pretty close to it.

Q. Well you must have fracd into the pipeline in that one instance when within a day, a day or two, you had interference observation in the -- or obtained observation -- in your observation well.

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

A. Well, at the period of time that the pressure is higher than the bubble point and the transmissibility -- or the diffusivity constant is high, you can do it even within a tight block.

Q. And the next sheet, then, in this section?

A. We described here on this fifth part of Section D just what we were just talking about, a comparison of ability of the high capacity system to drain these tight blocks with a well within the tight block, and we felt this important to -- to review this at this time. We discussed it earlier and brought it out in our '69 hearing and had part of our exhibits directed toward that, but recently there have been open letters to the President and other from well-known engineers, and there's been a general trend in the industry to drill more wells, infill wells, and one of the letters to the President and responses from the Department of Energy back to oil companies, all to the end that additional wells in certain reservoirs, particularly those under waterflood, can result in additional recovery.

And the principal has been that -- that on too wide a spacing with waterflooding you can have bypassing of the tight areas, and by drilling additional wells you can get injection wells in those tight spots and force the oil out and get additional recovery, and I think perhaps that's true. And the thought, then, of course, comes to mind in this

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

situation where we have a high capacity system and tight blocks, if that might not be the case here, that we might drill more wells and get more oil.

And the answer to that is no, that we can't, and we describe briefly here some of the engineering calculations that support that. We show, for instance, on this lefthand diagram, which incidentally is not to scale, but a tight block and we've used a circular system here just simply to have a simple formula to calculate. And say that we frac the well and then we develop a 400-foot fracture, it would have an effective wellbore radius of roughly 100 feet. This is one of the things that the engineers are pretty well agreed on under different flow theories and behavior of wells that have been fracd is that it doesn't make much difference whether when you frac a well, whether the fracture that you create extends away from the wellbore in two directions or in just one direction; whether the well is located at the end of the fracture or the middle of the fracture, you're going to have insofar as the pressure and production behavior of that area is concerned, a well with an effective wellbore radius of roughly 1/4th of the total length of the fracture.

With that, then, we can go with a simple steady state formula, which we show on the lower sheet here on the lefthand side for the situation that we've chosen here, 1000-foot radius, 100-foot wellbore radius, and transmissibility

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

of about .06 Darcy feet, we would have for 1500 pound pressure differential and the viscosity of oil that we have in Canada Ojitos or West Puerto Chiquito, productivity of that well is about 100 barrels a day. And we've assumed here a ratio of relative permeability of about 3/10ths, and that's because of the low pressure around the -- close to the well, the higher gas saturation and the lower permeability below it.

By comparison, that same block, if it's being drained by the high capacity system, the oil is flowing the other way instead, whereas we were looking at clearly a steady state situation for the well in the center of the block, we now have an unsteady state situation, and that's a little more complicated formula and I haven't even tried to analyze it.

But we can make a rough comparison by using the same formula for an instantaneous rate just to get a comparison of flow rates. And the flow rate, for instance, from a 900-foot radius to 1000-foot radius, instantaneous rate there for the same pressure differential and relative permeability would be about 20 times as much, about 2200 barrels a day could drain out of the block as compared to 100 barrels a day that the well itself would deliver from it.

Now, of course, we're not going to have that high pressure drop into the high capacity system because it's going to have a relatively high pressure, but we've cal-

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

culated, as shown under part B in the upper righthand part of the calculations here, it takes about 20 pounds pressure differential to give the same rate of flow for this example. And I might point out that from 900-foot radius to 1000-foot radius, we're talking about 20 percent of the volume of that block, so even though it's an instantaneous rate, based on a steady state formula, it still gives us a feel for the capacity of the -- of the system to drain.

And again, now, this is not like an injection well in the center of the block. If we had that, we would have just a repeat of the -- of the producing situation. But we're not injecting here. There's no oil has to move in into the center and out, and that's where all of the constriction comes, as we can tell from all these arrows concentrated in where we have a well in the center of this block, that's what causes the low rate of production.

On the other side, where we're flowing out of the block, we have to move just a very small amount of oil from the center part of the block, like 1 percent. So I feel confident that this is the situation, and not only can a well that's in communication, good communication with the high capacity system drain a block better than a well within it, there are probably some blocks that are so tight that you couldn't even drill a well that would be commercial, and yet you'll still drain something out of that by your high capacity

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

system.

(Thereupon a recess was taken.)

MR. VERITY: I believe at the time of the recess we were on Section D, Parts 5 and 6, and you'd pretty well gone through it.

I had one question with regard to it.

Q. Do these calculations and this method enable you to further confirm or to get a better idea with regard to what percentage of the oil is in the high transmissibility system and the low transmissibility system?

A. Well, that's a real complicated problem, and we went into it in one of the exhibits in the '69 hearing, and really about all we do here is -- is elaborate on that enough to show what we were talking about there.

The percent that's in the high capacity system and the low capacity system is really hard to tell. I'd estimate roughly 50 percent.

Q. And this lends further information to that?

A. Not really, doesn't not really as to percent.

Q. All right. Turning to Section E, the first part, will you go through that?

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

A. We want to review briefly the production history of the Canada Ojitos Unit and this map is the same structural contour map that we were looking at earlier except that we have colored on here the areas which we think were initially saturated with oil completely and partly with gas, and where the gas has invaded or replaced the oil that's produced.

Initially I believe we had gas-free oil from about the 1600-foot contour on down deeper. Above that, the grey shaded area was partly gas and partly oil saturated. The area colored in brown represents approximately the area that's still mostly oil, and the part colored in yellow shows the area which I believe was then drained of the high capacity system, and gas invaded the high capacity system approximately in that area.

Q. Anything further?

A. I might point out that that invaded area, or the area which we think is being depleted by the high capacity system, in round numbers is like 2 miles to 4 miles from the east side of the area to the west side.

Q. And proceeding now to the second part of Section E.

A. This is a little plat that I thought might be helpful as we look at some production history later on to identify where the wells are located. On this little plat we show the high capacity wells colored in -- encircled

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

in red, and as we get to their production graphs, their graphs will be colored pink.

The wells circled in blue are low capacity wells and their wells will be on blue sheets.

Q. This is actually a small but a repetition of the previous exhibit that's here, I believe it was A-1 or 2, wasn't it?

A. Yes, sir.

Q. It doesn't make any difference, but it is a repetition of that for convenience.

Then the next part of Section E.

A. This is a series of production graphs. The first one shows the total unit production and there's nothing really particular there that I want to point out, but as we move to the individual wells there's some things that we would like to look at.

Q. So that we can keep track as we're going through, this is the --

A. I'd like to just keep the map laid out so you can see the wells as you get to them.

Q. All right, your summary of all wells is the third part of this section.

A. Right.

Q. Then your next well, the fourth part is the K-13?

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Rt. 1 Box 193-B
Santa Fe, New Mexico 87501
Phone (505) 455-7409

A. Yes, sir. I might just point out here that we shut the K-13 well in when we started the interference test in 1965. Following that test I felt there was really no need to put the well back on production, the same as the A-23 observation well, because we began to get ideas that we would want to inject gas, and this would be a good gas injection well, and so we left it off production, except for a few months in 1967. We wanted to test it again before we put it on injection in 1968.

Q. And the next one, which is 5 is the A-14.

A. The A-14. This is the closest producing well to the injection well. We had estimated that the nearest wells, the A-14 and the P-11, might produce for a year or two before the gas would invade their area, and that's what we came up with. The A-14 in 1969 after about a year's production, the gas/oil ratio reached about 4000-to-1 and we shut it in.

Q. Then 6th part of this section is the P-11?

A. Yes, sir. There are two things we'd like to point out here.

Again, when the gas/oil ratio --

MR. NUTTER: Excuse me, Mr. Greer, just a moment here, let me catch Joe up here.

A. Okay.

MR. NUTTER: So you shut in the A-14 after the GOR skyrocketed, right?

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

A. Right, we shut them in at a ratio of 4000. It went up roughly as shown here on the graph, but really a ratio of 4000-to-1, there's a lot of wells you produce at ratios of 4000-to-1.

MR. NUTTER: Right.

A. But in our instance with the gas handling capacity and all that we had, it just made sense to shut the wells in at about that ratio.

MR. NUTTER: Okay. Then I think you were on P-11.

A. Yes, sir. On the P-11 we show the same thing and its ratio got up to about 4000-to-1. We shut it in, and I'd like to point out here, you see we commenced injecting gas in 1968 in August, and you can see a rather steep decline in production from this well prior to the time we injected gas. And, now this is an accelerated rate of decline, greater than actual decline of the well's productivity, the reason being that we continued to keep the casing shut-in and all the gas and the oil was produced through the pump. So as the pressure dropped why, of course, the gas would occupy a bigger part of the space in the pump and so you get a little higher drop in production than you really have dropped in productivity index.

Nevertheless, we did have a drop in productivity index. This is one of the wells that I was watching and I was concerned about, the productivity index dropping much

SALLY W. BOYD, C.S.R.
Rt. 1 Box 193-B
Santa Fe, New Mexico 87501
Phone (505) 455-2409

faster than the drop in reservoir pressure. The reservoir pressure was dropping, as I recall, at the rate of about 1-1/2 percent a year, and yet here a very steep decline in productivity. But the productivity index, as I recall, for this well and the L-11, which we'll look at in just a minute, was like from five to ten times as much as the drop in reservoir pressure.

And this was one of the things that convinced me that we needed to inject gas and maintain pressure and try to keep those fractures propped open, if that's what was causing the PI to drop off.

Q. Turning now to the first pink sheet of this section, which I believe is part seven.

A. Yes, sir.

This is the A-22. We just produced it for a short time. It initially came in after we started injecting gas, produced for about three years until the gas reached this well and shut it in at a ratio of about 4000-to-1, just like the others, and I wondered about this well, if gas was channeling to it or if we were really depleting the high capacity fracture system. I felt we probably were.

So after shutting it in for about a year we went back to test it to see if it was just a channel, perhaps the oil then would have leveled off and covered up the channel and we could find out by producing it whether this occurred or not. But instead it still had a high gas/oil ratio so we did

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

not produce it any further.

Q. Did -- can you tell us how much this well was draining; how big an area?

A. Well, like all the others, it was draining probably several thousand acres, but it actually, it had produced about 500,000 barrels, and in round numbers I felt like the high capacity system occupies maybe half of the reservoir. If the reservoir has, say, 2000 barrels per acre in place, that's 1000 barrels per acre in place in the high capacity system. If we get 50 percent recovery of that, that would be 500 barrels an acre recovery in the high capacity system.

Now over all you could average about half of that. So I think we're looking at 250 to 500 barrels per acre in the high capacity system. So 500,000 barrels would be like 1000 acres completely drained of the high capacity system if it's the high side,or 2000 acres if it's on the low side.

Q. So not less than 1000 and maybe as high as 2000?

A. Uh-huh.

Q. Next is the next pink sheet, which is eight of this section.

A. Yes, sir.

Q. The L-11.

A. The L-11. We had the same situation here. When the ratio reached about 4000-to-1 we shut the well in and

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

here again we were producing all gas and oil through the pump and so the well still had a capacity probably to produce several hundred barrels a day at the time we shut it in.

But nevertheless, in the same policy with others, we shut it in at a ratio of 4000-to-1.

Q. How many barrels did this well produce before you shut it in?

A. It produced about 1,200,000 barrels.

Q. And what did -- how big an area did it drain on the same calculation that you were defining before?

A. On the same calculation it would have completely drained, at 500 barrels an acre in the high capacity system, about 2400 acres, or 250 barrels, about 4800 acres.

And that's complete drainage again of the -- of that equivalent volume. Again it's undoubtedly draining, you know, 10,000 acres here.

Q. Then turning to the next --

A. Oh, excuse me, before we leave that, I would like to point out, I didn't mark it on here, but if you'll notice the decline in production from about 1966 to 1968, that is about a 12 percent rate of decline. And --

Q. It levels out in '69 and '70, '71, '72, and '73, but there at the start you do have a decline of about 12 percent.

A. Yes, sir, about 12 percent, and although

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

here again we had the casing shut in and that's perhaps accelerated over that well's actual capability to produce, it nevertheless is much higher than the drop in reservoir pressure. The pressure is dropping like 1-1/2 percent a year and the well's productivity index is dropping at maybe 8 or 10 percent, several times as much. And this well, now, up until 1968 the pressure in its area, in its structural position, was above the bubble point, so we know that it was not being affected by a relative permeability to oil. And so here again we have -- have this indication of an extremely high rate of drop in productivity following a drop in reservoir pressure.

Q. Turning to the next pink sheet, which is nine of this section, that's the E-10 well. Tell us about this.

A. Well, this well -- incidentally, this is one that produced absolutely nothing natural. When we fracd it, we apparently fracd it into the high capacity system. We had drilled it with air, showed neither oil nor gas on completion. We used a large frac treatment and it had initial productivity index of about 4 to 5. We produced it about 400 barrels initially, the capacity of the pump that we had on it, until in '69, after we installed -- or commenced gas injection, installed a gas lift system, and we put the well on gas lift and then we raised its rate to about 6 or 700 barrels a day, which is still far below its ability to produce, but as high as I thought we should produce the field.

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

Then over time we have gradually dropped its production as its gas/oil ratio increased. In 1978 it jumped up to about 2000-to-1 and we kept the production down to about 150 barrels a day, or 200. The ratio came back down to about 1000-to-1 and we increased the production back up a little bit in the early part of this year and now I think the ratio is back up to about 1500. We'll probably reduce it again.

Q. And what's the cumulated production of this well?

A. It's produced not quite 2,000,000 barrels.

Q. And with regard to the same calculation of drainage that you used before, 500 barrels and 250 barrels per acre, how big an area would that cover?

A. Well, that would be complete drainage of the high capacity system of from 4000 to 8000 acres.

Q. And again it's probably been a lot greater than that?

A. Right, yes, sir.

Q. The next sheet will be ten, and that's the L-27.

A. Yes, sir, that's the northernmost of the high capacity wells. It produces about 250 - 300 barrels a day. We have apparently a drop in productivity in '78 and '79 looks like a slight increase in gas/oil ratio, but it's pretty

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

hard to measure with those low volumes. It's produced a little over a million barrels.

Q. With a drainage of approximately 4800 acres?

A. Yes, sir, it could be as high as 4800 acres.

Q. Yes. And then part eleven of this section, the C-34.

A. This is one well that we've produced. This is the southernmost of the high capacity wells and it's fairly far down dip and in this well, rather than shutting it in when its gas/oil ratio got to 4000, we thought we would just run an experiment with it to see if we could confirm any of our thoughts about the tight block and high capacity fracture system, our theory, if there actually are a number of tight blocks with oil moving into the high capacity system by gravity drainage, theoretically that oil should move down those channels, even after we've depleted the high capacity system, there should be some oil coming out of these tight blocks. And so we though we would produce this well for an extended period of time to see if actually we could recover additional oil after the high capacity system was drained.

In this instance the gas/oil ratio increased to about 10,000-to-1 and then sort of leveled off. And it reached that point in about the first of 1974. Since

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

that time it's been increasing rather slowly. It's up to about 11 or 12,000, 13,000 maybe now, and its production rate has dropped off at the rate of about 7-1/2 percent a year.

Now here again, this is a well that's not produced at capacity. We just are handling about a million feet of gas a day with it, and -- but nevertheless, this gives us an indication of what might -- what we might do and how we might produce the other wells once the gas has reached all the down dip producers and we're on a cycling situation. If they behave like this, we're looking at a rather extended period of time of trying to capture the oil out of these tight blocks.

MR. NUTTER: By recycling.

A. Just by recycling. And if we extend these curves we show here that we pick up perhaps another 400,000 barrels of oil after the gas/oil ratio reached 10,000-to-1 on this well, and it had produced, oh, like 300,000 barrels at that time. NOw, in round numbers that's 50 percent out of one, the high capcity system, and perhaps 50 percent out of the tight blocks. We don't know that that confirms our earlier thinking that there might be half as much oil in the tight blocks and half in the high capacity system, but certainly it doesn't indicate anything much different from that.

Q. Then turning to the twelfth part of this section, the A-16.

A. Well, this well and the rest of the wells

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

are low capacity wells and we have some individual exhibits later on for them. I think it would be more productive just to move on to them, but we have them in here just to complete the record.

Q. So if someone wants to refer to them, and then what about 16, which is green?

A. Same thing.

Q. All right, so that brings us to Section F and the first -- the first page, which is a -- would you call that a graph? Sketch?

A. A sketch, yes, sir. We just wanted to show here one of the -- a problem, you might say, but one of the factors we have to consider in trying to analyze the behavior of these wells in the reservoir, and it's really important in the overall behavior to understand as much as we can about these little details, because they begin to take on a very significant aspect of the -- in the future development of the area, which I think is going to be of low capacity wells to the west of the present unit.

And this is to understand how the -- we maintain the pressure, how we measure the pressure in the reservoir, and how it's affected by the amount of gas we inject, and what we have to inject to maintain pressure.

We show here in this sketch a simplified gas cap colored in yellow with an oil zone, a dipping oil zone

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

below it.

And the problem we have here as compared to most reservoirs is because of the structural dip, which is significant, that as we produce oil not only does it come out of the reservoir, but the gas/oil contact moves down dip.

And for instance, the shaded area we can think of as the volume of oil that we produce and in the first sketch on the left we show pressure stabilized at 1400 pounds in the gas cap, 1431, say 100 feet lower, and 1462 a 100 feet lower than that.

If we produce that shaded area of oil and then replace it with gas at the same pressure that the gas cap has, 1400 pounds, as indicated here, the gas/oil contact then moves down through the so-called datum of zero, although we still have 1400 pounds in the gas cap, if we have a well at the datum of -100 its pressure is now only 1431 pounds because we've lost the weight of the column of oil above it.

So in order to maintain pressure we really have to not only replace that volume of oil, we have to increase the pressure in the entire gas cap to make up for it. And so the righthand side, then, we show the gas at an increased pressure in order to maintain pressure at the bottom.

Well, the calculations for that are shown on the schedule just below that and --

Q. It's on page two, or the second part of

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

the section.

A. Yes, sir. The summary for that is under Item 6, sub-line c., which shows depending on the rate of structural drop of 400 feet a mile or 200 feet a mile, and our high estimate or our low estimate, which depends partly on the configuration of the reservoir, we're looking at something like 800 to 1200 cubic feet per barrel for complete pressure maintenance.

Now we hope to pick up from 200 to 300 cubic feet per barrel out of the produced oil, which means we need makeup gas in the range of 500 to 1000 cubic feet per barrel or perhaps as an average I've estimated maybe .7 of an Mcf per barrel of makeup gas required to be purchased, to maintain the pressure.

Q. All right, you mean then, if I understand you, in addition to re-pressuring the gas that was produced incidental to the oil, you've also purchased gas that you have injected into this formation.

A. Right.

Q. And that was the reason that you had to do it, what you're talking about --

A. Right.

Q. -- or part of the reason, in addition to voiding the oil, you had to go further?

A. Right.

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

Q. All right.

A. And initially this was a minimal cost in the overall consideration of the project, with gas at 15 to 20 cents a thousand, it was practically nothing. But beginning in the '70s, why of course, the price of gas started to go up, the price of oil was frozen, and this began to create an economic concern, or burden.

We show on the next schedule, then, --

Q. That's three?

A. Three.

Q. The green sheet.

A. I believe that's a green sheet under this section. The relative cost of this makeup gas with the present price of gas of approximately $2.00 an Mcf, the bottom line shows that at the present price of oil that we're up to as much as 50 percent of our net income before we purchase makeup gas in order to buy enough gas to maintain pressure.

Now as the price of oil increases, if we get up to around $30.00 after the windfall profits tax, well, then we're only looking at 5, 6, or 7 percent, something again relatively small compared to the benefit.

But in the meantime, for the past few years, it hasn't made sense insofar as the high capacity wells which we have in the unit area, to try to maintain that pressure just absolutely even, because they have excess capacity

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

now. The only problem is how you handle the gas/oil ratio, and the gas, and such as that.

When it becomes significant, which we'll see here in a little while, is with the low capacity wells and the effect on them.

So this is the situation we had, and so we reduced the amount of gas that we were purchasing and injecting, and we show that on the next graph.

Q. Which is the fourth part of this section on the back of that sheet?

A. Yes, sir. There we see in general on the surface pressures of this observation well -- now the K-13 was one we initially used as an injection well. We later moved the injection wells back up dip and made this an observation well. And you can see here from the period from 1972 to '76 the pressure in the gas cap was increasing at the rate of about 12 pounds a year, which is just about what we would estimate would be required to maintain level pressures in the wells in the oil zone.

And the volumes of makeup gas is shown on the schedule just below that.

Q. That's five, part five.

A. Part five, yes, sir. In a period like from '73 to '76 we're running from about 500 to 900 cubic feet a barrel of purchase of makeup gas, which approximates

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

the 700 cubic feet per barrel we'd calculated would be required.

Then in '76 we dropped that substantially down to about 400 cubic feet a barrel and you can see an immediate drop. It happened within a month after we cut our purchses back. We had an interference effect that dropped the pressure like about 20 pounds and then it leveled off to about three pounds a year for a couple of years. Then we reduced the purchases again to about 200 cubic feet per barrel and we experienced now about 12 pounds per year drop in pressure.

Now really that is not a serious drop in pressure as most pressure maintenance projects would be viewed. At 1200 pounds pressure it would take 100 years for it to -- to be reduced to zero, but it is significant from the standpoint of small wells, which we will see in a little while.

MR. NUTTER: You'd be losing oil production as a result of this, right?

A. Right. There will be some production will be lost, without doubt, as a result, and of course it's a question of time and balance and economics and dollars a barrel that you can decide at what point you -- how far you go.

Q. If there wasn't any difference in this price, as the Examiner has observed difficulty in seeing, and the price of oil was gone up comparable to the price of gas, as it is in the marketplace, you could actually obtain

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

more oil recovery.

A. Oh, yeah, if we would have maintained the pressure.

Q. You bet. Anything further here before we turn to part six?

A. Part six shows a calculation of the rate of drop of pressure. Now what we want to arrive at is how much pressure are we losing around the down dip low capacity wells as a result of not maintaining pressure completely, and that becomes the sum, then, of the drop in pressure in the gas cap, plus whatever other -- the drop in pressure that we have resulting from the gas/oil contact falling down the structure.

And as those figures are summarized under columns ten and eleven, we're running from about .3 of a percent a year to 1.2 percent a year. I would imagine that the gas/oil contact probably is in the low part of the structure, I mean a shallow dip part about 200 feet a mile, and I would think we're looking at, under column eleven, probably .3 or .4 of a percent a year, so if we're losing 1 percent in the gas cap, .3 or .4 percent because of the drop in the fluid level, we can assume that we're losing right at 1.3 to 1.4 percent pressure per year in the area surrounding the low capacity wells.

Also, we show on here that if we had pro-

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

duced oil at the rate shown under column two, that's 1000 barrels an acre in the high capacity system, and we recovered it, say, in column three at 500 barrels an acre, we would have displaced the oil about 2 miles horizontally for a 10-mile segment of the reservoir. And if you'll recall that map we looked at just recently, the one that had the yellow colored displacement of oil, that's in round figures, by a couple of miles. We feel this tends to confirm --

Q That one you're referring to there is the exhibit in Section E, the first exhibit in Section E?

A. Yes, sir, first exhibit in Section E.

So we have calculated, of course, by our interference tests these volumes of oil in place on the order of 2000 barrels an acre, maybe 1500, how much of it could be produced in a high capacity system, and now as we calculate the volume that would be displaced, it seems to fit pretty well what we've actually observed in the field. It seems to confirm again our estimates in that regard.

Q Anything further on six?

A. No, sir.

Q Then let's direct your attention to part seven.

A. Part seven is a repeat of Figure 5 from Exhibit Two of the 1969 hearing, which shows the rate of gravity drainage that we can expect for structure that has a

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

dip of 400 feet per mile and the other conditions of the West Puerto Chiquito oil.

And of interest to us now when we're talking about these low capacity wells, they will have a transmissibility in the range of .02 to .06 or .08 Darcy feet, which is the lower lefthand side of this graph, and we can see that we're looking at gravity drainage rates of like 3 barrels to 8 barrels per mile, per linear mile. This means that if you have an area along the strike a mile wide that's draining with gravity drainage, the rates then are like 3 to 8 barrels a day.

And so we find that -- that -- and that's for 400 feet per mile. So we find when we get to these low capacity wells, that insofar as their tight block is concerned, if their tight block covers a very big area, that we're not looking at a very high rate of gravity drainage. We're going to have to look for something else to keep the wells producing.

Q. Then that brings us to Section G.

A. Yes, sir.

Q. The first part.

A. WE want to talk now about the influence of pressure maintenance on these low capacity wells and the first --as a preliminary to that, it's helpful to look at the rate of decline that was experienced in Boulder where they did not have pressure maintenance, and the wells were drilled

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

in what I would call -- and produced, in an uncontrolled fashion.

Now this is a 10-year graph, so compared with the ones we've been looking at, it's -- this rate of decline looks rather gentle, but actually it's about a 70 percent per year rate of decline, which is what they experienced at Boulder and what I think we would experience in our area if we didn't have pressure maintenance and control of the production.

Q. And what you would get from the west side of Chiquito without control.

A. Right.

Q. Then turning to part two?

A. Yes, sir.

Q. And I believe three is in conjunction with two?

A. Yes, sir. This is information regarding the Canada Ojitos Unit C-2, and this is the well that's circled in green on your map about the center of the map.

Q. That's in Section 2 of 25 North, 1 West.

A. Right. It had an initial producing ability of approximately 45 barrels a day. You can notice for the first two years, after we got the well fairly steadily on production, 1970 and '71, that was -- one of those peaks indicates production with a beam pump and another of them with a

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

Kobe pump, hydraulic pump, and in both instances we experienced problems in keeping the well steadily on production.

In 1971 we put the well on gas lift and it has been produced since that time with a very constant rate of gas injection and I think gives us a very good control of the ability of the well to produce, at least its relative ability. Now we might produce at a higher rate by using a higher volume of gas, but at least it's comparative.

And we have, you'll notice an almost flat rate of decline, zero percent, up until about 1976, and that's the year in which we cut back the gas purchased, and at that point it began to take on a rate of decline -- I have one curve here showing 3-1/2 percent a year, which might be a little bit above its --

Q. Starting in '76?

A. Starting in '76, uh-huh. It's actual rate of decline since '76 might be, oh, 4 or perhaps even 5, percent a year, which is significant and in a way it's a shame to see a drop in production like that resulting from failure to keep complete pressure maintenance, but if we compare it to the 70 percent a year that we might have without it, it's still very good.

Q. Mr. Greer, on this graph you show one -- well, I might say three red lines. One has a zero decline.

A. Right.

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

Q. And that was what you maintained in this well when you maintained pressure.

A. Yes, sir.

Q. Up to 1976 when -- when because of the cost of gas you had to not quite maintain the pressure you wanted.

Then it declined.

A. Right.

Q. Now you have another red line that has a very sharp dip.

A. Yes, sir.

Q. And tell us again, explain what is that line?

A. That line is a 70 percent rate of decline, which is the rate of decline that the Boulder wells experienced. I might add that had this well produced at that rate of decline it would have produced about 22,000 barrels of oil.

Actually, it's produced about 164,000 already and if it continues at the rate it's indicated, if you extrapolate that on out, that would reach about a total of 400,000 barrels, and if we assume that about 80 percent of that would have to be from solution gas drive, which it would be if it's producing from its own system and is not in conjunction with our overall pressure maintenance project, we just have to assume one of two things. The well's either

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

producing directly in communication with our -- our pressure maintenance project, or it's isolated from it in tight rock all its own. Under either condition you come up with several thousands of acres that the well's got to be produced.

Q. Well, on the -- on the Boulder method of projection, 20,000 barrels would certainly not be economic for these wells that cost what, nearly a million dollars?

A. They could cost all the way from $750,000 to a million dollars.

Q. All right. Then turning to the fourth and fifth parts of this section, which I believe ought to be taken together.

A. Yes, sir. This is similar information for the A-16 Well. The A-16 Well is the southernmost of the wells, the blue colored wells in the grey shaded area in Section 16.

Q. And again you've superimposed what the production would be without pressure maintenance?

A. Right.

Q. And again non-economical?

A. Right.

Q. You maintained a level rate of production as long as you maintained pressure.

A. Right, and when we -- when we stopped maintaining the pressure, we picked up a rate of decline of

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

about 7 percent a year, and here again, now, we know that the pressure is declining at the rate of probably not over 1-1/2 percent a year, and in addition, this well, the pressure is probably still above the bubble point. If we had nothing but a gas column from the surface of the ground to the well, we'd have close to 1500 pounds and the bubble point is 1520. And we know there's some oil in the reservoir left.

So this is another situation. We have a well that's producing at pressures above the bubble point, a rate of decline of several times in productivity compared to the drop in reservoir pressure.

Q. And another illustration of what you would have in this west part of Puerto Chiquito if there is no pressure maintenance maintained -- instituted.

A. Right. The critical thing is that even though we're maintaining pressure and at a fairly low rate of decline in overall reservoir pressure, still these low capacity wells are dropping at a rate which, well, it would be alarming if, for instance, we ceased gas injection altogether. There's no doubt that you instituted 7 percent a year, you'd be soon back to the 70 percent.

And starting out at such low rates, it's not so bad to have a 7 percent rate of decline in a well that has produced 1000, 2000 barrels a day, and you have it cut back because of gas/oil ratio, but it's the wells that you're

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

trying to produce everything they'll produce, these low capacity wells, that becomes critical to their being economical.

Q. That brings us to Section H.

A. Yes, sir.

Q. And the first part, tell us about it.

A. Okay. The first part of Section 8 is the reproduction of Figure 4-2 out of Appendix 4 of Exhibit Two of the '69 hearing. This shows the relative permeability ratios for fractured formations, and the dashed line is the line that I used to calculate the solution gas drive recovery from West Puerto Chiquito.

Once we had this information and the character of the oil, the amount of gas in solution, shrinkage, and so on, then it's just a matter of mechanics to calculate what percent of oil is recoverable. And any engineer's calculation, they may use different methods, but he'll come up with the same answer, and the answers are shown on the next graph.

Q. That's two?

A. Two, which is titled Solution Gas Drive Production History, and it's a reproduction of Figure 4-3 out of Appendix 4 of Exhibit Two of the '69 hearing.

And it shows the gas/oil ratio history, the pressure history, in the lower righthand corner about 5-1/2 percent of oil in place is about all that we're looking

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

at for solution gas drive.

Q. Then the third part?

A. The third part, then, is the repetition of the graph we looked at earlier, which shows barrels of oil in place per acre versus transmissibility. The area that we're concerned with is this lower lefthand corner, transmissibilities of 200 to 600 Darcy feet, and if this is a reasonable relation, which it appeared to be from the interference test and our estimate of oil in place at Boulder, then we would estimate for the low capacity area, that shaded in grey on our earlier maps, and on the little plat at the head of this other section, is something in the range of 200 to 600 or 800 barrels per acre. And that's all the oil that is in place.

And even if you say, well, we'll use 1000 barrels per acre in place for these low capacity wells and 5 percent of it, we're looking at 50 barrels an acre recovery for solution gas drive from the tight areas.

And that translates for 640-acre spacing about 30,000 barrels of oil, 32,000 barrels per well.

Q. Which is certainly not economical.

A. Not economical up to the cost of the well.

Q. Anything further on this exhibit?

A. No.

Q. Then that brings us finally to our last

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

section, which is Section I.

A. We show here the value of oil that we're looking at, hopefully, after October, 1981. The difference in the price of oil to the operators is going to be based on a result in the difference in the windfall profits tax.

We start out at $39.00 a barrel for everybody. We wind up inside the unit for an integrated oil company, the bottom line of this schedule, a little less than $16.00 a barrel; a qualified independent had $20.00 a barrel, whereas newly discovered oil would be $23.30 a barrel.

Q. Now a qualified independent would be less than 1000 barrels production, which takes a lesser windfall profits tax.

A. Yes, sir.

Q. And the second and the third parts, which I believe are related?

A. Yes, sir. Here we show the kinds of wells or production rates that would be required to -- to return the cost of drilling a well and how we arrived at what it would take to be a well that we would consider an economically producable well.

On the curve A, shows for a 70 percent rate of decline, the kind of production history we would anticipate for wells producing with solution gas drive to drain 640 acres, and on the lower sheet on the schedule, the upper

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

description of curve A shows that we would receive about $475,000, for a well of that character. Now this is for oil valued at $23.30 a barrel.

Curve B, then, is one that's required, you'd have to have a well of that character, which is 84 barrels a day initial production rate, producing with a 70 percent rate of decline, to give you a return on $750,000 well cost, plus 15 percent rate of return on your investment.

For comparison we put in the level line C, the curve C, which shows that if we can maintain a level production rate, we can start off with only 16 barrels a day, wind up with a 15 percent rate of return on a $750,000 investment, if we can maintain the pressure level.

Q. The next -- next part, which is four and five, which are related, I believe, again.

A. Yes, sir. This shows the same information that's going to apply for oil valued at $15.90 a barrel, which will be the value of oil inside a unit.

Here the comparative numbers are we have to get up to 123 barrels a day initial productivity and drain 1250 acres in order to obtain a rate of return of 15 percent on $750,000.

Q. This is a repetition of the previous one but with -- with --

A. Different oil.

SALLY W. BOYD, C.S.R.
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Q. -- old oil rather than new oil.

A. Right.

Q. Anything further on that?

A. No, sir.

Q. Mr. Greer, in my introductory remarks, or my opening statement, I made reference to the fact that our application suggested a pattern, drilling pattern, on 640-acre spacing of 165 feet from the center of any quarter/quarter section.

Koch has suggested that should be 330 feet and we concur in that, do we?

A. Yes, sir. I don't recall exactly where the 165 feet came from other than it resulted from the first hearing in 1963, and it seems to me that it was one of the Commission engineers who wanted that small window, but I don't recall why or any of the details of it. But as far as we're concerned I see no -- no problem with it, and as a practical matter when we get out and locate the well on the ground, I think the final location is going to result from what the forest ranger will agree to as to where we can put it. All of this land that we're talking about is -- nearly all of it is forest land.

Q And does the Forest Service like and approve wider spacing?

A. Yes, sir, they do.

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Rt. 1 Box 193-B
Santa Fe, New Mexico 87501
Phone (505) 455-7409

Q. It's less damage and interference with the native habitat of the forest.

A. Yes, sir, and if there were no other -- if everything else is the same, there are no other consideration, we ought to go to wide spacing just simply to protect the forest.

Q. All right. Mr. Greer, would you care to very briefly summarize what we have demonstrated in Exhibit One, Sections A through I?

A. Yes, sir. We've shown what is a reasonable calculation of the oil in place, wide communication and drainage, drainage of large areas by wells, and the necessity of maintaining pressure in order to have economically producable wells in the low capacity areas.

Q. Anything further?

A. Well, in order to have pressure maintenance and injection of gas, we have to have unitization, and we feel it's going to be essential to unitize the --

Q. Suppose you had a well drilled over in the west edge of the Puerto Chiquito, and there was no control on it, which under present circumstances that would be it. What -- what could this create?

A. You mean if we were to drill -- if the well were to be drilled outside the unit?

Q. Yes, to the west.

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

A. Of course if it's a small well and there's no channeling of gas to it, why there would be no particular problem, but if there could be a channeling of gas to it or if enough wells were drilled and they were produced at rates too high for the gravity drainage potential of the reservoir, why of course it could destroy the -- the entire reservoir, the entire 50,000 acres.

Q. And what could this mean in terms of barrels and dollars to the owners within Canada Ojitos Unit?

A. Well, of course, it would be a substantial effect. We'd be talking about hundreds of millions of dollars.

Q. What would that require on the part of the unit?

A. Well, that would mean that if such a well were drilled and existed and imposed a threat to the -- the proper production of the unit area, we would simply have to ask through statutory unitization that the well be brought into the Canada Ojitos Unit.

Q. Anything further?

A. No, other than that would be a painful process to the guy outside the unit because he'd be faced with lower price for his oil, and such as that, but painful or not --

Q. It would be nothing comparable to what it would do to the owners of the unit --

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

A. Right.

Q. And to the -- and to the conservation of oil or greatest recovery of oil in the area.

A. Right.

Q. Anything further?

MR. VERITY: We offer Exhibit One into evidence.

MR. NUTTER: Exhibit One will be admitted in evidence.

MR. VERITY: I believe that's all.

MR. NUTTER: Are there any questions of Mr. Greer? He may be excused.

Mr. Verity, we have received correspondence from a number of companies,

We have a Telex from Sun Gas, a Division of Sun Oil Company, supporting the application.

We have a letter from Mountain Fuel, signed by R. E. Pittum (sic) supporting the application with a larger tolerance for location requirements.

We have a letter from Tommy Roberts, representing Dugan Production Corporation supporting the application.

We have a letter from Randall Moke, representing Patrick Petroleum Company supporting the application.

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

We have a letter from Barrett Pierce supporting the application.

We have a letter from Jack London, Jr., representing himself, supporting the application, wholeheartedly supporting the application.

We have a letter from Jack London, Jr., on behalf of William D. Montin, Incorporated, wholeheartedly supporting the application.

We have a letter from Jack London, Jr., representing Montin-Hardwick Pipeline, wholeheartedly supporting the application.

We also have a letter from Koch Exploration supporting the application, and also making reference to the well location tolerance.

And I discussed this with someone from Koch over the phone the other day, and as a result I have worked up some figures on well locations.

Now the way the application was filed was for the well to be located within 160 feet -- 165 feet of the center of the quarter/quarter section. There are 16 quarter/quarter sections in a section and this, if each one of those was 165-foot radius circle would give you something less than 2 acres, so there would be a total of less than 32 acres in a section, which would be an admissable location.

Now on standard 40-acre spacing you're

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

allowed to drill wells within 330 feet of the boundary of the 40-acre tract. So you can drill within a 10-acre square inside the 40; in other words, 25 percent, or 10 acres of a 40 are eligble as locations.

Now I've worked up a possible solution to this that would allow a greater tolerance.

If a well were required to be located within 660 feet of the boundary of the section, that would be the outer boundary of the section, not closer than 330 feet to the quarter section lines and no closer than 5 feet to the quarter/quarter section line, this would add up to a total of 246 acres, 246.9 acres that you could drill on, or 38.6 percent of the total area in the unit.

This exceeds the amount that would be drilled on in a 40-acre pool. In the event, unlikely as it might be, that we could ever have an infill drilling program and go to 160-acre spacing, then no well would be closer that 160 -- 330 feet to the outer boundary of the unit, and in the event it ever went to 40-acre spacing, it would be no closer than 5 feet to the outer boundary, but I don't think that's going to happen.

MR. VERITY: All right, that's -- that certainly would be acceptable to us.

MR. GREER: Oh, I see no problem.

MR. NUTTER: You represent Koch?

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

MR. FRIEND: Yes.

MR. NUTTER: Does that sound satisfactory to Koch?

Okay, does anyone have anything further they wish to offer in Case Number 6997?

We'll take the case under advisement and the hearing is adjourned.

MR. VERITY: Thank you, sir.

(Hearing concluded.)

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

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 C.S.R.

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

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 6997 heard by me on 8/6 1980.

_____, Examiner
Oil Conservation Division

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION
STATE LAND OFFICE BLDG.
SANTA FE, NEW MEXICO
6 August 1980

EXAMINER HEARING

IN THE MATTER OF:

Application of Benson-Montin-Greer Drilling Corporation for amendment of pool rules, Rio Arriba County, New Mexico.

CASE **6997**

BEFORE: Daniel S. Nutter
(On 7 August 1980)

TRANSCRIPT OF HEARING

A P P E A R A N C E S

For the Oil Conservation Division: Ernest L. Padilla, Esq.
Legal Counsel to the Division
State Land Office Bldg,
Santa Fe, New Mexico 87501

For the Applicant: **George L. Verity, Esq.**
BAY, HAMILTON, LEES, SPEARS & VERITY
501 Northwest Thirteenth
Oklahoma City, Oklahoma

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

I N D E X

ALBERT R. GREER

Direct Examination by Mr. Verity 9

E X H I B I T S

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

MR. NUTTER: We'll call Case Number 6997, which is the application of Benson-Montin-Greer Drilling Corporation for amendment of pool rules, Rio Arriba County, New Mexico.

Call for appearances.

MR. VERITY: Mr. George L. Verity, and Tom Kellahin for the applicant.

MR. NUTTER: Are there other appearances in Case 6997?

Mr. Verity, would you proceed?

MR. VERITY: Yes, Your Honor. I think that a brief opening statement might be helpful and I would like to make a few remarks and comments in this regard.

In the first place, I'd like to say that after several years it is a pleasure to be back in New Mexico generally and before this Commission in particular. I spent several very pleasureable years out here and a lot of my fond memories are of this Commission.

Today I'm back again on Puerto Chiquito. Puerto Chiquito first came before this Commission prior to 1963 when the -- when Benson-Montin-Greer requested the Commission to approve the Canada Ojitos Unit.

Then in 1963, after a well was drilled, and possibly two, they came before the Commission and we requested 160-acre temporary spacing. At that time both East

SALLY W. BOYD, C.S.R.
Rt. 1 Box 193-B
Santa Fe, New Mexico 87501
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and West Puerto Chiquito were thought to be one pool. Shortly after that, or a few years after that, it was realized that there was a barrier between East and West Puerto Chiquito, and it was -- an order was entered to establish it as two pools.

In -- after 1963, when five wells had been drilled in a cluster with approximately -- yes, approximately two miles distance between two of them, Benson-Montin-Greer had the courage and it takes quite a bit, to interrupt all of the production from all five of those wells for a period of sixty days so that they could conduct one of the most remarkable interference tests that I've had the privilege of having anything to do with or having heard of in many years of oil and gas practice in Texas, New Mexico, and Oklahoma.

This interference test was conducted in 1965 and in 1966 the results of it were presented to this Commission in Cause Number 3455, which the 1963 hearing was the same number.

At that time it was established that there was -- that the pool was definitely a Niobrara with three sections in it; that it was a low grade reservoir; that there was wide drainage; that everyone of these five wells were affected by anything that happened in any one of them; and 320-acre temporary spacing was requested.

B-M-G expressed complete opinions with

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

regard to the pool and how it should be developed at that time and today, after seventeen years of history of the West Puerto Chiquito - Mancos Oil Pool, all of the theories and opinions that were expressed to the Commission back at that time have been established and are now a matter of history.

It isn't always the case in any oil field that management will permit the remarkable engineering that has been achieved in this pool. Pools like the Boulder Pool, immediately to the north, just a few miles to the north of West Puerto Chiquito, was the same type of pool, the same structure, the same relative circumstances, and as these wells do in fractured -- in a fractured zone, as we have here, they frequently come in large, that happened in the Boulder Pool just as it's happened in Puerto Chiquito, but up there they didn't fully appreciate the nature of the pool and what it was. They hurriedly got an 80-acre spacing and drilled it up on 80 acres. They didn't realize that pressure maintenance was necessary, and after a period of five years the wells were pretty well all gone, and they left a great amount of reserves in the formation that could have,with the type of engineering that has been practiced in the Canada Ojitos Unit and West Puerto Chiquito,recovered a much greater percentage of the oil in place.

Shortly thereafter the 320-acre spacing and the dramatic interference test that I referred to earlier,

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

B-M-G and the management of Canada Ojitos established a pressure maintenance by injecting gas in the upper edge of the pool. Without this pressure maintenance and controlled development of the pool on a scientific petroleum engineering basis, we would only have been able to recover approximately 5-1/2 percent of the oil in place under Puerto Chiquito; whereas, as it has been developed we expect to recover between 50 and 60 percent of the oil in the high capacity system and up to 50 percent of the oil in the low capacity system, which Mr. Greer will explain to you during his testimony.

MR. NUTTER: What's your estimate of the recoveries up there in Boulder-Mancos?

MR. VERITY: In -- up in Boulder-Mancos I don't know exactly what those recoveries were, but they had a 70 percent decline per year of their recoveries.

Our evidence will show you that even on the low capacity wells, that we have been able to maintain the initial production of those wells over a period of years so that we will show that not only the high capacity but the low capacity wells, also, drain a wide area.

We have two wells which we will be talking about along with the others, one, the well in Section 10, had produced 2-million barrels of oil and we will show that this has drained an area of approximately 6000 acres. The L-11 Well in Section 11 has produced a million barrels of oil

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

and that has drained an area far in excess of 640 acres.

The initial five well interference test enabled us to establish that the oil in place in this area was between 1500 and 2500 barrels. Then after that interference test B-M-G took one of those wells and never put it back on production and used it, and it is still being used, as an observation test well.

Then when they started injecting gas in the upper side of the pool, they were able to run additional interference tests, and by those interference tests at that juncture, they could more particularly refine their knowledge with regard to the amount of oil in place and they knew then that it was between 1600 and 2000 barrels. They think actually that it's probably towards the lower bracket of those two figures.

This brings us to the problem which is before us today, which is the zone or the area on the west edge of West Puerto Chiquito, which has not to this time been developed. It is most probably underlain by oil. We don't know yet whether that is positive or not and we don't know for sure whether it will have high capacity or just low capacity system. But it requires planning and today we think requires action of this committee.

If that area is to recover more than merely a 5-1/2 percent of the oil in place, then there is going to

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

have to be pressure maintenance over there. We are not today in a position to request pressure maintenance, which must be preceded by a unit, but it is in B-M-G's plans that a unit be formed in that area, but today, and as a preliminary step to that, we request 640-acre spacing.

If that area is developed, as Boulder was, they would have approximately 8000 barrels of recovery to an 80-acre spacing and would not be able on 320-acre spacing to obtain a profitable well. It would not be economically feasible.

So as a first step there we today request, and will prove, we feel, that we are entitled to have the spacing changed from 320 acres to 640 acres.

I am pleased that I believe all of the working interest owners in that area, at least all who have responded to the Commission, have supported 640-acre spacing. And I believe there have been four operators that have responded and supported our application.

One of them, Koch, has requested that the spacing provide for a distance of well being drilled 330 feet from any -- center of any quarter/quarter section, whereas our application just picked up the 165-foot distance that was in the previous orders.

We actually concur with Koch's position on this and think that it would be better to have 330 acres --

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

330 feet from the center of the quarter/quarter section rather than the 165 feet that is expressed in our application.

We will have one exhibit with comprehensive parts to it, and it is of its nature based on previous studies that have been presented to this Commission in the 1963, 1966, and 1969 hearings in Cause 3455. For that reason, in order to -- that we may be more brief and not have to go through all the details of our calculations which are in those records, we would like to incorporate the record of those three hearings in that cause number into this record.

MR. NUTTER: Okay, it's three hearings in Case Number --

MR. VERITY: In Case Number 3455. That was the 1963, 1966, and 1969 hearings in that cause.

MR. NUTTER: The record in Case Number 3455, the hearings held in 1963, 1966, and 1969 will be incorporated by reference in this case.

MR. VERITY: Good. With that, I'd like to call Mr. Al Greer to the stand.

(Witness sworn.)

ALBERT R. GREER

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

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

DIRECT EXAMINATION

BY MR. VERITY:

Q. Will you please state your name?

A. Albert R. Greer.

Q. Mr. Greer, what is your occupation?

A. I'm a petroleum engineer and officer for Benson-Montin-Greer Drilling Corp.

Q. You're a graduate petroleum engineer?

A. Yes, sir.

Q. You have testified before this Commission on numerous occasions as an expert petroleum engineer?

A. Yes, sir.

Q. I believe that Benson-Montin-Greer is the operator of the Canada Ojitos Unit.

A. That's correct.

Q. And you have been the engineer that has designed and carried out the program of development and production of that unit?

A. Yes, sir.

Q. Have you -- having done that, you have, of course, more than made a study, you've progressed with all the development of the unit and are intimately familiar with all of the scientific and engineering mechanics that have gone into the development of the pool?

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Rt. 1 Box 193-B
Santa Fe, New Mexico 87501
Phone (505) 455-7409

Q. Are you also familiar with the development of the Boulder Pool to the north of Puerto Chiquito?

A. Yes, sir. Of course we don't have as much information on Boulder as our own operation, but I'm familiar with what's been published.

Q. I direct your attention to what the reporter has marked as Exhibit Number One. Did you prepare this exhibit?

A. Yes, sir.

Q. Mr. Greer, I notice that it is made up in sections A through Section I, with several parts in each section.

A. Yes, sir.

Q. And will our testimony develop its way through that exhibit from A to I?

A. Yes, sir.

Q. Was this exhibit prepared by you and under your supervision?

A. Yes, sir.

Q. I notice that there is an index to the exhibit prior to Section 1. Turning on past that exhibit -- I said Section 1. I mean Section A, turning on past that to Section A, will you please address yourself to the first part of Section A, which I notice is a map, and tell us about it.

A. Yes, sir. Well, first we might should point out in regard to the index and some of the exhibits, be-

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

fore we pass on.

Q Yes.

A A number of the exhibits are -- are reproductions from exhibits of earlier hearings, and where that is the case, we've noted that in the index and we've identified the case number and the exhibit and as we come to those, I'll try to identify them and in order to save time I'll just refer to the '66 hearing or '69 hearing exhibit, such as that.

Under Section A the first plat is a new plat at this hearing, and it shows the East and West Puerto Chiquito Pools outlined, with the East Puerto Chiquito being on the right; the West Puerto Chiquito being on the left, and it has -- the West Puerto Chiquito is outlined in orange.

Within the West Puerto Chiquito Pool is the Canada Ojitos Unit, which is identified with a green boundary. In the north part a proposed North Canada Ojitos Unit with a purple boundary, and to the west, a proposed West Canada Ojitos Unit, and that's shown in a pink color.

Also is shown in a grey shading the exception tracts, which are irregular tracts required to meet the 640-acre spacing proration unit without -- or where we could not meet it because of the boundaries or the irregular sections themselves having less than 640 acres in them.

Q Mr. Greer, that -- each of these units is 640 acres where it's possible to make it so, is that correct?

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Phone (505) 455-7409

A. Approximately. There are a couple of exceptions to that.

Q. Across the south boundary of 27 North, 1 West, there are some small ones, and the nonstandard one in Section 1, 24 North, 1 West.

A. Yes, sir.

Q. I notice, Mr. Greer, that -- that there is only one well in any one section, except for Section 11 of 25 North, 1 West. Do you have any remarks to make about that?

A. Yes, sir. Those two wells are actually about 4000 feet apart, about 4/5ths of a mile, and are actually farther apart than some wells will be where there's just one well to a section. But in a sense, the spirit of our application is that there be only one well to a section and in that because of that we will plan on just producing one of those two wells in that section. We'll leave the other one shut-in as an observation well.

So we do not need an exception for Section 11.

Q. Which well do you plan to have -- to make the unit well?

A. We would probably produce the down dip well, which would be the one to the west, the L-11.

Q. Now, then, do you plan any other units

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

in the West Puerto Chiquito?

A Yes, sir. Before we go to that I suppose we should talk about the spacing unit in Section 1, that 320-acre tract.

Q All right, yes, Section 1 of 24 North, 1 West. Go ahead.

A That's the only irregular unit less than 640 acres and the reason for that is there's an injection well on that north half of Section 1, and in the south half of Section 1 there is a small window of fee land that is not committed to the unit agreement, and if we were to include that in the whole spacing unit, we'd have to force pool or something, and the owners preferred not to be worried with that kind of an action and the gascap acreage doesn't have a large equity, so there's not much at stake to the royalty interest, and they just preferred not to mess with it. So --

Q So we ask an exception there to the 640 acres in the north half of Section 1 being it.

A Yes, sir.

Q Now then, turning to possibility of other units.

A Yes, sir. We hope to form a unit in the north part of the pool, the North Canada Ojitos Unit. That's all Indian land. We've had some time. It seems to take an awful long time working with the Indians to form units. We

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

were several years in getting their approval of the East Puerto Chiquito Mancos Unit, which is also shown on this plat in the north part of the East Puerto Chiquito Pool.

And as a preliminary step to reaching unitization up there, we plan on a working interest unit initially and commingling the oil and gas and installing a gas lift system in order that we can be in shape the instant we get their approval to have the gas gathered and -- and so that we can drill an injection well and inject gas, and in a sense we would have the same kind of an operation on a smaller scale in this unit as we have in Canada Ojitos to the south. We weould not expand the Canada Ojitos Unit to the north because of the Indians have always objected to putting their land in with others, particularly where they are a minority share of the unit.

But we see no problem there in the two units meeting and both injecting gas.

Then to the west we propose the West Canada Ojitos Unit and here we have a more complicated problem in a sense, in several senses, we have a more complicated problem. The first and most logical plan to develop this acreage would be simply to expand Canada Ojitos to the west, but we have a problem there in that the Federal regulations regarding pricing of oil and windfall profits tax. Oil presently within the unit is receiving a price of about $6.25 a

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

barrel plus, depending on where the production for any one month falls with respect to its base period control level. The same oil produced just across the line would receive $39.00 a barrel. If we expand the unit and drill wells in the new area to the west, then we'd be under the same situation of $6.00 oil plus whatever increases we get being above our base grade production level.

Now the price of oil, of course, is supposed to be equalized in this phased de-regulation of oil prices by October of 1981. That could eliminate the difference in prices in that problem as of that time, but still we have a difference of a windfall profits tax being higher on the acreage -- or the lands inside the unit, the wells inside the unit, as compared to those outside, or if we formed a new unit.

MR. NUTTER: Well, Mr. Greer, is the oil over in this west side better than the oil to the east?

A. That's a good question. That's a good question. Unfortunately, the laboratory analysis, I'm sure, if the wells are drilled, will show it to be exactly the same, same character, same quality.

Just one of those unfortunate things that makes a problem in developing our oil properties.

The other difficulty is and we propose this new unit, and then that's the only reason, of course, so that we can receive a fair price for the oil, is that we can-

SALLY W. BOYD, C.S.R.
Rt. 1 Box 193-B
Santa Fe, New Mexico 87501
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not inject gas in that area itself. I think that it will -- from what we know now, there's no rational or reasonable plan that we can devise that would let us do that. The character of the formation is such that I just don't believe it would work.

The dip of the formation is too shallow and if it has the permeability, the transmissability that I think it will have, injection wells there would result in gas just channeling within a matter of days, if not hours, to the producing wells, and it just would not work.

But we believe that we can maintain pressure in that area from the main unit to the east, and I see no problem mechanically in doing that. The problem that we have is a boundary agreement between the two units, and this, of course, will be one of the most complicated features of the development plan. But once we've -- have overcome that, and we've made some initial steps in solving that, I see it as a practical approach, and hopefully within ten years set out in the law, the windfall profits tax will phase out and at that time hopefully we could join the two units into one. The timing necessary to do it would be when we would be marketing gas from the west area. Up until that time, as long as we're gathering gas, saving it and storing it, I see no problem.

Q Very well. I meant to say at the start,

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

and I want to say now, that I hope Your Honor will interrupt for questioning any time there's something that you don't quite understand or you would like to explore more fully, and as a matter of fact, I also would like to invite Mr. Friend, I believe it is, and Ms. Umshler, who are here from Koch and from USGS, to interrupt with questions as we proceed with this testimony, because I want everybody to understand it and I think that that would save time and be the best way to do it, Your Honor, and we invite that.

All right, Mr. Greer, now directing your attention to the second part of Section A of Exhibit One. Will you explain that exhibit to us?

A. Yes, sir. Here we'd like to go a little bit beyond, or outside the scope of engineering, perhaps, to talk a little bit about the reasons why this pool might be where it is, and some of the geological concepts as to why we find oil in these places, and as a result, then, where the probable boundaries of the pool, the reservoir, are, and then from that to draw some conclusions about the expansion of the area with additional development.

And I might say at the outset that just as all the engineering features have been interesting in this pool, one of the most interesting ones I've ever studied, so are some of the geological concepts.

The theory that I like best, the one to

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

which I subscribe, as to why this oil reservoir exists where it is, has to do with the fracturing of the formation and creating of reservoir void space by fracturing, and this is brought about by flexing of the formation.

Since our 1969 hearing one of the geologists who work for us made a study based on the fracturing characteristics of dolomite and calcite and he came up with the theory that where you have a high percent of dolomite, that the formation is more brittle, more apt to fracture than if it's calcite, and he found a high percent of dolomite in wells in this area, and when we add those two things together, it makes sense to me.

Now there are some other theories, one of which we have the old "creekology" theory that, we've had some of the geologists come to us and say, well, we can trace the canyons here and where the good wells are and it's old "creekology", and of course, the answer to that is that where this pool lies in Santa Fe National Forest, a really beautiful forest, topography is rugged. Differences in elevation of 1000 or 1500 feet in just a short horizontal distance, the net result of it all being that from a standpoint of not destrying the forest, doing our best to operate here and to protect it, and also drill wells at minimum cost, we just keep them in the canyons where it's easy to get to them.

So that kind of answers the "creekology"

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

theory, but pursuing the "creekology" theory, we've had some of the geologists that subscribe to the fault theory, that here are faults and where you have faults is where the production is, and they give us an east/west fault down through some of the better wells, and of course that sounded fine until we -- until we drilled a well 3 or 4 miles north of their fault system and got another good well, and then we drilled 3 or 4 miles south and we got another one, and then they have to go back to their areal photo maps and try to find some more lines they didn't see at first.

So the end result of all of it is that the one theory or concept that seems to best fit this reservoir is the one where the formation flexes, you have fracturing, and where you have fracturing you have, over a fairly wide area, reservoir with enough porosity and permeability to give production, allow production.

And when we ran an interference test that pretty well confirmed it, in that there's just no way that we have a high concentration of oil in any one area. It has to be small volume of oil per acre over a large area.

Briefly, the flexing features that we recognize here, first I might say that the boundaries of the pool on this map, the more or less north/south orange colored line is one that separates the East and West Puerto Chiquito Pools. The north boundary is the north part of the map. The

SALLY W. BOYD, C.S.R.
Rt. 1 Box 193-B
Santa Fe, New Mexico 87501
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west boundary of the pool is the west part of the map, and the south part of the pool is the south part of the map.

We can look about the center of the map on the east side near the C-5 injection well, and the color coding and symbols of these wells, the triangular ones are injection wells; the blue are wells -- are shut-in observation wells; those colored in red are the ones that are currently producing.

Near the C-5 Well in the blue shaded area is the first flex from the outcrop, and moving a couple miles to the east, the dashed line is the outcrop of the formation that produces here. And the dip of the formation from the outcrop into the blue shaded area runs from like 2 to 3000 feet per mile. It's a steep dip, fairly uniform dip, and in areas, not here, but on the west side of the basin, where we cored wells in this part of the formation, we'd always find a hard, tight, compact, no transmissibility.

MR. NUTTER: As I understand it, Mr. Greer, now you've got 200 foot contours, right, like right there where the C-5 is?

A Right, and to the --

MR. NUTTER: And to the east those are all 1000 foot contours.

A Those are 1000 foot, right, and at that point at the blue coloring to the west, we start with 200 foot

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

contours. And there in the blue shaded area in Section 5, why, instead of 2-to-3000 feet per mile, we're down to about 1000 feet per mile, so there's the first real flex.

Then the green shaded area, we're looking in round numbers at 4-to-500 feet per mile, so there's another flex.

Then in the brown shaded area we drop down to about 200 feet a mile.

And then when we get over into the grey shaded area, why, it's less than 200 feet a mile, maybe 100 feet a mile, and on farther west within the pool, we're looking then at a fairly flat dip of less than 100 feet per mile.

The best wells have been those right up and down the center in and near the brown and green shaded areas. To the north there's a deterioration of -- of the production, and the zones we can see a little bit on some of the cross sections we'll look at later, the four wells clustered at the end of the coloring, the brown coloring to the north of those four, two of the wells have capacities like 30 to maybe 50 barrels a day. Two of them have capacities less than 10 barrels a day.

Then on the very south part of the pool, in that blue shaded area, the contours spread again and we feel that not only is there a shallow dip there, that probably will be unproductive, but also this is sort of a re-

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

entrance. We can see that the, moving from right to left across the blue colored area, you're just moving up a little valley, in a sense. Where we've had the same kind of a re-entrance in East Puerto Chiquito on the very north part of the pool, we've also had low capacity or nonproductive wells.

Now we don't know that the south part of the pool south of the unit will be nonproductive and we think it should not be taken out of the pool until somebody wants to drill a well there and determine for certain, but our feeling is it probably will not produce.

On the east boundary we believe we've pretty well defined that by the change in the flexing of the formation as it falls generally, that east side of the blue shaded area and our orange boundary between the two pools.

To the north, between the orange colored boundary and the green and blue shading, where we have no coloring at all, is an area of fairly uniform dip, and my feeling is that it probably will be a very low capacity wells, if any at all, in there, and the only value we can see of that probably would be for location of an injection well or two to take care of the wells in the proposed North Canada Ojitos Unit.

MR. NUTTER: Mr. Greer, is this change in dip and flexing evident from the surface or is it too mountainous to see it?

SALLY W. BOYD, C.S.R.
Rt. 1 Box 193-B
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A. It's pretty hard to see. Right at the outcrop you can get a good dip of the formation there.

MR. NUTTER: At that point.

A. At that point, and that then fits pretty well the subsurface control in that area. And from there on we're limited pretty much to the -- to the subsurface work.

Q. Mr. Greer, would you explain briefly for us the plan of your Canada Ojitos Unit?

A. Yes, sir. After we ran the interference test in 1965, and it confirmed some of our earlier suspicions, you might say, of the character of the formation, we concluded a couple of things.

One was that we had to have wide spacing. We had to have control rates of production in order to try to achieve gravity drainage efficiency, and this was an instance where pressure maintenance could have a most dramatic effect. Most pressure maintenance projects, we look at increases in production of something comparable to primary production. If, for instance, the primary production from a field is like a million barrels, why, in round numbers and rule of thumb, you ordinarily can say, well, by waterflooding we might get another million barrels, and by tertiary methods, perhaps, you can get up to that amount again.

But you're looking at only, ordinarily, something like doubling what you might otherwise get.

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

In this instance where we can achieve gravity drainage recovery, as compared to the solution gas drive recovery, which is what you're going to get if you don't take special measures, we're looking at like ten times as much recovery, and -- and the way to achieve the gravity drainage recovery is -- is to keep the production rate low enough so that it's within the gravity drainage potential of the reservoir. And two things are required to do that. One is keep the production rate low. The other thing is do whatever you can so to keep the reservoir's capability of giving a high gravity drainage rate up. And how do you keep that capability up? Well, the answer is to keep the pressure up. We've found, first by just general information from other pools that produce in this formation, that wells seem to have an exceptionally high rate of dropping in productivity with dropping pressure, and it could not be explained with relative permeabilities or any of the customary engineering features of production.

We hypothesized that maybe it's the fractures squeezing together as the pressure drops off. We found in our wells here, varying from well to well, ratios of like 3 to 10 to 1, and by that I mean if the reservoir pressure drops 1 percent, the productivity might drop 3 to 10 percent. Or if the reservoir pressure drops 5 percent, the productivity can drop 50 percent. And this, under condi-

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

tions of pressures above the bubble point, which are not influenced by gas/oil ratios, relative permeability, or anything else.

So we concluded we needed to maintain the pressure. We investigated how that might be done, whether by waterflooding or gas injection. And we, in that study we coined a phrase of channeling potential, which we described in our -- in the 1969 hearing, and we concluded that we could maintain pressure with injection of gas, as compared to injection of water, with roughly 1/50th to 1/100th times as many wells. In other words, we could maintain pressure, we estimated at that time, say, with one or two wells in the gas-cap, that would take 100 to 200 wells of water injection wells to maintain the same pressure, and yet inject at a low enough rate in each well to not have the water channeled to the producers.

MR. NUTTER: Mr. Greer, have you had any experience, you mentioned that if you dropped the pressure there's a possibility of fractures squeezed together and you lose the permeability and productivity. Have you had the experience anywhere where you've restored injection and increased the pressure and had those fractures open back up again?

A. Yes, sir, as near as we can tell, and unfortunately I've misplaced the statistics of that, but we did

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

check it. When we get to one of the exhibits later where we show where we injected gas and the pressure was increased, not because of the volume but simply the interference effect, we had very close control on one of our -- the one well that I was watching for that purpose, and we did restore not only the productivity but the productivity index, and it was admittedly a fairly small increase in pressure, but it was measurable and it was there.

And how far back we could go with that, of course, no one knows, but it did happen in this one well that we had the control on.

Q. The next exhibit, Mr. Greer, of Section A, is a log. Will you tell us about it?

A. Yes, sir. This just shows generally the three zones that we found to be productive that's in the Niobrara member of the Mancos shale, which is the source of the production in the West Puerto Chiquito Pool.

The top zone we call A and the second one B, and the bottom zone C. The little shading within the colored zones are parts of the formation where we have found either productivity natural or zones that have responded to frac treatment.

In the south part of the unit most of the production comes from Zone C, the bottom zone. In the north part of the unit most of the production is from Zones A and B,

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

Q The next part of Section A I see is a cross section. Will you go over the details of that?

A. Yes, sir. We wanted to show this cross section essentially to bring out the fact that the producing interval in the entire area has roughly the same thickness in any one of these zones throughout the area.

We have a large difference in production, productivity, cumulative production, such as that, between the wells, or among the wells, and this has come about because of wide drainage, not because in one well, for instance, the zone is 10-times as thick as in another one. It just is not there.

Also, we can see that Zone C, the lower zone, has sort of deterioration, both to the north and to the south; also slight deterioration of the A and B Zones to the south.

That's about all we need to show with this.

Q. Then turning to Section B of Exhibit One, the first part is in four divisions. Will you go over that with us?

A. Yes, sir. Now this is a -- we go over here in a summary fashion the 1965 interference test, and this particular plat, the first plat under Section B, is a repeat of Section J-1 of the Exhibit Three in the 1966 hearing. At

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

that time there were only five wells in the West Puerto Chiquito Pool. We conducted this interference test in four phases. The first phase we show in the upper lefthand corner. We had all five wells shut-in.

In phase two we started producing the well colored in red, the P-11, and we produced it for awhile.

Then in phase three we continued producing the P-11 Well and put the L-11 Well on production.

And in phase four we put the A-14 on production and had three of them on production and two wells shut-in.

Now the wells that were shut-in, three of those were used as observation wells. That's the three south wells, the A-14, the K-13, and A-23. And the distances between the wells are shown on these plats. For instance, in phase two, when we started the test, the maximum distance from the producing well to an observation is about 7000 feet. In phase three, when we put the L-11 on production, the maximum distance was up to about 9000 feet.

Q Mr. Greer, this was -- these tests were the first time that you actually proved your wide drainage?

A Yes, sir. When we drilled the last well to be drilled, I believe, on this -- at this time, of these five wells, I believe it was the L-11, and in the course of completing that well and measuring fluid levels on it following

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

the frac treatment, which is something we've always done, I began to suspect that the behavior of the fluid level, which is a reflection of the pressure in the well, was being affected by production from the other wells, like a mile away, and that well was completed in the fall of 1964, and so because of that thing, we devised this interference test run in 1965 to confirm what appeared to be just the most unusual communication among wells.

Q. And that was the last time that you drilled two wells in one section --

A. Yes, sir.

Q. --- was in Section 11?

A. Right.

Q. Turning now to the second part of Section B, will you explain this plat to us? Or graph.

A. Yes, sir, this graph shows the production rate during and before and after the interference test, and it shows the fluid levels in the observation well during the test, and this also is a repeat of part of this 1966 hearing, Exhibit Three, Section 7 -- or Section J, Part 7.

The production rate is shown on the bottom of the graph with the shaded area. The scale is on the left-hand side. We were producing in the range of 1500 barrels a day until April. We shut all but a couple of the wells in and reduced the rate to about 500 barrels a day. During that

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

period of time the fluid level in the A-14 -- and these fluid levels, now, are measured with a wooden float on a wire line, on a Halliburton wire line, and we found that we could measure pressure differences very accurately that way. It has a high sensitivity. Our men got to where they could measure the fluid level within a half a foot, and the oil weighs about .3 of a pound per square inch per foot, so that means that they could measure pressure differences like 15/100ths of a pound.

We'd take fluid levels at least once a day, sometimes twice a day in these observation wells, and we'd see, in the month of May, for instance, the fluid levels on the A-14 appeared to be dropping and we thought, well, that could possibly be the result of the wells that were producing.

We shut all the wells in early in June and the fluid levels built up, and let them build up for a couple of months, and which incidentally, was a delay in production for this entire test of about 60,000 barrels there and for the other two periods of time a total of, oh, 70 or 80,000 barrels of production, delayed production, which even at that time represented several hundred thousand dollars cost of the test. To run a test like that today would be to delay three or four million dollars worth of production, and it's just unlikely that one would ever run another test like this.

Q. Did you have any trouble getting your management to go along with that at that time?

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Rt. 1 Box 193-B
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Phone (505) 455-7409

A. We fortunately have a lot of good partners. They realized the importance of the test like this and they went along with it. It was so dramatic and so important, we felt, that we were going to be developing a pool in a fashion heretofore not heard of; we would be asking for large participating areas from the USGS; we would be asking the Oil Conservation Commission at that time for spacing wider than normally approved for oil wells, and because of that, we, although I knew we would later on present this information, of course, under oath and I knew the people would believe me, nevertheless we thought it would be good to have witnesses. And so we asked the Conservation Commission and the USGS to send engineers out and help us witness this test.

And where we have the little solid color square flags are points which were -- we had witnesses of either the Oil Conservation Commission or the USGS, or both. So we had not only a good interference test, we had a well documented and observed test.

Q. Both the USGS and the Commission were not present at each and every one, but one of them or both of them.

A. At wherever there's a flag.

Q. Now I notice on this exhibit you have little inserted plats. Does that demonstrate the --

A. Those are the phases.

Q. -- phases of your interference test?

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

A. Right.

Q. So in the first one of those, which appears in June and July, you have no black well indicated, so all of them are shut-in during that 60 days.

A. That is correct.

Q. And then the next one shows one, and three, and the last one four?

A. Right. And I might point out, about mid-July -- no, it was about the 23rd or 24th of July, we produced the P-11 for a couple of days, and you can see the immediate effect on the fluid levels of the observation wells when we put that well on production. We produced it that way for a purpose. The purpose was to draw the fluid level down in the annulus so that we'd have a solid column of gas from the surface to the pump. That way -- and then we pumped all of the oil and the gas up through the pump, rather than the customary method of bringing gas out the annulus. The reason for that, being that with a solid column of gas from the surface to the pump we could, then, by taking dead weight pressures on the surface, have a very accurate measurement of the working pressure of that pump. And so we could determine the operation pressure very accurately by doing that.

Then we started our test --

Q. And you got an immediate effect in the other three wells?

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

A. Well, just conditioning the well to get ready to --

Q. Yeah.

A. -- take the test showed up on -- we hadn't planned that, but that's the way it turned out.

Because of that, then, we had in mind starting our test within a day or two after -- after we conditioned it, but in view of the fact of the reaction we got, we thought we'd best wait a few more days until it took on the character that they had before.

Then on about the 4th of August, we started producing one well, the P-11, we can see these first flags, or the second set of flags, we witnessed the fluid level before we started the well up and then approximately 24 hours later, and it's interesting that at distances up to 9000 feet, not quite 2 miles, from the producing well, we could measure the pressure interference on the observation well, the A-23.

We produced that well, then, for about a month and we conditioned the L-11 and put it on and started the L-11 test, then, about the end of September.

MR. NUTTER: I think you stated that that was a distance of about 9000 feet. That was about 7000 on that one, Mr. Greer.

A. Oh, right.

MR. NUTTER: From the P-11 to the --

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

A. Right, right you are. I'm mistaken. It's about 9000 when we started the L-11.

Q. 6950 from the P-11 to the A-23.

A. Right; right. I was wrong.

Then at the end of September we started the L-11 is when we had the 9000 foot distance, and it, too, showed up in 24 hours.

MR. NUTTER: Now the P-11 was on production while -- it remained on production, and then you started the L-11.

A. Right, in addition. You can see the increase in production there at the end of September where we went from roughly 500 barrels a day to roughly 1000.

Q. That's on the bottom of the chart.

A. On the bottom of the chart, uh-huh.

MR. NUTTER: And the dip in the pressure decline, or the fluid level decline, steepens.

A. Steepens.

MR. NUTTER: Where the other wells --

A. Then the A-23 Well, that one that's the upper observation well on this graph, is the one that has been an observation well all its life. I think we produced it about a month or two. It had a capacity of about 150 barrels a day. When we ran this interference test we decided that we just didn't need that well. We could produce all the oil out of the

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

others and it could far better serve our needs by just being an interference -- or an observation well. And so it has never produced since that time. We've used it always as an observation well.

Q. Turning now to the next exhibit of Section B, which I believe is a portion of the first part, will you explain that to us?

A. Yes, sir. This is the third part of Section B and it's a reproduction of Section M-2 out of Exhibit Three of the '66 hearing.

Q. Excuse me, you said the third part of Section B. You mean the second part of Section B.

A. Right, Section B, second part.

Q. Being --

A. No, I believe it's the third part.

Q. Well, I beg your pardon. I beg your pardon, the third part, let me get that straight. Thank you, it is the third part of Section B. Go ahead.

A. Here we show the interference effect, the amount that we or I judged would be the interference effect on the L-11. We projected the interference effect caused by the P-11 and where the fluid level would -- probably would have been had we not put the L-11 on production.

Then from that interference effect we can calculate then oil in place per acre, and I might say that

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

this is about the only way in a fractured formation like this that you can calculate oil in place correct. There's no way to core the wells or to try to determine from logs or any other way. We didn't know how accurate this would be when we first ran this test, but all the indications were that it was a good and a reliable test, and I had a considerable amount of confidence in it, in the test within the limits at which we believed -- or how accurate we thought we thought we were with the test.

Q. Then turning to the next sheet, the next part of Section B.

A. This is a repeat of Section N-1 out of Exhibit Three of the '66 hearing, and in that 1966 hearing we show in detail the -- just exactly how we calculated the oil in place per acre, all of the details of the calculation taking the formula from the beginning to the end. The formula we used was the exponential integral solution of the diffusivity equation, and that I felt was the best -- the best relation to use. It depends on -- it's based on a point source, which of course we don't have a point source. We have a well, not only a well, but it has been fracd and there have been other solutions to that equation, particularly taking into account the length of fractures, or presumed fracture following a frac treatment.

But in this instance we found that the --

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

this formation comprises a system of tight blocks and high capacity fracture system. This well drilled in a tight block, its interference effect, then, when it reaches the high capacity system then will not be -- or the influence of the fracture within that tight block will not be carried beyond the high capacity system. And so from that point on -- and from that point on it's a large part of the reservoir compared to the area, the tight block around the well that then the point source formula with its application to distances beyond the well, I think is a very accurate way to determine this. So, using this formula and the other information of which we had a pretty good control, and by pretty good control I mean the viscosity of the oil, the compressibility of the oil from bottom hole samples, all the factors that it takes to make an accurate calculation with one exception, and that exception was the compressibility of the rock itself, of the fractured shale.

I could find in the literature compressibilities for sandstone, limestone, but there was nothing on fractured shale. So we made an estimate, a fairly broad -- covered a fairly broad range, and for minimum compressibility of the formation and the connate water, I came up with 20×10^{-6} for an effective compressibility to oil.

The maximum, I felt, would be not over 50. By using those two extremes and making calculations for the 14 day period at each day, I come up with a maximum of

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

about 2500 barrels an acre in place, or a minimum of about 1000.

And as part of the test that we look at to determine whether it's a reliable test, is that the fact that we get roughly the same result whether we take information one day or five days or ten days. In other words, that did not change.

Q Actually, if I understand what you're saying, if your information was absolutely precise and if your theory was 100 percent correct, these -- each of these numbers in columns two and three would be the same from one day to fourteen days.

A Yes, sir.

Q But actually there is very little variance, which does confirm your theory?

A Yes. So at that point we felt like, we're looking at oil in place per acre - now this is not per acre foot - this is per acre, that's just all the oil there is, from 1000 to 2500 barrels.

Then if we narrow that down, I felt these were the extremes, that probably we're looking at 1500 to 2000 barrels per acre.

So this was information we had as of the 1966 hearing, and this is the way we analyzed it and presented it to the Commission.

Q It has proven correct but has been more

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

refined.

A. That's what I read from the next test that we ran.

Q. Turning now to Section C, will you explain the first part of that?

A. Yes, sir. This is a section of another graph similar to the one that we looked at before, except that this is for the period of August and September of 1968, and covers the time when we commenced gas injection. And this is a repeat of Exhibit Two, Appendix 1, Figure 1-8 of the 1969 hearing.

When we injected gas it was at a rate which would displace a fairly large volume of oil, like 1000 or 1500 barrels a day, and this displacement of reservoir volume, then, would create an interference effect on the injection side, just the same as when we had wells shut in and started production, but that sent a pressure pulse through the reservoir by the same token we send one through the reservoir when we inject in them. And a well 2 or 3000 feet away can feel the effect of injection of fluids in the reservoir, and of course it doesn't know whether it's gas or oil. It doesn't make any difference, once you have the reservoir volume that's being displaced you create this pressure pulse and you have an interference effect.

Well, the fluid level was dropping at a

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

rate -- and again I might say that we had excellent control on the rate at which the pressure was dropping in our observation well. This is now three years following the 1965 test. The A-23 observation well had been shut in all that time, fluid levels measured every day, and in addition to fluid levels we had from time to time measured bottom hole pressures, too, to confirm the trend of pressure decline. So we can see that we started injection, I believe it was August 8.

MR. NUTTER: Which was the injection well, Mr. Greer?

A. The injection well was K-13.

MR. NUTTER: K-13.

A. Yes, sir.

MR. NUTTER: And A-23 is your observation well, then.

A. A-23 is observation, uh-huh.

The gas injection rate is shown at the top of the graph. The oil production rate is to the lower part of the graph. The fluid level and the way that it increased the little circles.

Then from that --

Q. But sometimes I notice on this you were again taking two tests a day.

A. Yes, sir.

Q. Occasionally have two tests, and yet one

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

test every day; sometimes two.

A. Yes, uh-huh. Sometimes, particularly when it rained in that area, it's hard to get to the well and if there's a blank spot that's usually the case why they didn't take it.

A. I think you got a test every day.

MR. NUTTER: No, he didn't get one on --

A. It looks like August 10th or 11th.

MR. NUTTER: -- August 10th or 11th.

A. I'm sure that was a rainstorm that interrupted that one.

Q. Anything more with regard to that exhibit?

A. No, sir.

Q. Turning to the second part of Section C.

A. This shows some of our -- the results of some of our calculations, results from that test. At this point now we have a little different situation than we did earlier. I used the same formula but the oil now is, the pressure of it is below the bubble point. It has a high compressibility as compared to earlier. The 1965 test, it was conducted at a time when the reservoir pressure was higher than the bubble point and the oil was very incompressible. In fact it was just about like water. Now that the pressure is below the bubble point, at least in the area near the observation and injection wells, the compressibility is much higher, and

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

that results in a couple of things. Because of the boundary effects and such, I couldn't make a direct calculation like I did earlier. I had to calculate different examples and pick out what seemed to best fit the data.

You can see here I show transmissibility running from 1 Darcy foot to 4 Darcy feet and the one that seemed to best fit this early part of the curve is a transmissibility of about 1.8 Darcy feet, and this for 1600 barrels of oil in place per acre.

Now I varied also the volume of oil, and to see its results, and we have roughly the same degree of accuracy there. By changing 2 or 300 barrels per acre, you would get a fairly wide separation from the observed information.

From this it looked to me like the transmissibility was probably about 1.8 Darcy feet, 1600 barrels per acre in place.

Then to continue --

Q. You're now turning to the third part of this section?

A. Yes, sir. And this is a repeat of Figure 1-10 out of Appendix 1 in Exhibit Two from the 1969 hearing.

And here we continue by imposing a boundary conditions as to what might -- and we can calculate what might be the curves under certain boundary conditions.

Curve 1 we have for infinite conditions,

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

as though the reservoir continued forever.

Curve 2 is the assumption that somewhere within about a mile west of the -- of this area we would have an increased transmissibility, which we think is the case. That would change it to the curve 2. Then if in addition there is a gas cap about 3500 feet east of the injection well, and you impose that on the other two conditions, you'd come up with Curve 3. Now we don't know if that's exactly the situation, but it's pretty reasonable to believe that that's why the pressure behaved as it did. It seems to pretty well fit those conditions.

And that's all for 1600 barrels of stock tank oil in place per acre, which seems to pretty well confirm the test that we'd run earlier under an entirely different set of conditions; namely high compressibility in the last test, and in this test because of the higher compressibility of the oil, then the effect of the unknown value of the compressibility of the formation becomes more insignificant because it's a minor factor now.

So we have those two things. We have two interference tests, one in which we have an indefinite value of the compressibility of the formation, which adds to the error.

We eliminate that in the second test because it's not even present, and yet in the second test we

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

come up with a number which fits fairly close to what we had the first time. So it tends to confirm what we earlier thought.

Q. Now directing your attention to the fourth part of this section.

A. Well this is a repeat of Figure 1-16 out of Appendix 1 of Exhibit Two of the 1969 hearing, and this shows kind of a summary of the transmissibility, which we calculated for the area around the wells which were in the initial interference test.

The blue shaded area is an area which I feel was probably covered and as an average would be represented by the 1965 test, the information on it. This test we ran in 1968 because of the higher compressibility and the other factors would cover a smaller area, and the area that I think that it covered would be the northeast to southwest shaded area around the K-13.

Then we ran another test, which we reported in the '69 hearing, of just transimissibility in the area covering the -- covered by the northwest to southeast shading involving the E-10 well, and it's a little different area.

The first one that we ran, the blue shaded area, we felt like the transmissibility was in the range of 5 to 10 Darcy feet. I estimated 6.3 to 6.8 would be my best estimate for that.

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

Then the one we just ran, or just discussed in 1968, we came up with 1.8 Darcy feet, but that was at a time when we had some free gas saturation and the transmissibility would have been less because of that, because of the relative permeability to oil being dropped off, and I felt like that that area probably would have been in the range of 2-1/2 to 3-1/2 Darcy feet.

Then the west part of the area is like 10 to 12, and so if we add the -- take an average of the two individual tests, the one on the west shaded area, the one on the east shaded area, and average those, we come up with something fairly close to what we felt was the average of the entire area to begin with.

So this tends to confirm our initial calculations of oil in place and transmissibility and we felt like we had sampled a fairly sizeable part of the reservoir, like ten or twelve sections.

MR. NUTTER: Mr. Greer, you've also got a change in dip right there where those transmissibilities change.

A. Yes, sir.

MR. NUTTER: Would that also enter into it?

A. Well, it's my feeling that that could be the reason why it's there. We can measure -- we can actually

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

measure that it is there from the test, and my feeling is that that's probably why it's there. And in a way it's fortunate, because in round numbers we have twice as high a transmissibility in the west area with about 200 feet per mile dip, and in the east area, then, with half that transmissibility but twice the dip, gives us an average, then, in terms of gravity drainage -- those two factors work together in gravity drainage, so then we have the same gravity drainage potential for those two parts of the reservoir.

Q. At the time that you drilled these wells did you anticipate this matter of flex, at this point?

A. When we drilled the first wells? No, sir.

Q. Anything further on that exhibit?

A. No, sir.

Q. Were there other interference tests that occurred just incidentally because you had that observation well open?

A. Oh, yes, sir. Nearly every well that we drilled we found interference of some kind or another. After the pressure dropped 2 or 300 pounds and we'd drill a well like 3 or 4 miles away from the other, we'd find that the pressure was down. One time we fracd a well 2-1/2 miles away from the observation well and we could see the increase in the effect in the pressure in the observation well just from a frac treatment.

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

Q How long did it take to make that observation?

A Just a few days.

Q Practically like a pipe, isn't it?

A Yes, sir.

Q Turning to Section D.

A Section D, we'd like to talk a little bit about the comparison of oil in place of the sandstone reservoir and the fractured reservoir for the same transmissibility. The colored graph, one with yellow and brown coloring, the first part of Section D, is a repeat of Figure 9 of Exhibit One from the 1966 hearing, and the thing that I'd like to show here, the brown shaded area represents a relation of porosity to permeability, which was taken from the literature from, as I recall, thousands of wells reported by Bulnes and Fitting years ago in the technical literature.

The area colored in yellow shows the relation of porosity to permeability for a fracture system of horizontal fractures of equal width, and the width in this instance is shown in inches by the little circles along the sloping lines.

And the significant thing here is like for instance, a permeability of 10 millidarcies, you might have -- expect something, if that's in a sandstone, a porosity of like 10 to 20 percent. In a system of horizontal fractures

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

you're looking at like 1/10th percent porosity, something like 1/100th of the volume, and then the significance here is that if you drill a well in the sandstone reservoir and make like 100 barrels a day, ordinarily you feel like you've got some kind of reserve, perhaps, to back it up, and if it's in a sand the chances are that you do have. But you can drill the same kind of a well, come up with the same kind of a well in a fracture system with just a minimal amount of oil in place, perhaps 1/10th or 1/100th as much as if you were in a sandstone.

To pursue that further, then, in the '69 hearing in Figure 3-4 of Appendix 3 of Exhibit Two at that hearing, we presented this graph, which is the grey shaded graph, the second part of this Section D, in which we have begun to approximate what we might expect in terms of barrels per acre, as compared to transmissibility or for given transmissibility, and here we just doubled the porosity for any given permeability and this is just a judgment decision as to how one might arrive at some kind of a number that would give us an estimate of what we might actually be looking at.

By doing that and taking the upper part of the yellow shaded area from the first graph, we come up with the grey shaded area on this second graph.

Again, the lines, the upper one a designation of A, the center one B, and the lower one C. For that

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

relation, then, we can calculate oil in place per acre as a function of transmissibility, and that we've shown on the next graph, the third part of Section D, and this was the Exhibit Two in the 1969 hearing, Figure 3-5 of Appendix 3.

And on this we have chosen like 17 feet of formation with characteristics of A from the previous graph. That would have a volume of oil in place the same as 50 feet of character B or 150 feet of character C.

Then going up to the next line we had 33 feet of A, which is equivalent of 100 of B, 300 feet of C, and so on. My feeling was that we could cover the waterfront with -- with that range of pay thicknesses for the zones that we were looking at in this reservoir.

The result of our 1965 test, we show by the little blue shaded mark a little over 6 Darcy feet and 1500 to 2000 barrels per acre.

Then the pink shaded mark is the result of the 1968 interference test at 1600 barrels an acres and running from 2-1/2 to 3-1/2 Darcy feet.

And then the green circle shows approximately what Boulder might have been, somewhere from 2000 to 4000 barrels an acre in place and like 10 to 20 Darcy feet. And incidentally, in Boulder, perhaps I should mention it now, I believe the question was earlier asked, what percent recovery did Boulder have. I feel like it was in the range of 15 to 30

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

percent.

The thing that concerned me about Boulder, how it was produced and the situation we had in Canada Ojitos was that Boulder had an ideal situation for gravity drainage, a pool like 3-1/2 to 4 miles long along the strike, a short distance, like a mile, down dip, a high rate of dip, a small amount of gas in solution, all of the factors which would give you a good gravity drainage. And so in Boulder I know that they had some gravity drainage, a substantial amount of gravity drainage. There's no way they could drill and produce the wells without getting some just by happenstance.

Our situation was entirely different. There's no way -- instead of having the one mile down dip to drain the oil, we had about four miles down dip, and instead of a small amount of gas in solution, we had a comparatively large amount of gas in solution, all of which worked for poor solution gas-drive performance and against good gravity drainage.

Q So our unpressured production here would have been a lot less than it was in Boulder.

A Right. So even if they got 15 to 30 percent in Boulder, there's no way we could have gotten over 5 or 6 percent in Canada Ojitos if we produced it the same way.

MR. NUTTER: Now did you say the blue there on that last exhibit was the 1965 test?

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

A. Yes, sir, uh-huh.

MR. NUTTER: And the pink was the '68 test?

A. Yes, sir.

Q. Then your next page of this section is what I'd call a schematic drawing. Will you explain that to us?

A. Yes, sir. This represents what I believe the reservoir comprises, and namely, a high capacity fracture system with tight blocks. And of course we don't know just the shape of those tight blocks. I've drawn them here sort of rounded. We know it's a fracture system. Some theories regarding fractured reservoirs are that, of course, they would be systems of sort of parallel fractures, maybe parallelograms or squares, or whatever. This we don't know.

But what we do know is that the individual wells behave just as though they were in their own little reservoir of 20 acres, 40 acres, 100 acres, surrounded by a high capacity system. Between our interference tests and the tests of individual wells, we can determine this without question. There is no other way that we can -- or that the pressures and the production of any of the wells can be described by anything other than individual little reservoirs surrounded by high capacity system.

MR. NUTTER: Well now, these segmented worms you've got crawling all over here, these are thos e pipe-

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

lines Verity was referring to before, aren't they?

A. Those are the pipelines; the oil just moves through almost instantaneously.

One of the -- one of the interesting features of this is that -- that if you can get a well producing in good communication with that high capacity system, that well can drain its block; the high capacity system can drain the other blocks, better than wells within the blocks themselves.

And this is a very significant, important feature in our concept of producing this reservoir.

MR. NUTTER: Now when you complete these wells you frac them, right?

A. Yes, sir.

MR. NUTTER: So you might have a well that's completed in one of these tight blocks and then you'd frac over into one of the pipelines.

A. You try to get into the pipeline. Whether you get into the pipeline is -- I know, I felt like we have in at least one well, but at least you get close to the pipeline, or a good enough communication that if not a direct tie into it, at least pretty close to it.

Q. Well you must have fraed into the pipeline in that one instance when within a day, a day or two, you had interference observation in the -- or obtained observation -- in your observation well.

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

A. Well, at the period of time that the pressure is higher than the bubble point and the transmissibility -- or the diffusivity constant is high, you can do it even within a tight block.

Q. And the next sheet, then, in this section?

A. We described here on this fifth part of Section D just what we were just talking about, a comparison of ability of the high capacity system to drain these tight blocks with a well within the tight block, and we felt this important to -- to review this at this time. We discussed it earlier and brought it out in our '69 hearing and had part of our exhibits directed toward that, but recently there have been open letters to the President and other from well-known engineers, and there's been a general trend in the industry to drill more wells, infill wells, and one of the letters to the President and responses from the Department of Energy back to oil companies, all to the end that additional wells in certain reservoirs, particularly those under waterflood, can result in additional recovery.

And the principal has been that -- that on too wide a spacing with waterflooding you can have bypassing of the tight areas, and by drilling additional wells you can get injection wells in those tight spots and force the oil out and get additional recovery, and I think perhaps that's true. And the thought, then, of course, comes to mind in this

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

situation where we have a high capacity system and tight blocks, if that might not be the case here, that we might drill more wells and get more oil.

And the answer to that is no, that we can't, and we describe briefly here some of the engineering calculations that support that. We show, for instance, on this lefthand diagram, which incidentally is not to scale, but a tight block and we've used a circular system here just simply to have a simple formula to calculate. And say that we frac the well and then we develop a 400-foot fracture, it would have an effective wellbore radius of roughly 100 feet. This is one of the things that the engineers are pretty well agreed on under different flow theories and behavior of wells that have been fracd is that it doesn't make much difference whether when you frac a well, whether the fracture that you create extends away from the wellbore in two directions or in just one direction; whether the well is located at the end of the fracture or the middle of the fracture, you're going to have insofar as the pressure and production behavior of that area is concerned, a well with an effective wellbore radius of roughly 1/4th of the total length of the fracture.

With that, then, we can go with a simple steady state formula, which we show on the lower sheet here on the lefthand side for the situation that we've chosen here, 1000-foot radius, 100-foot wellbore radius, and transmissibility

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

of about .06 Darcy feet, we would have for 1500 pound pressure differential and the viscosity of oil that we have in Canada Ojitos or West Puerto Chiquito, productivity of that well is about 100 barrels a day. And we've assumed here a ratio of relative permeability of about 3/10ths, and that's because of the low pressure around the -- close to the well, the higher gas saturation and the lower permeability below it.

By comparison, that same block, if it's being drained by the high capacity system, the oil is flowing the other way instead, whereas we were looking at clearly a steady state situation for the well in the center of the block, we now have an unsteady state situation, and that's a little more complicated formula and I haven't even tried to analyze it.

But we can make a rough comparison by using the same formula for an instantaneous rate just to get a comparison of flow rates. And the flow rate, for instance, from a 900-foot radius to 1000-foot radius, instantaneous rate there for the same pressure differential and relative permeability would be about 20 times as much, about 2200 barrels a day could drain out of the block as compared to 100 barrels a day that the well itself would deliver from it.

Now, of course, we're not going to have that high pressure drop into the high capacity system because it's going to have a relatively high pressure, but we've cal-

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

culated, as shown under part B in the upper righthand part of the calculations here, it takes about 20 pounds pressure differential to give the same rate of flow for this example. And I might point out that from 900-foot radius to 1000-foot radius, we're talking about 20 percent of the volume of that block, so even though it's an instantaneous rate, based on a steady state formula, it still gives us a feel for the capacity of the -- of the system to drain.

And again, now, this is not like an injection well in the center of the block. If we had that, we would have just a repeat of the -- of the producing situation. But we're not injecting here. There's no oil has to move in into the center and out, and that's where all of the constriction comes, as we can tell from all these arrows concentrated in where we have a well in the center of this block, that's what causes the low rate of production.

On the other side, where we're flowing out of the block, we have to move just a very small amount of oil from the center part of the block, like 1 percent. So I feel confident that this is the situation, and not only can a well that's in communication, good communication with the high capacity system drain a block better than a well within it, there are probably some blocks that are so tight that you couldn't even drill a well that would be commercial, and yet you'll still drain something out of that by your high capacity

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

system.

(Thereupon a recess was taken.)

MR. VERITY: I believe at the time of the recess we were on Section D, Parts 5 and 6, and you'd pretty well gone through it.

I had one question with regard to it.

Q Do these calculations and this method enable you to further confirm or to get a better idea with regard to what percentage of the oil is in the high transmissibility system and the low transmissibility system?

A Well, that's a real complicated problem, and we went into it in one of the exhibits in the '69 hearing, and really about all we do here is -- is elaborate on that enough to show what we were talking about there.

The percent that's in the high capacity system and the low capacity system is really hard to tell. I'd estimate roughly 50 percent.

Q And this lends further information to that?

A Not really, doesn't not really as to percent.

Q All right. Turning to Section E, the first part, will you go through that?

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Rt. 1 Box 193-B
Santa Fe, New Mexico 87501
Phone (505) 455-7409

A. We want to review briefly the production history of the Canada Ojitos Unit and this map is the same structural contour map that we were looking at earlier except that we have colored on here the areas which we think were initially saturated with oil completely and partly with gas, and where the gas has invaded or replaced the oil that's produced.

Initially I believe we had gas-free oil from about the 1600-foot contour on down deeper. Above that, the grey shaded area was partly gas and partly oil saturated. The area colored in brown represents approximately the area that's still mostly oil, and the part colored in yellow shows the area which I believe was then drained of the high capacity system, and gas invaded the high capacity system approximately in that area.

Q. Anything further?

A. I might point out that that invaded area, or the area which we think is being depleted by the high capacity system, in round numbers is like 2 miles to 4 miles from the east side of the area to the west side.

Q. And proceeding now to the second part of Section E.

A. This is a little plat that I thought might be helpful as we look at some production history later on to identify where the wells are located. On this little plat we show the high capacity wells colored in -- encircled

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

in red, and as we get to their production graphs, their graphs will be colored pink.

The wells circled in blue are low capacity wells and their wells will be on blue sheets.

Q This is actually a small but a repetition of the previous exhibit that's here, I believe it was A-1 or 2, wasn't it?

A Yes, sir.

Q It doesn't make any difference, but it is a repetition of that for convenience.

Then the next part of Section E.

A This is a series of production graphs. The first one shows the total unit production and there's nothing really particular there that I want to point out, but as we move to the individual wells there's some things that we would like to look at.

Q So that we can keep track as we're going through, this is the --

A I'd like to just keep the map laid out so you can see the wells as you get to them.

Q All right, your summary of all wells is the third part of this section.

A Right.

Q Then your next well, the fourth part is the X-13?

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Rt. 1 Box 193-B
Santa Fe, New Mexico 87501
Phone (505) 455-7409

A. Yes, sir. I might just point out here that we shut the K-13 well in when we started the interference test in 1965. Following that test I felt there was really no need to put the well back on production, the same as the A-23 observation well, because we began to get ideas that we would want to inject gas, and this would be a good gas injection well, and so we left it off production, except for a few months in 1967. We wanted to test it again before we put it on injection in 1968.

Q And the next one, which is 5 is the A-14.

A The A-14. This is the closest producing well to the injection well. We had estimated that the nearest wells, the A-14 and the P-11, might produce for a year or two before the gas would invade their area, and that's what we came up with. The A-14 in 1969 after about a year's production, the gas/oil ratio reached about 4000-to-1 and we shut it in.

Q Then 6th part of this section is the P-11?

A Yes, sir. There are two things we'd like to point out here.

Again, when the gas/oil ratio --

MR. NUTTER: Excuse me, Mr. Greer, just a moment here, let me catch Joe up here.

A Okay.

MR. NUTTER: So you shut in the A-14 after the GOR skyrocketed, right?

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

A. Right, we shut them in at a ratio of 4000. It went up roughly as shown here on the graph, but really a ratio of 4000-to-1, there's a lot of wells you produce at ratios of 4000-to-1.

MR. NUTTER: Right.

A. But in our instance with the gas handling capacity and all that we had, it just made sense to shut the wells in at about that ratio.

MR. NUTTER: Okay. Then I think you were on P-11.

A. Yes, sir. On the P-11 we show the same thing and its ratio got up to about 4000-to-1. We shut it in, and I'd like to point out here, you see we commenced injecting gas in 1968 in August, and you can see a rather steep decline in production from this well prior to the time we injected gas. And, now this is an accelerated rate of decline, greater than actual decline of the well's productivity, the reason being that we continued to keep the casing shut-in and all the gas and the oil was produced through the pump. So as the pressure dropped why, of course, the gas would occupy a bigger part of the space in the pump and so you get a little higher drop in production than you really have dropped in productivity index.

Nevertheless, we did have a drop in productivity index. This is one of the wells that I was watching and I was concerned about, the productivity index dropping much

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

faster than the drop in reservoir pressure. The reservoir pressure was dropping, as I recall, at the rate of about 1-1/2 percent a year, and yet here a very steep decline in productivity. But the productivity index, as I recall, for this well and the L-11, which we'll look at in just a minute, was like from five to ten times as much as the drop in reservoir pressure.

And this was one of the things that convinced me that we needed to inject gas and maintain pressure and try to keep those fractures propped open, if that's what was causing the PI to drop off.

Q. Turning now to the first pink sheet of this section, which I believe is part seven.

A. Yes, sir.

This is the A-22. We just produced it for a short time. It initially came in after we started injecting gas, produced for about three years until the gas reached this well and shut it in at a ratio of about 4000-to-1, just like the others, and I wondered about this well, if gas was channeling to it or if we were really depleting the high capacity fracture system. I felt we probably were.

So after shutting it in for about a year we went back to test it to see if it was just a channel, perhaps the oil then would have leveled off and covered up the channel and we could find out by producing it whether this occurred or not. But instead it still had a high gas/oil ratio so we did

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

not produce it any further.

Q Did -- can you tell us how much this well was draining; how big an area?

A Well, like all the others, it was draining probably several thousand acres, but it actually, it had produced about 500,000 barrels, and in round numbers I felt like the high capacity system occupies maybe half of the reservoir. If the reservoir has, say, 2000 barrels per acre in place, that's 1000 barrels per acre in place in the high capacity system. If we get 50 percent recovery of that, that would be 500 barrels an acre recovery in the high capacity system.

Now over all you could average about half of that. So I think we're looking at 250 to 500 barrels per acre in the high capacity system. So 500,000 barrels would be like 1000 acres completely drained of the high capacity system if it's the high side,or 2000 acres if it's on the low side.

Q So not less than 1000 and maybe as high as 2000?

A Uh-huh.

Q Next is the next pink sheet, which is eight of this section.

A Yes, sir.

Q The L-11.

A The L-11. We had the same situation here. When the ratio reached about 4000-to-1 we shut the well in and

SALLY W. BOYD, C.S.R.
Rt. 1 Box 193-B
Santa Fe, New Mexico 87501
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here again we were producing all gas and oil through the pump and so the well still had a capacity probably to produce several hundred barrels a day at the time we shut it in.

But nevertheless, in the same policy with others, we shut it in at a ratio of 4000-to-1.

Q How many barrels did this well produce before you shut it in?

A It produced about 1,200,000 barrels.

Q And what did -- how big an area did it drain on the same calculation that you were defining before?

A On the same calculation it would have completely drained, at 500 barrels an acre in the high capacity system, about 2400 acres, or 250 barrels, about 4800 acres.

And that's complete drainage again of the -- of that equivalent volume. Again it's undoubtedly draining, you know, 10,000 acres here.

Q Then turning to the next --

A Oh, excuse me, before we leave that, I would like to point out, I didn't mark it on here, but if you'll notice the decline in production from about 1966 to 1968, that is about a 12 percent rate of decline. And --

Q It levels out in '69 and '70, '71, '72, and '73, but there at the start you do have a decline of about 12 percent.

A Yes, sir, about 12 percent, and although

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

here again we had the casing shut in and that's perhaps accelerated over that well's actual capability to produce, it nevertheless is much higher than the drop in reservoir pressure. The pressure is dropping like 1-1/2 percent a year and the well's productivity index is dropping at maybe 8 or 10 percent, several times as much. And this well, now, up until 1968 the pressure in its area, in its structural position, was above the bubble point, so we know that it was not being affected by a relative permeability to oil. And so here again we have -- have this indication of an extremely high rate of drop in productivity following a drop in reservoir pressure.

Q. Turning to the next pink sheet, which is nine of this section, that's the E-10 well. Tell us about this.

A. Well, this well -- incidentally, this is one that produced absolutely nothing natural. When we fracd it, we apparently fracd it into the high capacity system. We had drilled it with air, showed neither oil nor gas on completion. We used a large frac treatment and it had initial productivity index of about 4 to 5. We produced it about 400 barrels initially, the capacity of the pump that we had on it, until in '69, after we installed -- or commenced gas injection, installed a gas lift system, and we put the well on gas lift and then we raised its rate to about 6 or 700 barrels a day, which is still far below its ability to produce, but as high as I thought we should produce the field.

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Rt. 1 Box 193-B
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Phone (505) 455-7409

Then over time we have gradually dropped its production as its gas/oil ratio increased. In 1978 it jumped up to about 2000-to-1 and we kept the production down to about 150 barrels a day, or 200. The ratio came back down to about 1000-to-1 and we increased the production back up a little bit in the early part of this year and now I think the ratio is back up to about 1500. We'll probably reduce it again.

Q And what's the cumulated production of this well?

A. It's produced not quite 2,000,000 barrels.

Q And with regard to the same calculation of drainage that you used before, 500 barrels and 250 barrels per acre, how big an area would that cover?

A. Well, that would be complete drainage of the high capacity system of from 4000 to 8000 acres.

Q And again it's probably been a lot greater than that?

A. Right, yes, sir.

Q The next sheet will be ten, and that's the L-27.

A. Yes, sir, that's the northernmost of the high capacity wells. It produces about 250 - 300 barrels a day. We have apparently a drop in productivity in '78 and '79 looks like a slight increase in gas/oil ratio, but it's pretty

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

hard to measure with those low volumes. It's produced a little over a million barrels.

Q With a drainage of approximately 4800 acres?

A Yes, sir, it could be as high as 4800 acres.

Q Yes. And then part eleven of this section, the C-34.

A This is one well that we've produced. This is the southernmost of the high capacity wells and it's fairly far down dip and in this well, rather than shutting it in when its gas/oil ratio got to 4000, we thought we would just run an experiment with it to see if we could confirm any of our thoughts about the tight block and high capacity fracture system, our theory, if there actually are a number of tight blocks with oil moving into the high capacity system by gravity drainage, theoretically that oil should move down those channels, even after we've depleted the high capacity system, there should be some oil coming out of these tight blocks. And so we though we would produce this well for an extended period of time to see if actually we could recover additional oil after the high capacity system was drained.

In this instance the gas/oil ratio increased to about 10,000-to-1 and then sort of leveled off. And it reached that point in about the first of 1974. Since

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

that time it's been increasing rather slowly. It's up to about 11 or 12,000, 13,000 maybe now, and its production rate has dropped off at the rate of about 7-1/2 percent a year.

Now here again, this is a well that's not produced at capacity. We just are handling about a million feet of gas a day with it, and -- but nevertheless, this gives us an indication of what might -- what we might do and how we might produce the other wells once the gas has reached all the down dip producers and we're on a cycling situation. If they behave like this, we're looking at a rather extended period of time of trying to capture the oil out of these tight blocks.

MR. NUTTER: By recycling.

A. Just by recycling. And if we extend these curves we show here that we pick up perhaps another 400,000 barrels of oil after the gas/oil ratio reached 10,000-to-1 on this well, and it had produced, oh, like 300,000 barrels at that time. NOw, in round numbers that's 50 percent out of one, the high capcity system, and perhaps 50 percent out of the tight blocks. We don't know that that confirms our earlier thinking that there might be half as much oil in the tight blocks and half in the high capacity system, but certainly it doesn't indicate anything much different from that.

Q. Then turning to the twelfth part of this section, the A-16.

A. Well, this well and the rest of the wells

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

are low capacity wells and we have some individual exhibits later on for them. I think it would be more productive just to move on to them, but we have them in here just to complete the record.

Q So if someone wants to refer to them, and then what about 16, which is green?

A Same thing.

Q All right, so that brings us to Section F and the first -- the first page, which is a -- would you call that a graph? Sketch?

A A sketch, yes, sir. We just wanted to show here one of the -- a problem, you might say, but one of the factors we have to consider in trying to analyze the behavior of these wells in the reservoir, and it's really important in the overall behavior to understand as much as we can about these little details, because they begin to take on a very significant aspect of the -- in the future development of the area, which I think is going to be of low capacity wells to the west of the present unit.

And this is to understand how the -- we maintain the pressure, how we measure the pressure in the reservoir, and how it's affected by the amount of gas we inject, and what we have to inject to maintain pressure.

We show here in this sketch a simplified gas cap colored in yellow with an oil zone, a dipping oil zone

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

below it.

And the problem we have here as compared to most reservoirs is because of the structural dip, which is significant, that as we produce oil not only does it come out of the reservoir, but the gas/oil contact moves down dip.

And for instance, the shaded area we can think of as the volume of oil that we produce and in the first sketch on the left we show pressure stabilized at 1400 pounds in the gas cap, 1431, say 100 feet lower, and 1462 a 100 feet lower than that.

If we produce that shaded area of oil and then replace it with gas at the same pressure that the gas cap has, 1400 pounds, as indicated here, the gas/oil contact then moves down through the so-called datum of zero, although we still have 1400 pounds in the gas cap, if we have a well at the datum of -100 its pressure is now only 1431 pounds because we've lost the weight of the column of oil above it.

So in order to maintain pressure we really have to not only replace that volume of oil, we have to increase the pressure in the entire gas cap to make up for it. And so the righthand side, then, we show the gas at an increas[illegible] pressure in order to maintain pressure at the bottom.

Well, the calculations for that are shown on the schedule just below that and --

Q It's on page two, or the second part of

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

the section.

A. Yes, sir. The summary for that is under Item 6, sub-line c., which shows depending on the rate of structural drop of 400 feet a mile or 200 feet a mile, and our high estimate or our low estimate, which depends partly on the configuration of the reservoir, we're looking at something like 800 to 1200 cubic feet per barrel for complete pressure maintenance.

Now we hope to pick up from 200 to 300 cubic feet per barrel out of the produced oil, which means we need makeup gas in the range of 500 to 1000 cubic feet per barrel or perhaps as an average I've estimated maybe .7 of an Mcf per barrel of makeup gas required to be purchased, to maintain the pressure.

Q All right, you mean then, if I understand you, in addition to re-pressuring the gas that was produced incidental to the oil, you've also purchased gas that you have injected into this formation.

A Right.

Q And that was the reason that you had to do it, what you're talking about --

A Right.

Q -- or part of the reason, in addition to voiding the oil, you had to go further?

A Right.

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

Q All right.

A And initially this was a minimal cost in the overall consideration of the project, with gas at 15 to 20 cents a thousand, it was practically nothing. But beginning in the '70s, why of course, the price of gas started to go up, the price of oil was frozen, and this began to create an economic concern, or burden.

We show on the next schedule, then, --

Q That's three?

A Three.

Q The green sheet.

A I believe that's a green sheet under this section. The relative cost of this makeup gas with the present price of gas of approximately $2.00 an Mcf, the bottom line shows that at the present price of oil that we're up to as much as 50 percent of our net income before we purchase makeup gas in order to buy enough gas to maintain pressure.

Now as the price of oil increases, if we get up to around $30.00 after the windfall profits tax, well, then we're only looking at 5, 6, or 7 percent, something again relatively small compared to the benefit.

But in the meantime, for the past few years, it hasn't made sense insofar as the high capacity wells which we have in the unit area, to try to maintain that pressure just absolutely even, because they have excess capacity

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

now. The only problem is how you handle the gas/oil ratio, and the gas, and such as that.

When it becomes significant, which we'll see here in a little while, is with the low capacity wells and the effect on them.

So this is the situation we had, and so we reduced the amount of gas that we were purchasing and injecting, and we show that on the next graph.

Q Which is the fourth part of this section on the back of that sheet?

A. Yes, sir. There we see in general on the surface pressures of this observation well -- now the K-13 was one we initially used as an injection well. We later moved the injection wells back up dip and made this an observation well. And you can see here from the period from 1972 to '76 the pressure in the gas cap was increasing at the rate of about 12 pounds a year, which is just about what we would estimate would be required to maintain level pressures in the wells in the oil zone.

And the volumes of makeup gas is shown on the schedule just below that.

Q That's five, part five.

A Part five, yes, sir. In a period like from '73 to '76 we're running from about 500 to 900 cubic feet a barrel of purchase of makeup gas, which approximates

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

the 700 cubic feet per barrel we'd calculated would be required.

Then in '76 we dropped that substantially down to about 400 cubic feet a barrel and you can see an immediate drop. It happened within a month after we cut our purchses back. We had an interference effect that dropped the pressure like about 20 pounds and then it leveled off to about three pounds a year for a couple of years. Then we reduced the purchases again to about 200 cubic feet per barrel and we experienced now about 12 pounds per year drop in pressure.

Now really that is not a serious drop in pressure as most pressure maintenance projects would be viewed. At 1200 pounds pressure it would take 100 years for it to -- to be reduced to zero, but it is significant from the standpoint of small wells, which we will see in a little while.

MR. NUTTER: You'd be losing oil production as a result of this, right?

A. Right. There will be some production will be lost, without doubt, as a result, and of course it's a question of time and balance and economics and dollars a barrel that you can decide at what point you -- how far you go.

Q. If there wasn't any difference in this price, as the Examiner has observed difficulty in seeing, and the price of oil was gone up comparable to the price of gas, as it is in the marketplace, you could actually obtain

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

more oil recovery.

A. Oh, yeah, if we would have maintained the pressure.

Q. You bet. Anything further here before we turn to part six?

A. Part six shows a calculation of the rate of drop of pressure. Now what we want to arrive at is how much pressure are we losing around the down dip low capacity wells as a result of not maintaining pressure completely, and that becomes the sum, then, of the drop in pressure in the gas cap, plus whatever other -- the drop in pressure that we have resulting from the gas/oil contact falling down the structure.

And as those figures are summarized under columns ten and eleven, we're running from about .3 of a percent a year to 1.2 percent a year. I would imagine that the gas/oil contact probably is in the low part of the structure, I mean a shallow dip part about 200 feet a mile, and I would think we're looking at, under column eleven, probably .3 or .4 of a percent a year, so if we're losing 1 percent in the gas cap, .3 or .4 percent because of the drop in the fluid level, we can assume that we're losing right at 1.3 to 1.4 percent pressure per year in the area surrounding the low capacity wells.

Also, we show on here that if we had pro-

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

duced oil at the rate shown under column two, that's 1000 barrels an acre in the high capacity system, and we recovered it, say, in column three at 500 barrels an acre, we would have displaced the oil about 2 miles horizontally for a 10-mile segment of the reservoir. And if you'll recall that map we looked at just recently, the one that had the yellow colored displacement of oil, that's in round figures, by a couple of miles. We feel this tends to confirm --

Q That one you're referring to there is the exhibit in Section E, the first exhibit in Section E?

A Yes, sir, first exhibit in Section E.

So we have calculated, of course, by our interference tests these volumes of oil in place on the order of 2000 barrels an acre, maybe 1500, how much of it could be produced in a high capacity system, and now as we calculate the volume that would be displaced, it seems to fit pretty well what we've actually observed in the field. It seems to confirm again our estimates in that regard.

Q Anything further on six?

A No, sir.

Q Then let's direct your attention to part seven.

A Part seven is a repeat of Figure 5 from Exhibit Two of the 1969 hearing, which shows the rate of gravity drainage that we can expect for structure that has a

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

dip of 400 feet per mile and the other conditions of the West Puerto Chiquito oil.

And of interest to us now when we're talking about these low capacity wells, they will have a transmissibility in the range of .02 to .06 or .08 Darcy feet, which is the lower lefthand side of this graph, and we can see that we're looking at gravity drainage rates of like 3 barrels to 8 barrels per mile, per linear mile. This means that if you have an area along the strike a mile wide that's draining with gravity drainage, the rates then are like 3 to 8 barrels a day.

And so we find that -- that -- and that's for 400 feet per mile. So we find when we get to these low capacity wells, that insofar as their tight block is concerned, if their tight block covers a very big area, that we're not looking at a very high rate of gravity drainage. We're going to have to look for something else to keep the wells producing.

Q Then that brings us to Section G.

A Yes, sir.

Q The first part.

A WE want to talk now about the influence of pressure maintenance on these low capacity wells and the first --as a preliminary to that, it's helpful to look at the rate of decline that was experienced in Boulder where they did not have pressure maintenance, and the wells were drilled

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

in what I would call -- and produced, in an uncontrolled fashion.

Now this is a 10-year graph, so compared with the ones we've been looking at, it's -- this rate of decline looks rather gentle, but actually it's about a 70 percent per year rate of decline, which is what they experienced at Boulder and what I think we would experience in our area if we didn't have pressure maintenance and control of the production.

Q And what you would get from the west side of Chiquito without control.

A Right.

Q Then turning to part two?

A Yes, sir.

Q And I believe three is in conjunction with two?

A Yes, sir. This is information regarding the Canada Ojitos Unit C-2, and this is the well that's circled in green on your map about the center of the map.

Q That's in Section 2 of 25 North, 1 West.

A Right. It had an initial producing ability of approximately 45 barrels a day. You can notice for the first two years, after we got the well fairly steadily on production, 1970 and '71, that was -- one of those peaks indicates production with a beam pump and another of them with a

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

Kobe pump, hydraulic pump, and in both instances we experienced problems in keeping the well steadily on production.

In 1971 we put the well on gas lift and it has been produced since that time with a very constant rate of gas injection and I think gives us a very good control of the ability of the well to produce, at least its relative ability. Now we might produce at a higher rate by using a higher volume of gas, but at least it's comparative.

And we have, you'll notice an almost flat rate of decline, zero percent, up until about 1976, and that's the year in which we cut back the gas purchased, and at that point it began to take on a rate of decline -- I have one curve here showing 3-1/2 percent a year, which might be a little bit above its --

Q. Starting in '76?

A. Starting in '76, uh-huh. It's actual rate of decline since '76 might be, oh, 4 or perhaps even 5, percent a year, which is significant and in a way it's a shame to see a drop in production like that resulting from failure to keep complete pressure maintenance, but if we compare it to the 70 percent a year that we might have without it, it's still very good.

Q. Mr. Greer, on this graph you show one -- well, I might say three red lines. One has a zero decline.

A. Right.

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

Q And that was what you maintained in this well when you maintained pressure.

A Yes, sir.

Q Up to 1976 when --- when because of the cost of gas you had to not quite maintain the pressure you wanted.

Then it declined.

A Right.

Q Now you have another red line that has a very sharp dip.

A Yes, sir.

Q And tell us again, explain what is that line?

A That line is a 70 percent rate of decline, which is the rate of decline that the Boulder wells experienced. I might add that had this well produced at that rate of decline it would have produced about 22,000 barrels of oil.

Actually, it's produced about 164,000 already and if it continues at the rate it's indicated, if you extrapolate that on out, that would reach about a total of 400,000 barrels, and if we assume that about 80 percent of that would have to be from solution gas drive, which it would be if it's producing from its own system and is not in conjunction with our overall pressure maintenance project, we just have to assume one of two things. The well's either

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

producing directly in communication with our -- our pressure maintenance project, or it's isolated from it in tight rock all its own. Under either condition you come up with several thousands of acres that the well's got to be produced.

Q Well, on the -- on the Boulder method of projection, 20,000 barrels would certainly not be economic for these wells that cost what, nearly a million dollars?

A They could cost all the way from $750,000 to a million dollars.

Q All right. Then turning to the fourth and fifth parts of this section, which I believe ought to be taken together.

A Yes, sir. This is similar information for the A-16 Well. The A-16 Well is the southernmost of the wells, the blue colored wells in the grey shaded area in Section 16.

Q And again you've superimposed what the production would be without pressure maintenance?

A Right.

Q And again non-economical?

A Right.

Q You maintained a level rate of production as long as you maintained pressure.

A Right, and when we -- when we stopped maintaining the pressure, we picked up a rate of decline of

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

about 7 percent a year, and here again, now, we know that the pressure is declining at the rate of probably not over 1-1/2 percent a year, and in addition, this well, the pressure is probably still above the bubble point. If we had nothing but a gas column from the surface of the ground to the well, we'd have close to 1500 pounds and the bubble point is 1520. And we know there's some oil in the reservoir left.

So this is another situation. We have a well that's producing at pressures above the bubble point, a rate of decline of several times in productivity compared to the drop in reservoir pressure.

Q And another illustration of what you would have in this west part of Puerto Chiquito if there is no pressure maintenance maintained -- instituted.

A Right. The critical thing is that even though we're maintaining pressure and at a fairly low rate of decline in overall reservoir pressure, still these low capacity wells are dropping at a rate which, well, it would be alarming if, for instance, we ceased gas injection altogether. There's no doubt that you instituted 7 percent a year, you'd be soon back to the 70 percent.

And starting out at such low rates, it's not so bad to have a 7 percent rate of decline in a well that has produced 1000, 2000 barrels a day, and you have it cut back because of gas/oil ratio, but it's the wells that you're

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

trying to produce everything they'll produce, these low capacity wells, that becomes critical to their being economical.

Q. That brings us to Section H.

A. Yes, sir.

Q. And the first part, tell us about it.

A. Okay. The first part of Section 8 is the reproduction of Figure 4-2 out of Appendix 4 of Exhibit Two of the '69 hearing. This shows the relative permeability ratios for fractured formations, and the dashed line is the line that I used to calculate the solution gas drive recovery from West Puerto Chiquito.

Once we had this information and the character of the oil, the amount of gas in solution, shrinkage, and so on, then it's just a matter of mechanics to calculate what percent of oil is recoverable. And any engineer's calculation, they may use different methods, but he'll come up with the same answer, and the answers are shown on the next graph.

Q. That's two?

A. Two, which is titled Solution Gas Drive Production History, and it's a reproduction of Figure 4-3 out of Appendix 4 of Exhibit Two of the '69 hearing.

And it shows the gas/oil ratio history, the pressure history, in the lower righthand corner about 5-1/2 percent of oil in place is about all that we're looking

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

at for solution gas drive.

Q Then the third part?

A. The third part, then, is the repetition of the graph we looked at earlier, which shows barrels of oil in place per acre versus transmissibility. The area that we're concerned with is this lower lefthand corner, transmissibilities of 200 to 600 Darcy feet, and if this is a reasonable relation, which it appeared to be from the interference test and our estimate of oil in place at Boulder, then we would estimate for the low capacity area, that shaded in grey on our earlier maps, and on the little plat at the head of this other section, is something in the range of 200 to 600 or 800 barrels per acre. And that's all the oil that is in place.

And even if you say, well, we'll use 1000 barrels per acre in place for these low capacity wells and 5 percent of it, we're looking at 50 barrels an acre recovery for solution gas drive from the tight areas.

And that translates for 640-acre spacing about 30,000 barrels of oil, 32,000 barrels per well.

Q Which is certainly not economical.

A. Not economical up to the cost of the well.

Q Anything further on this exhibit?

A. No.

Q Then that brings us finally to our last

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

section, which is Section I.

A. We show here the value of oil that we're looking at, hopefully, after October, 1981. The difference in the price of oil to the operators is going to be based on a result in the difference in the windfall profits tax.

We start out at $39.00 a barrel for everybody. We wind up inside the unit for an integrated oil company, the bottom line of this schedule, a little less than $16.00 a barrel; a qualified independent had $20.00 a barrel, whereas newly discovered oil would be $23.30 a barrel.

Q. Now a qualified independent would be less than 1000 barrels production, which takes a lesser windfall profits tax.

A. Yes, sir.

Q. And the second and the third parts, which I believe are related?

A. Yes, sir. Here we show the kinds of wells or production rates that would be required to -- to return the cost of drilling a well and how we arrived at what it would take to be a well that we would consider an economically producable well.

On the curve A, shows for a 70 percent rate of decline, the kind of production history we would anticipate for wells producing with solution gas drive to drain 640 acres, and on the lower sheet on the schedule, the upper

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

description of curve A shows that we would receive about $475,000, for a well of that character. Now this is for oil valued at $23.30 a barrel.

Curve B, then, is one that's required, you'd have to have a well of that character, which is 84 barrels a day initial production rate, producing with a 70 percent rate of decline, to give you a return on $750,000 well cost, plus 15 percent rate of return on your investment.

For comparison we put in the level line C, the curve C, which shows that if we can maintain a level production rate, we can start off with only 16 barrels a day, wind up with a 15 percent rate of return on a $750,000 investment, if we can maintain the pressure level.

Q The next -- next part, which is four and five, which are related, I believe, again.

A Yes, sir. This shows the same information that's going to apply for oil valued at $15.90 a barrel, which will be the value of oil inside a unit.

Here the comparative numbers are we have to get up to 123 barrels a day initial productivity and drain 1250 acres in order to obtain a rate of return of 15 percent on $750,000.

Q This is a repetition of the previous one but with -- with --

A Different oil.

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

Q -- old oil rather than new oil.

A. Right.

Q Anything further on that?

A. No, sir.

Q Mr. Greer, in my introductory remarks, or my opening statement, I made reference to the fact that our application suggested a pattern, drilling pattern, on 640-acre spacing of 165 feet from the center of any quarter/quarter section.

Koch has suggested that should be 330 feet and we concur in that, do we?

A. Yes, sir. I don't recall exactly where the 165 feet came from other than it resulted from the first hearing in 1963, and it seems to me that it was one of the Commission engineers who wanted that small window, but I don't recall why or any of the details of it. But as far as we're concerned I see no -- no problem with it, and as a practical matter when we get out and locate the well on the ground, I think the final location is going to result from what the forest ranger will agree to as to where we can put it. All of this land that we're talking about is -- nearly all of it is forest land.

Q And does the Forest Service like and approve wider spacing?

A. Yes, sir, they do.

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

Q It's less damage and interference with the native habitat of the forest.

A Yes, sir, and if there were no other -- if everything else is the same, there are no other consideration, we ought to go to wide spacing just simply to protect the forest.

Q All right. Mr. Greer, would you care to very briefly summarize what we have demonstrated in Exhibit One, Sections A through I?

A Yes, sir. We've shown what is a reasonable calculation of the oil in place, wide communication and drainage, drainage of large areas by wells, and the necessity of maintaining pressure in order to have economically producable wells in the low capacity areas.

Q Anything further?

A Well, in order to have pressure maintenance and injection of gas, we have to have unitization, and we feel it's going to be essential to unitize the --

Q Suppose you had a well drilled over in the west edge of the Puerto Chiquito, and there was no control on it, which under present circumstances that would be it. What -- what could this create?

A You mean if we were to drill -- if the well were to be drilled outside the unit?

Q Yes, to the west.

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

A Of course if it's a small well and there's no channeling of gas to it, why there would be no particular problem, but if there could be a channeling of gas to it or if enough wells were drilled and they were produced at rates too high for the gravity drainage potential of the reservoir, why of course it could destroy the -- the entire reservoir, the entire 50,000 acres.

Q And what could this mean in terms of barrels and dollars to the owners within Canada Ojitos Unit?

A Well, of course, it would be a substantial effect. We'd be talking about hundreds of millions of dollars.

Q What would that require on the part of the unit?

A Well, that would mean that if such a well were drilled and existed and imposed a threat to the -- the proper production of the unit area, we would simply have to ask through statutory unitization that the well be brought into the Canada Ojitos Unit.

Q Anything further?

A No, other than that would be a painful process to the guy outside the unit because he'd be faced with lower price for his oil, and such as that, but painful or not --

Q It would be nothing comparable to what it would do to the owners of the unit --

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

A. Right.

Q. And to the -- and to the conservation of oil or greatest recovery of oil in the area.

A. Right.

Q. Anything further?

MR. VERITY: We offer Exhibit One into evidence.

MR. NUTTER: Exhibit One will be admitted in evidence.

MR. VERITY: I believe that's all.

MR. NUTTER: Are there any questions of Mr. Greer? He may be excused.

Mr. Verity, we have received correspondence from a number of companies.

We have a Telex from Sun Gas, a Division of Sun Oil Company, supporting the application.

We have a letter from Mountain Fuel, signed by R. E. Pittum (sic) supporting the application with a larger tolerance for location requirements.

We have a letter from Tommy Roberts, representing Dugan Production Corporation supporting the application.

We have a letter from Randall Hoke, representing Patrick Petroleum Company supporting the application.

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

We have a letter from Barrett Pierce supporting the application.

We have a letter from Jack London, Jr., representing himself, supporting the application, wholeheartedly supporting the application.

We have a letter from Jack London, Jr., on behalf of William D. Montin, Incorporated, wholeheartedly supporting the application.

We have a letter from Jack London, Jr., representing Montin-Hardwick Pipeline, wholeheartedly supporting the application.

We also have a letter from Koch Exploration supporting the application, and also making reference to the well location tolerance.

And I discussed this with someone from Koch over the phone the other day, and as a result I have worked up some figures on well locations.

Now the way the application was filed was for the well to be located within 160 feet -- 165 feet of the center of the quarter/quarter section. There are 16 quarter/quarter sections in a section and this, if each one of those was 165-foot radius circle would give you something less than 2 acres, so there would be a total of less than 32 acres in a section, which would be an admissable location.

Now on standard 40-acre spacing you're

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

allowed to drill wells within 330 feet of the boundary of the 40-acre tract. So you can drill within a 10-acre square inside the 40; in other words, 25 percent, or 10 acres of a 40 are eligble as locations.

Now I've worked up a possible solution to this that would allow a greater tolerance.

If a well were required to be located within 660 feet of the boundary of the section, that would be the outer boundary of the section, not closer than 330 feet to the quarter section lines and no closer than 5 feet to the quarter/quarter section line, this would add up to a total of 246 acres, 246.9 acres that you could drill on, or 38.6 percent of the total area in the unit.

This exceeds the amount that would be drilled on in a 40-acre pool. In the event, unlikely as it might be, that we could ever have an infill drilling program and go to 160-acre spacing, then no well would be closer that 160 -- 330 feet to the outer boundary of the unit, and in the event it ever went to 40-acre spacing, it would be no closer than 5 feet to the outer boundary, but I don't think that's going to happen.

MR. VERITY: All right, that's -- that certainly would be acceptable to us.

MR. GREER: Oh, I see no problem.

MR. NUTTER: You represent Koch?

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

MR. FRIEND: Yes.

MR. NUTTER: Does that sound satisfactory to Koch?

Okay, does anyone have anything further they wish to offer in Case Number 6997?

We'll take the case under advisement and the hearing is adjourned.

MR. VERITY: Thank you, sir.

(Hearing concluded.)

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

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

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 6997, heard by me on 8/6 1980.

_____, Examiner
Oil Conservation Division

BENSON-MONTIN-GREER DRILLING CORP.
EXHIBITS IN CASE NO. 6997
BEFORE THE OIL CONSERVATION DIVISION
OF THE NEW MEXICO DEPARTMENT OF
ENERGY AND MINERALS
WEST PUERTO CHIQUITO POOL
RIO ARRIBA COUNTY, NEW MEXICO
AUGUST 6, 1980

INDEX OF
BENSON-MONTIN-GREER DRILLING CORP. EXHIBITS
IN CASE NO. 6997
BEFORE THE OIL CONSERVATION DIVISION OF THE
NEW MEXICO DEPARTMENT OF ENERGY AND MINERALS

AUGUST 6, 1980

PART I GENERAL INFORMATION

SECTION A:

1. Location map showing pool and unit boundaries and identification of irregular spacing units requested.
2. Colored contour map showing interpreted areas of varying reservoir characteristics.
3. Typical electrical log of productive intervals.
4. North-south cross-section of well logs. (Section F of Exhibit 3, Case 3455, 11-16-66)

PART II INFORMATION RELATIVE TO RESERVOIR DRAINAGE CHARACTERISTICS AND PER-ACRE OIL-IN-PLACE DETERMINATIONS

SECTION B: Summary of 1965 interference test

1. Plat showing the four phases of the test (Section J-1 of Exhibit 3, Case 3455, 11-16-66)
2. Graph (1965) showing fluid levels and production data (Section J-7 of Exhibit 3, Case 3455, 11-16-66)
3. Plat of portion of graph (2) used in calculating oil in place (Section M-2 of Exhibit 3 of Case 3455, 11-16-66)
4. Schedule of results of calculations (Section M-1 of Exhibit 3, Case 3455, 11-16-66)

SECTION C: Summary of 1968 Interference Test

1. Plat of fluid levels, production and injection rates, August and September, 1968 (Figure I-8 of Appendix I of Exhibit 2, Case 3455, 12-17-69)

2. Graph of fluid levels and calculated interference curves (Figure I-9 of Appendix I of Exhibit 2, Case 3455, 12-17-69)

3. Ditto including boundary effects (Figure I-10 of Appendix I of Exhibit 2, Case 3455, 12-17-69)

4. Plat showing transmissibilities and areal coverage of tests (Figure I-16 of Appendix I, Case 3455, 12-17-69).

SECTION D: Variation of Oil in Place as Function of Transmissibility

1. Comparison of ratio of permeability to porosity for sandstone reservoirs with that for fractured reservoirs (Figure 9 of Exhibit 1 in Case 3455, 11-16-66)

2. Ditto for selected relations of K/o (A, B, C) (Figure III-4 of Appendix III of Exhibit 2, Case 3455, 12-17-69)

3. Relation of per-acre oil-in-place to transmissibility for selected relations of K/o and pay thickness (Figure III-5 of Appendix III of Exhibit 2, Case 3455, 12-17-69)

4. Sketch showing "jigsaw-puzzle" concept of high capacity fracture system and tight blocks.

5. Comparison of drainage of tight fracture block by well located within it and drainage of same block by high capacity fracture system.

PART III REVIEW OF PRODUCTION HISTORY, CANADA OJITOS UNIT

SECTION E:

1. Structural contour map showing gas injection pattern and oil displacement areas.

2. Colored contour map showing interpreted areas of varying reservoir characteristics (same as Section A (2) but small scale) with high capacity wells identified with red circles, low capacity wells identified with blue circles.

3. Production history graphs (pink graphs are for wells circled in red, blue graphs for wells circled in blue on plat E (2) above.

SECTION F: Information relative to Pressure Maintenance by Gas Injection and Note on Gravity Drainage

1. Sketch showing relative pressure in gas cap and oil zone under complete pressure maintenance.

2. Pressure maintenance volumes required for gas cap pressure of 1400 psig and dipping reservoir and oil produced by gravity drainage.

3. Relative cost of "make-up" gas as function of oil price for complete pressure maintenance.

4. Graph, surface pressures of K-13 observation well.

5. Approximate equivalent volumes of make-up gas expressed as cubic feet per barrel of oil produced.

6. Approximate reservoir pressure decline from vertical drop in gas-oil contact face and horizontal displacement of oil in high capacity fracture system.

7. Graph of gravity drainage rates (Figure 5 of Exhibit 2, Case 3455, 12-17-69)

PART IV — INFORMATION REGARDING PRODUCTION BEHAVIOR OF LOW CAPACITY WELLS AND ABILITY OF LOW CAPACITY WELLS TO DRAIN LARGE AREAS

SECTION G: Apparent influence of pressure maintenance on production behavior of low capacity wells

1. Boulder Mancos Pool production history.
2. Graph of production history, Canada Ojitos Unit C-2
3. Remarks regarding production behavior and drainage areas.
4. Graph of production history, Canada Ojitos Unit A-16
5. Remarks

PART V — ECONOMICS OF MARGINAL WELLS IN AREA OF SMALL STRUCTURAL DIP

SECTION H: Information relative to Solution-Gas Drive Performance

1. Graph of relative permeability of fractured formations (Fig. IV-2 of Appendix IV of Exhibit 2, Case 3455, 12-17-69)
2. Graph of solution-gas drive production performance (Fig. IV-3 of Appendix IV of Exhibit 2, Case 3455, 12-17-69)
3. Relation of per-acre oil in place to transmissibility (repeat of Section D (3) above)

SECTION I

1. Schedule of oil values.
2. Graph of example production performance required to provide 15% return on investment on $23.30 per barrel.

3. Schedule of statistics regarding example production performance required to provide 15% return on investment at $23.30 per barrel.

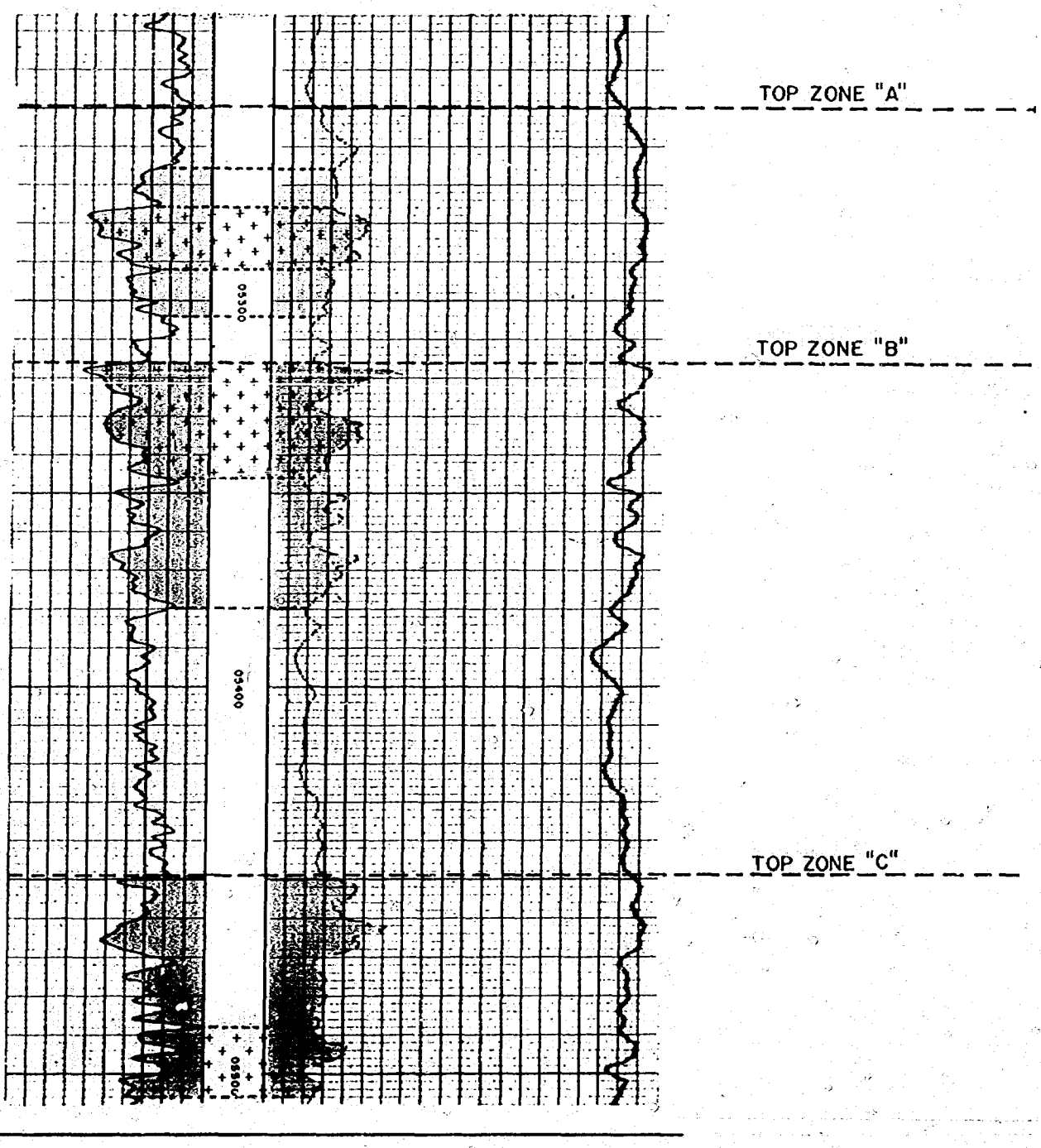
4. Graph of example performance required to provide 15% return on investment at $15.90 per barrel.

5. Schedule of statistics regarding example production performance required to provide 15% return on investment at $15.90 per barrel.

IDENTIFICATION OF MAIN PRODUCING ZONES
NORTHEAST PUERTO CHIQUITO
AND
SOUTHWEST PUERTO CHIQUITO

BENSON-MONTIN-GREER DRLG. CORP.

CAÑADA OJITOS UNIT NO. B-18



PLAT OF THE FOUR PHASES

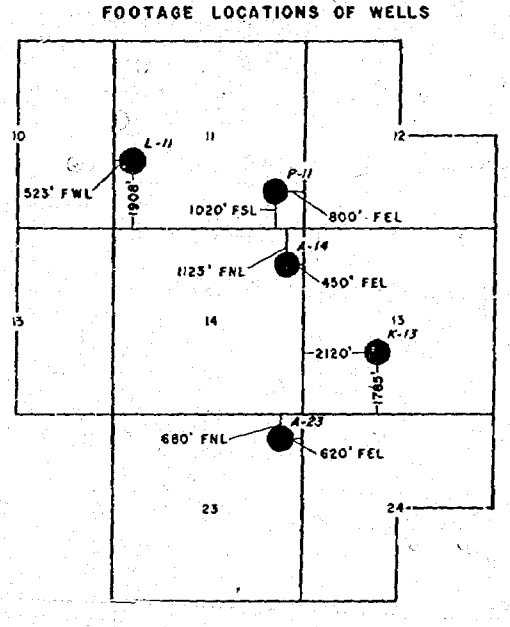
OF THE

1965 - 66 INTERFERENCE TEST

NIOBRARA - GREENHORN PARTICIPATING AREA

CANADA OJITOS UNIT

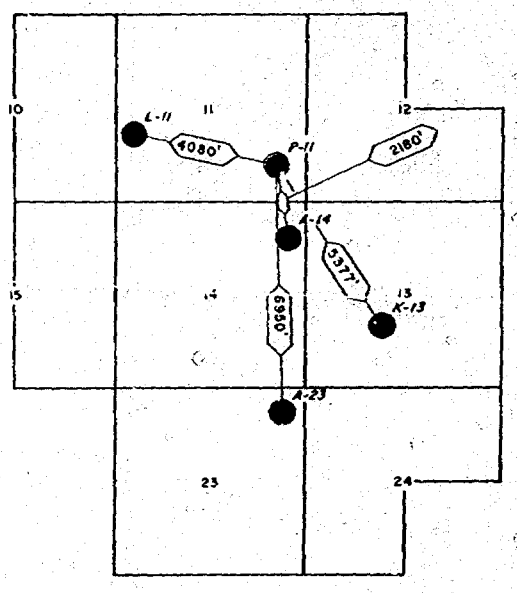
FOOTAGE LOCATIONS OF WELLS



ALL WELLS SHUT-IN

PHASE I

DISTANCES FROM P-11 TO SHUT-IN WELLS

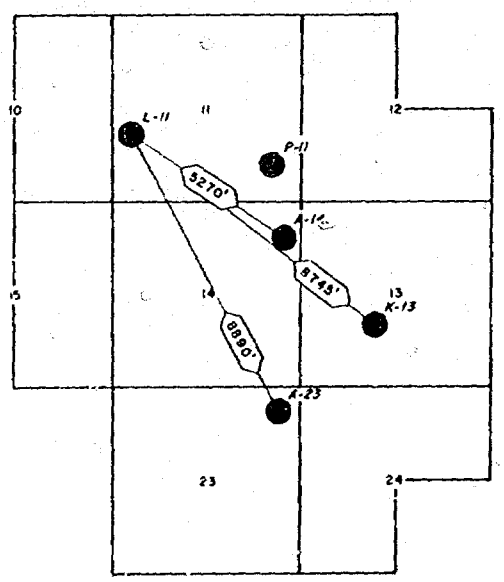


PRODUCING WELL

SHUT-IN WELL

PHASE II

DISTANCES FROM L-11 TO SHUT-IN WELLS

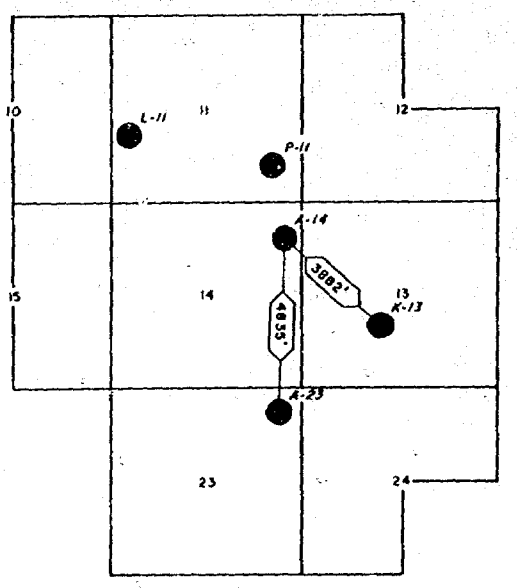


PRODUCING WELL

SHUT-IN WELL

PHASE III

DISTANCES FROM A-14 TO SHUT-IN WELLS



PRODUCING WELL

SHUT-IN WELL

PHASE IV

PER-ACRE OIL IN PLACE
CANADA OJITOS UNIT NIOBRARA PARTICIPATING AREA
DETERMINED FROM INTERFERENCE TEST
SEPTEMBER-OCTOBER, 1965
L-11 PRODUCING, A-14 OBSERVATION WELL

TIME AFTER START OF TEST AT WHICH INTERFERENCE PRESSURE DROP MEASURED	OIL IN PLACE (STOCK TANK BARRELS/ACRE FOR ASSUMED EFFECTIVE COMPRESSIBILITY INDICATED) For C_e = 20×10^{-6}	For C_e = 50×10^{-6}
1 day	2250	890
2 days	2520	1010
3 days	2670	1070
4 days	2740	1090
5 days	2660	1050
6 days	2600	1030
8 days	2520	1010
10 days	2460	980
12 days	2420	960
14 days	2440	970

NOTE: (1) C_e = 20×10^{-6} results from assumed undersaturated compressibility of 10.5×10^{-6}, connate water 3.3×10^{-6}, formation compressibility of 6.7×10^{-6} and saturation as follows:

Undersaturated oil 75% of pore space
Saturated oil - 0
Connate water 25% of pore space

(2) C_e = 50×10^{-6} results from same values of fluid compressibilities but with formation compressibility of 23×10^{-6} and connate water saturation of 40% (assumed also no saturated oil in reservoir)

CAÑADA OJITOS UNIT
NIOBRARA PARTICIPATING AREA

PRODUCTION RATE
FOR PARTICIPATING AREA

GAS INJECTION RATE

PLOT OF FLUID LEVEL
FOR A-23

1968

GAS INJECTION RATE

B.H.P.

GAS INJECTION COMMENCED AUGUST 9, 1968

F.L.

OIL PRODUCTION RATE

O-33 ON PRODUCTION

A-16 ON PRODUCTION

A-14 ON PRODUCTION

L-11 ON PRODUCTION

P-11 ON PRODUCTION

E-10 ON PRODUCTION

AUGUST

SEPTEMBER

FLUID LEVEL - FEET FROM SURFACE (G.L.)

GAS INJECTION RATE - MCF/DAY

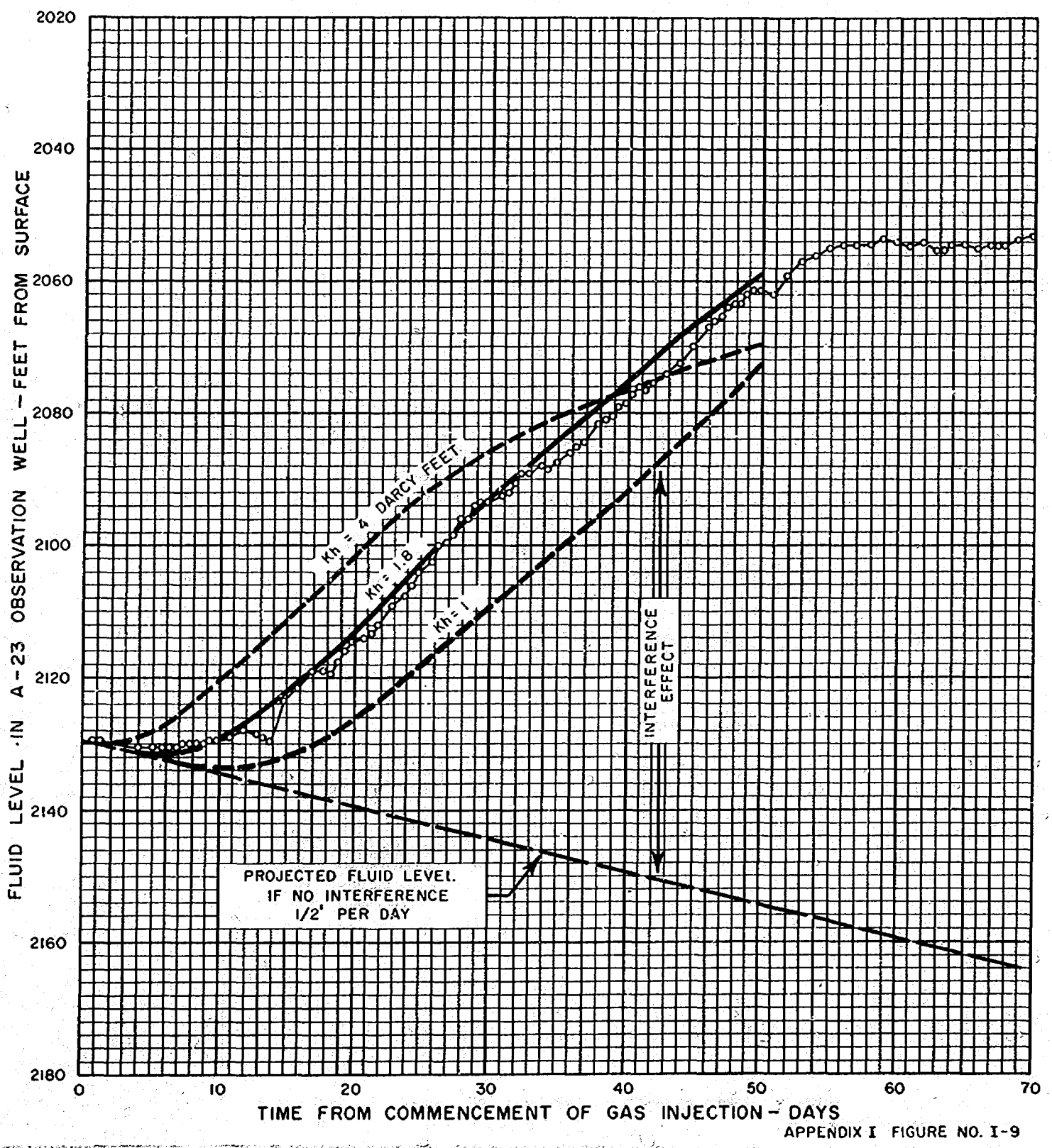
BOTTOM HOLE PRESSURE (6300') IN A-23 - psig

TOTAL PARTICIPATING AREA PRODUCTION RATE - B.O.P.D.

APPENDIX I FIGURE NO. I-8

COMPARISON OF
ACTUAL INTERFERENCE EFFECT
OF INITIAL GAS INJECTION
ON FLUID LEVEL OF A-23 OBSERVATION WELL
WITH CALCULATED EFFECTS

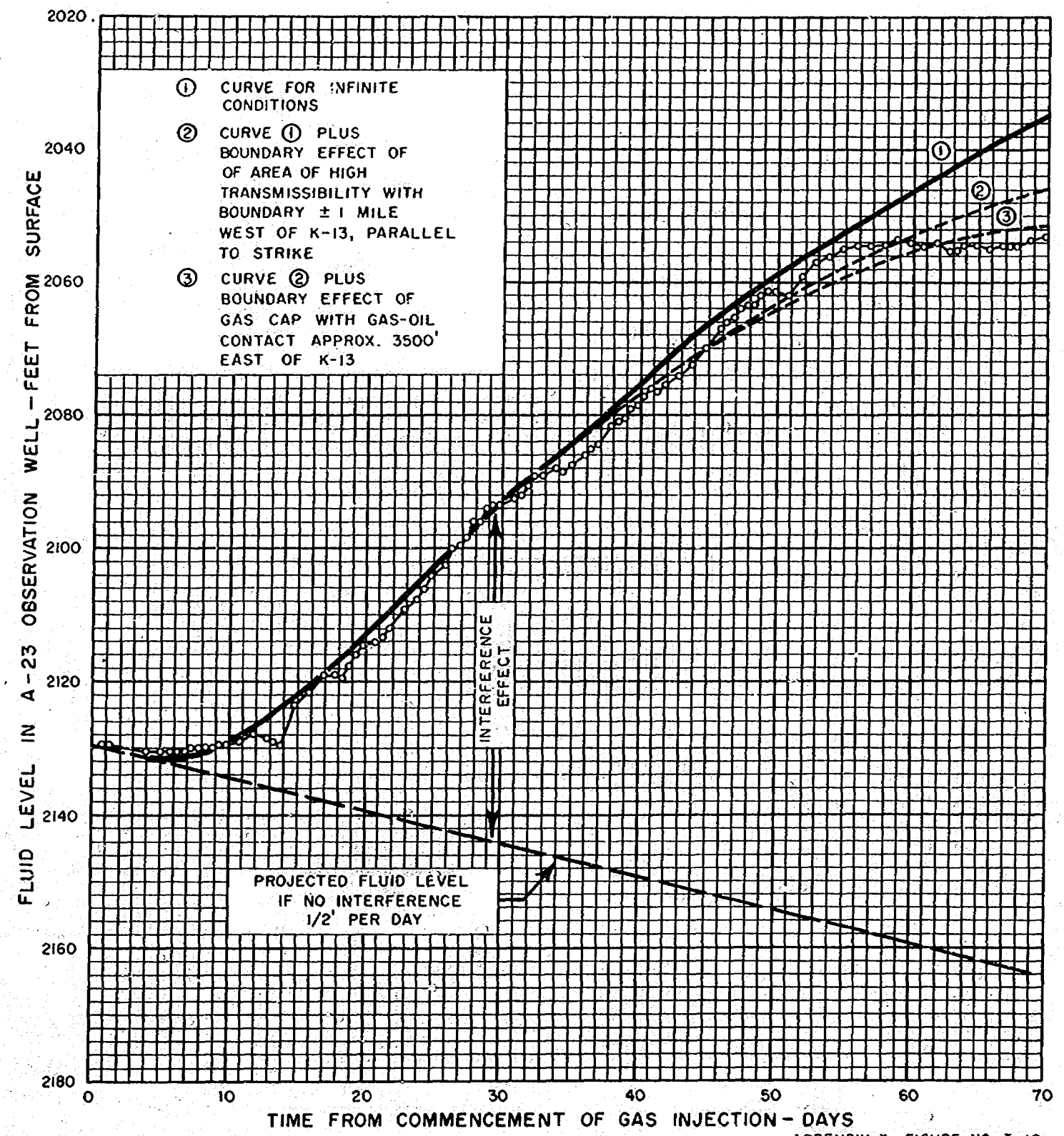
FOR CONDITIONS OF:
$C_e = 415 \times 10^{-6}$ F.V.F. = 1.28
ϕh = 1600 BBLS/ACRE STOCK TANK OIL
AND TRANSMISSIBILITIES AS SHOWN
o - MEASURED FLUID LEVELS



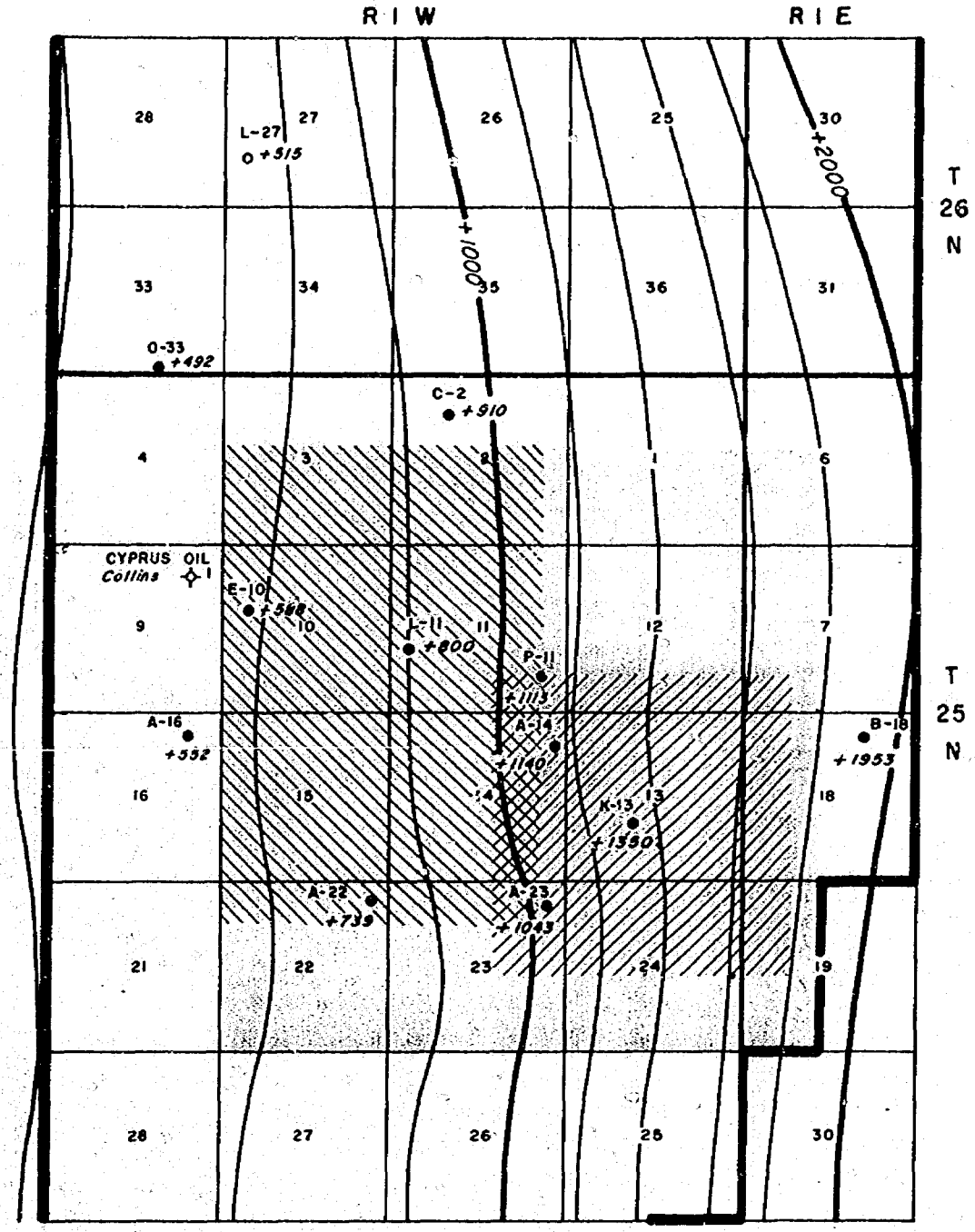
APPENDIX I FIGURE NO. I-9

COMPARISON OF ACTUAL INTERFERENCE EFFECT OF INITIAL GAS INJECTION ON FLUID LEVEL OF A-23 OBSERVATION WELL WITH CALCULATED EFFECTS

FOR CONDITIONS OF:
C_e = 415 x 10^{-6} F.V.F. = 1.28
ϕh = 1600 BBLS/ACRE STOCK TANK OIL
TRANSMISSIBILITY = 1.8 DARCY FEET
o – MEASURED FLUID LEVELS



APPENDIX I FIGURE NO. I-10



PLAT OF PART
OF
CAÑADA OJITOS UNIT
SHOWING ESTIMATED
RESERVOIR TRANSMISSIBILITY
BY AREAS OF TESTS

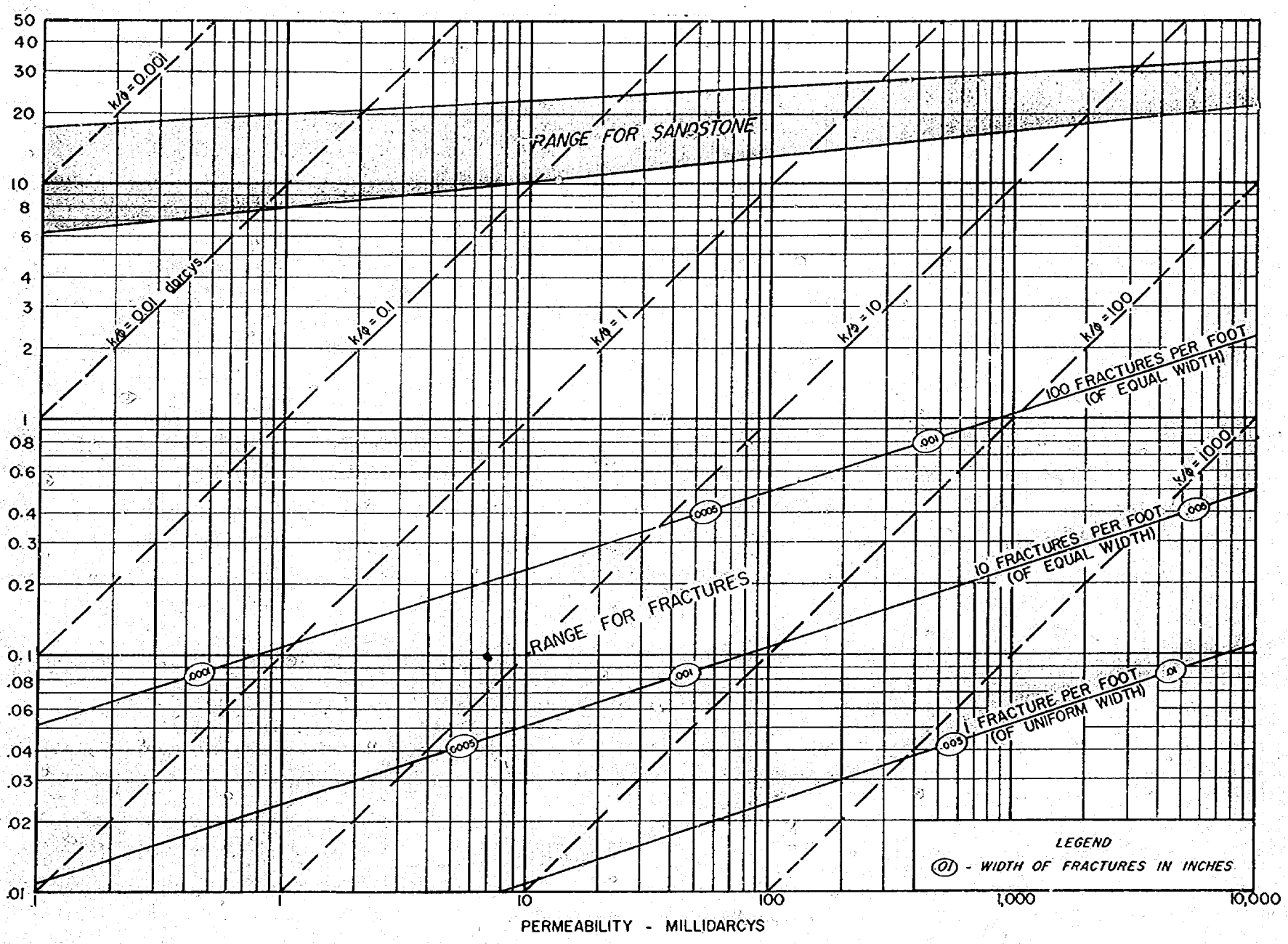
- 2.5 TO 3.5 DARCY FEET
- 10 TO 12 DARCY FEET
- 5 TO 10 DARCY FEET

CONTOURED ON TOP OF "A" MARKER
C. I. 200'
NOVEMBER, 1969
BOUNDARY OF CAÑADA OJITOS UNIT

APPENDIX I FIGURE NO. I-16

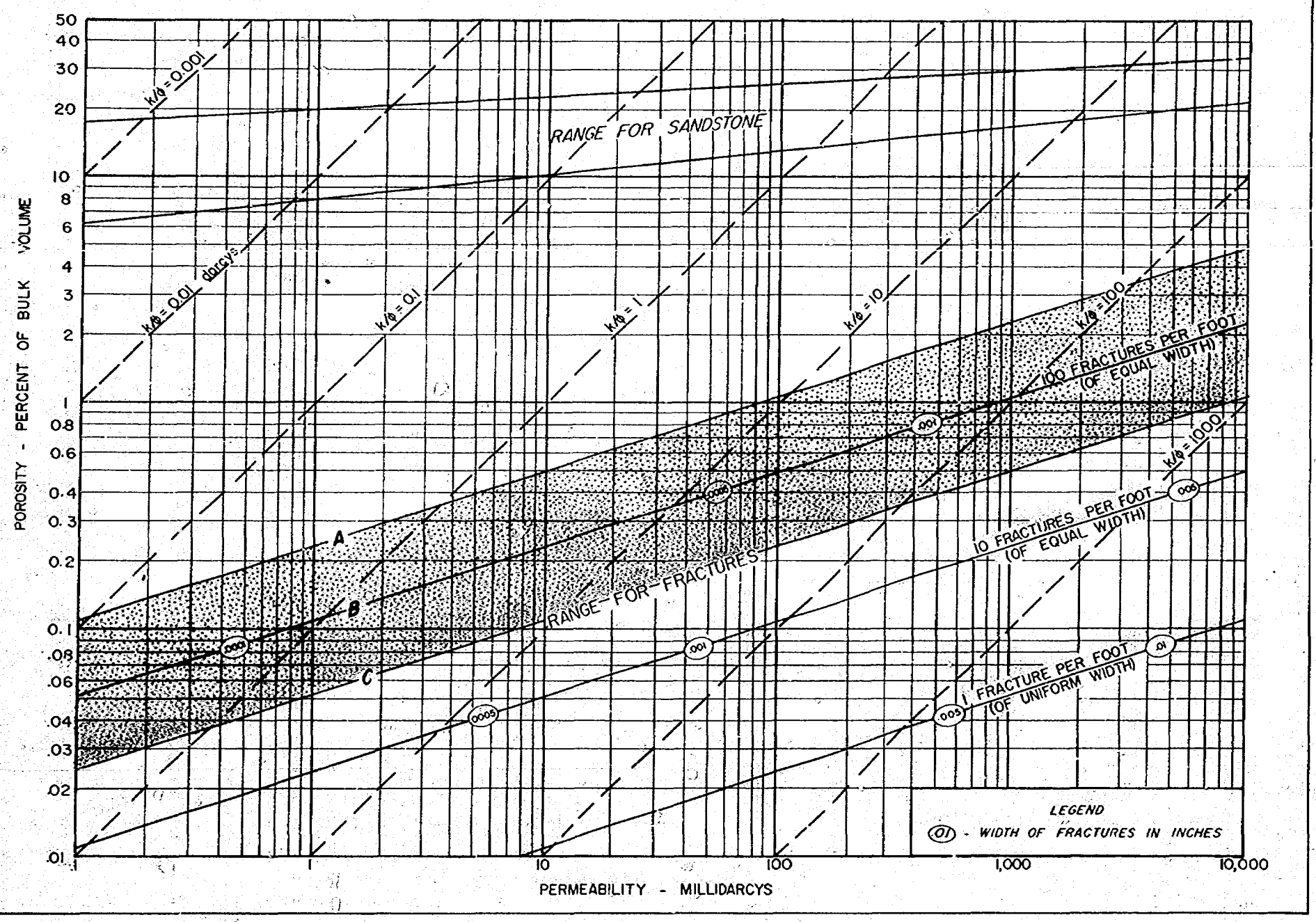
VALUES OF KΦ FOR SANDSTONE RESERVOIRS AND FOR FLOW SYSTEMS OF FRACTURES IN AN IMPERMEABLE MATRIX

FRACTURES PARALLEL TO DIRECTION OF FLOW



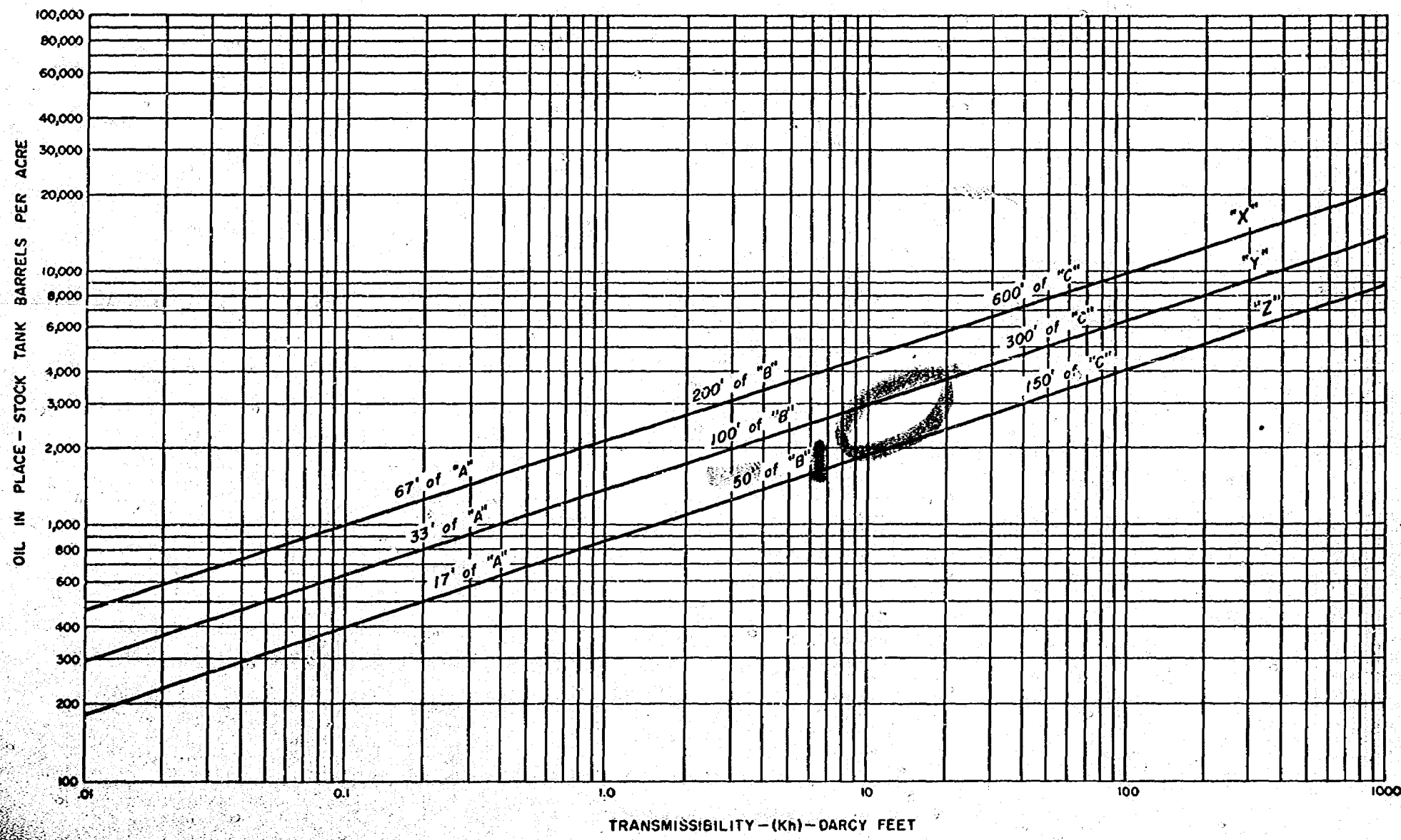
VALUES OF Kϕ FOR SANDSTONE RESERVOIRS AND FOR FLOW SYSTEMS OF FRACTURES IN AN IMPERMEABLE MATRIX

FRACTURES PARALLEL TO DIRECTION OF FLOW



APPENDIX III FIGURE NO. III-4

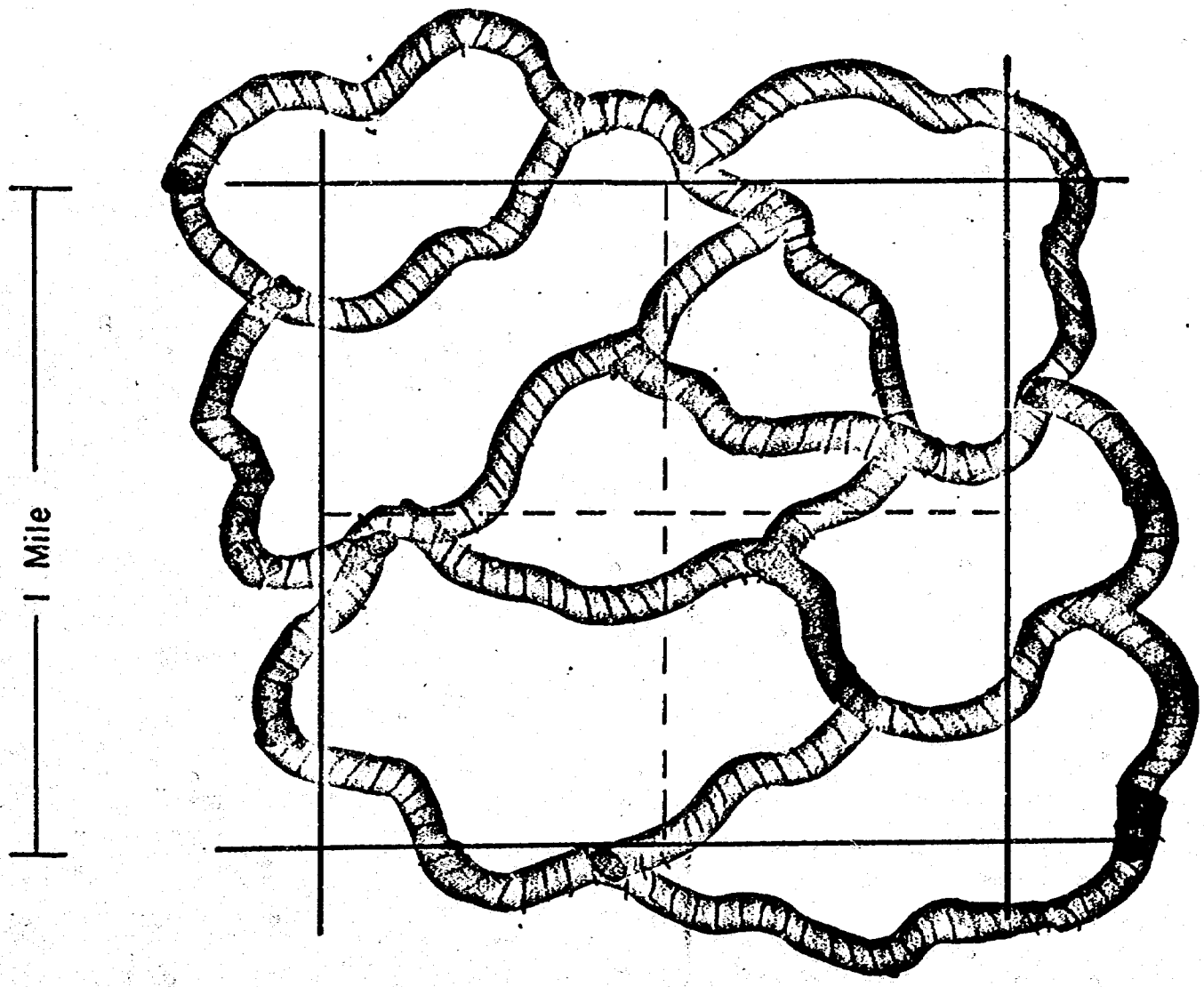
RELATION OF OIL IN PLACE
TO
TRANSMISSIBILITY
FOR
POROSITY–PERMEABILITY RELATIONS
"A", "B" & "C"
AND FOR
RESERVOIR THICKNESSES SHOWN
F.V.F.=1.29



FILE : 13A

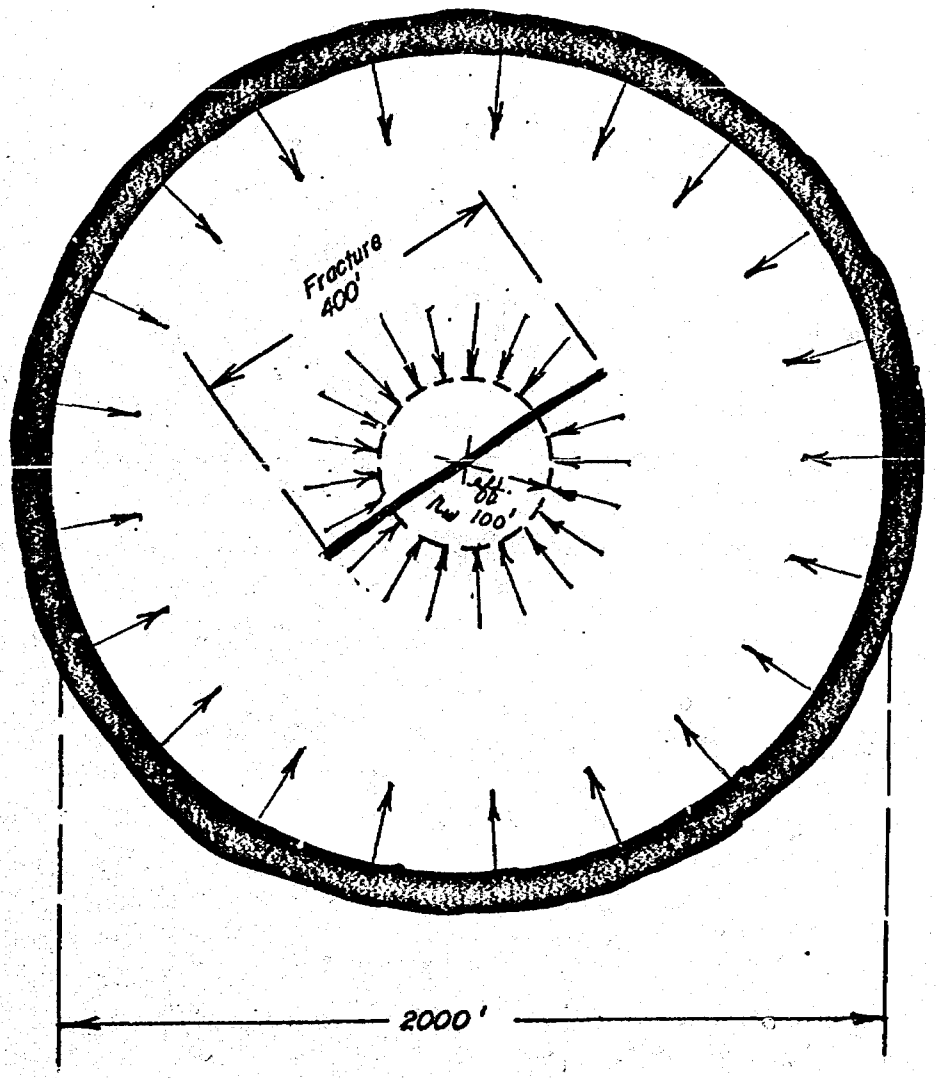
APPENDIX III FIGURE NO. III-5

SCHEMATIC DIAGRAM
OF
"JIG-SAW PUZZLE" CONCEPT
OF
TIGHT BLOCKS & HIGH CAPACITY
FRACTURE SYSTEM



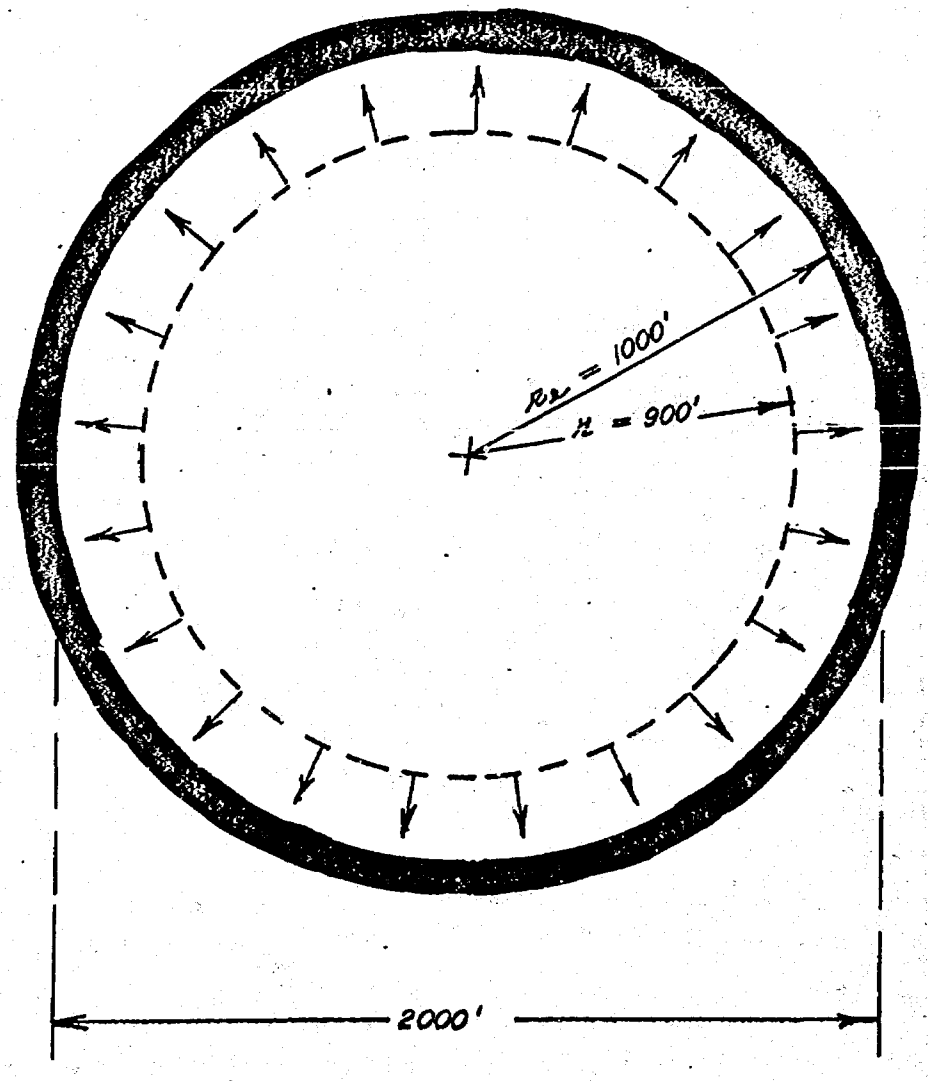
TIGHT BLOCK DRAINED
BY
INTERNAL WELL

(Not To Scale)



TIGHT BLOCK DRAINED
BY
HIGH CAPACITY FRACTURES SYSTEM

(Not To Scale)



TIGHT BLOCK DRAINED BY CENTRALLY LOCATED WELL
Initial Production Rate
(Flow system steady state)

For: r_e = 1000'

eff. r_w = 100' (1/4 of 400' fracture)

ΔP = 1500#

μ = .68 cp

B = 1.29

K_o/K = .3

Kh = .0635 darcy feet

$$Q = \frac{(3.07)(kh)(\Delta P)}{\mu B \log_{10}(r_e/r_w)} \times (K_o/K)$$

≈ 100 BOPD

TIGHT BLOCK DRAINED BY HIGH CAPACITY FRACTURE SYSTEM

(Flow system unsteady state)

Instantaneous initial flow rate from 900' to 1000' radius (per steady state relation)

A. for same pressure drawdown as for centrally located well (1500#)

$$Q = \frac{(3.07)(.0635)(1500)(.3)}{(.68)(1.29)\log_{10} 1000/900)}$$

≈ 2200 BOPD

B. Pressure differential required to allow 100 BOPD at K_o/K = 1

$$= \frac{(100)(.68)(1.29)(\log_{10} 1000/900)}{(3.07)(.0635)(1)}$$

≈ 20#

MAXIMUM TIME REQUIRED TO REACH STATE CONDITIONS
IN EXAMPLE B FOR TIGHT BLOCK DRAINED BY HIGH CAPACITY FRACTURE SYSTEM

1. At pressures just above bubble point

$(C_e = \pm 40 \times 10^{-6})$

$$\eta = \frac{(6.328)(K)}{C_e \mu \phi}$$

$$= \frac{(6.325)(.91)}{(40 \times 10^{-6})(.68)} = 2.1 \times 10^5$$

$$t = \frac{r^2}{4\eta} = \frac{(1000)^2}{(4)(2.1 \times 10^5)}$$

≈ 1.2 days

Kh = .0635 darcy feet

ϕh = (from graph D-3 herein)

BOPA for .0635 Kh is 420 BOPA

$$\frac{(420)(1.29)}{7750} = .0699$$

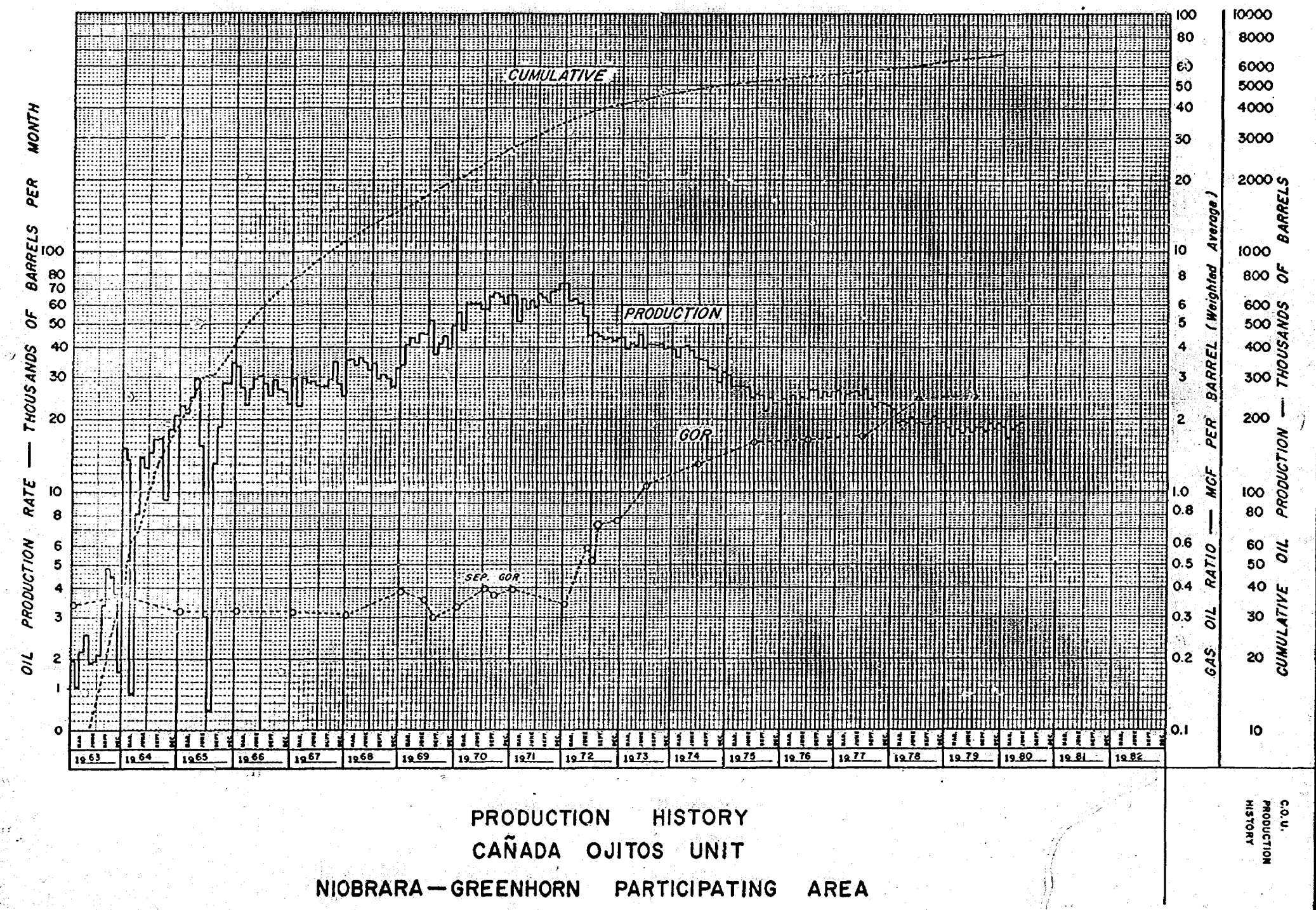
$$\frac{Kh}{\phi h} = \frac{K}{\phi} = \frac{.0635}{.0699} = .91$$

2. At pressure just below the bubble point

$(C_e = \pm 400 \times 10^{-6})$

η = 10 x above

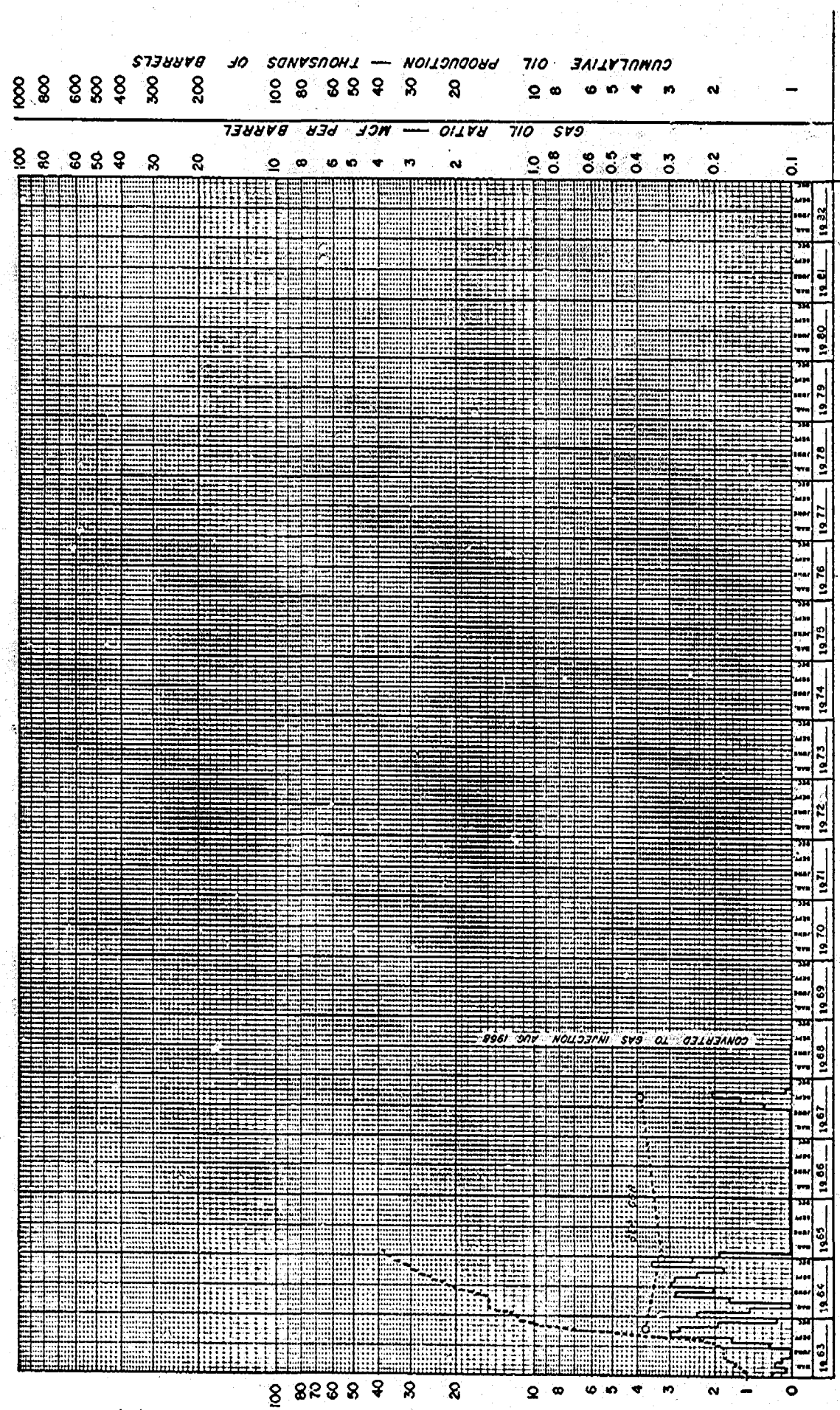
t = 10 x above (± 12 days)



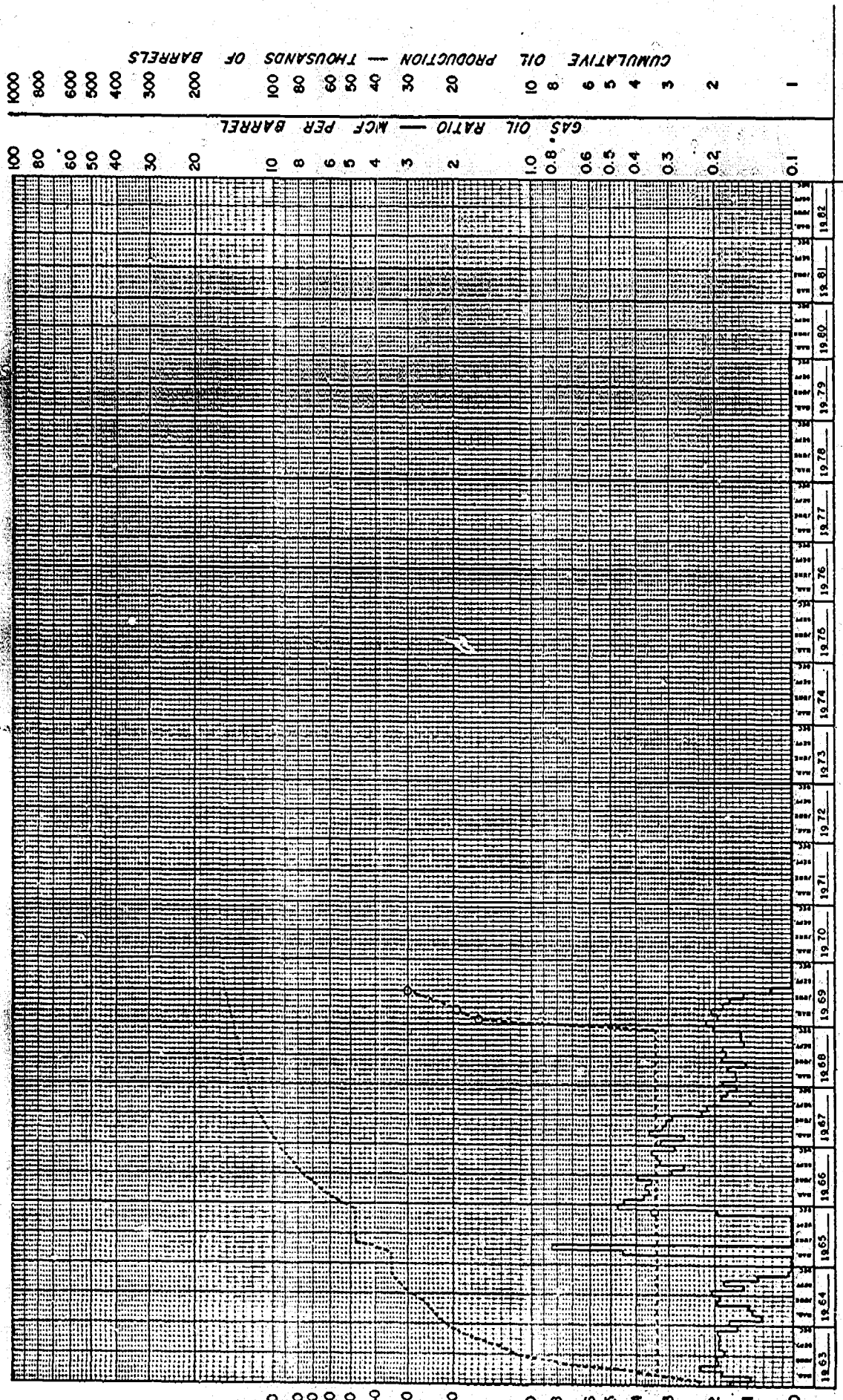
PRODUCTION HISTORY
CAÑADA OJITOS UNIT
NIOBRARA—GREENHORN PARTICIPATING AREA

C.O.U.
PRODUCTION
HISTORY

PRODUCTION HISTORY
CANADA OJITOS UNIT WELL K-13



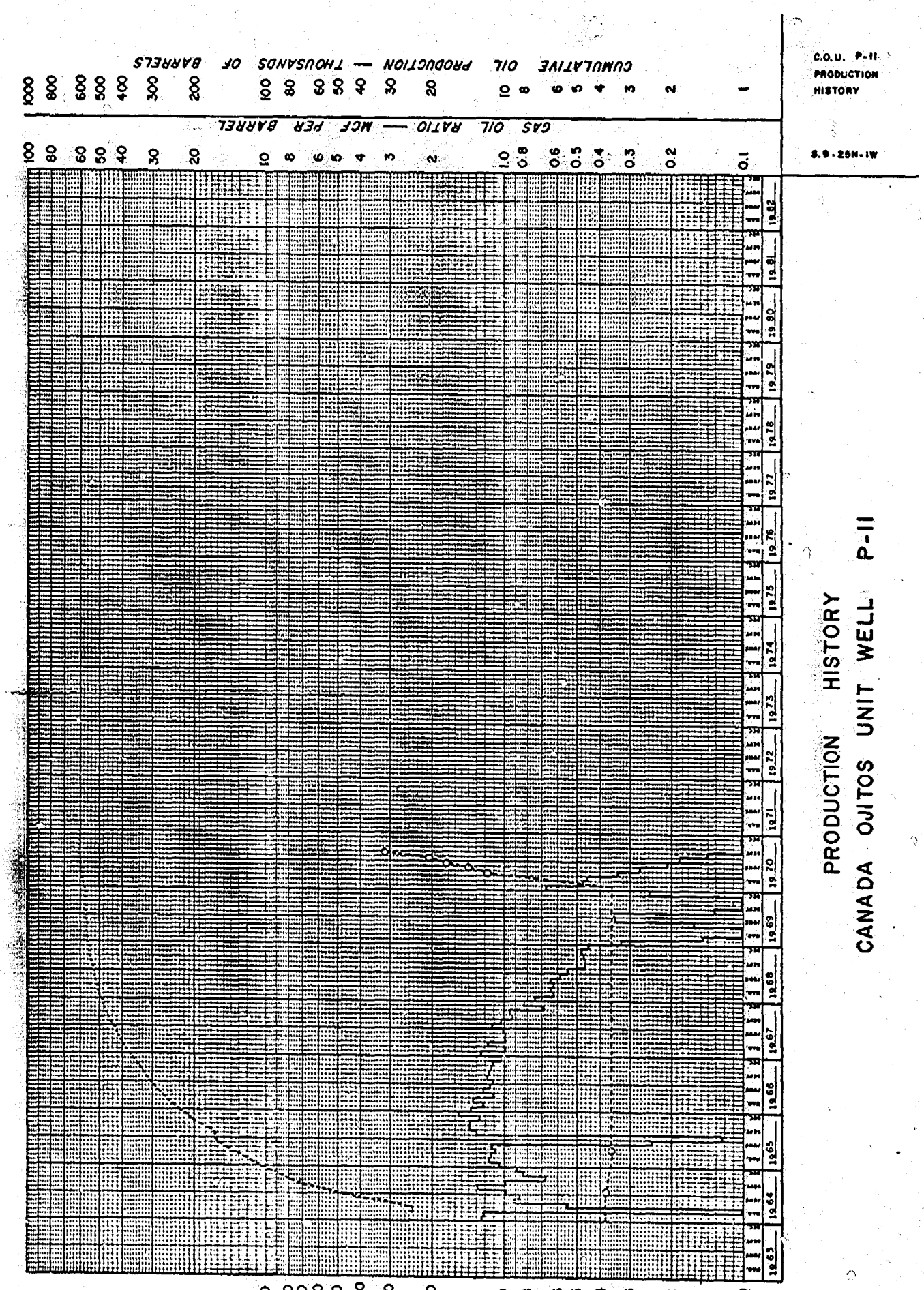
PRODUCTION HISTORY
CANADA OJITOS UNIT WELL A-14



C.O.U. A-14
PRODUCTION
HISTORY

S. 14 - 25N-1W

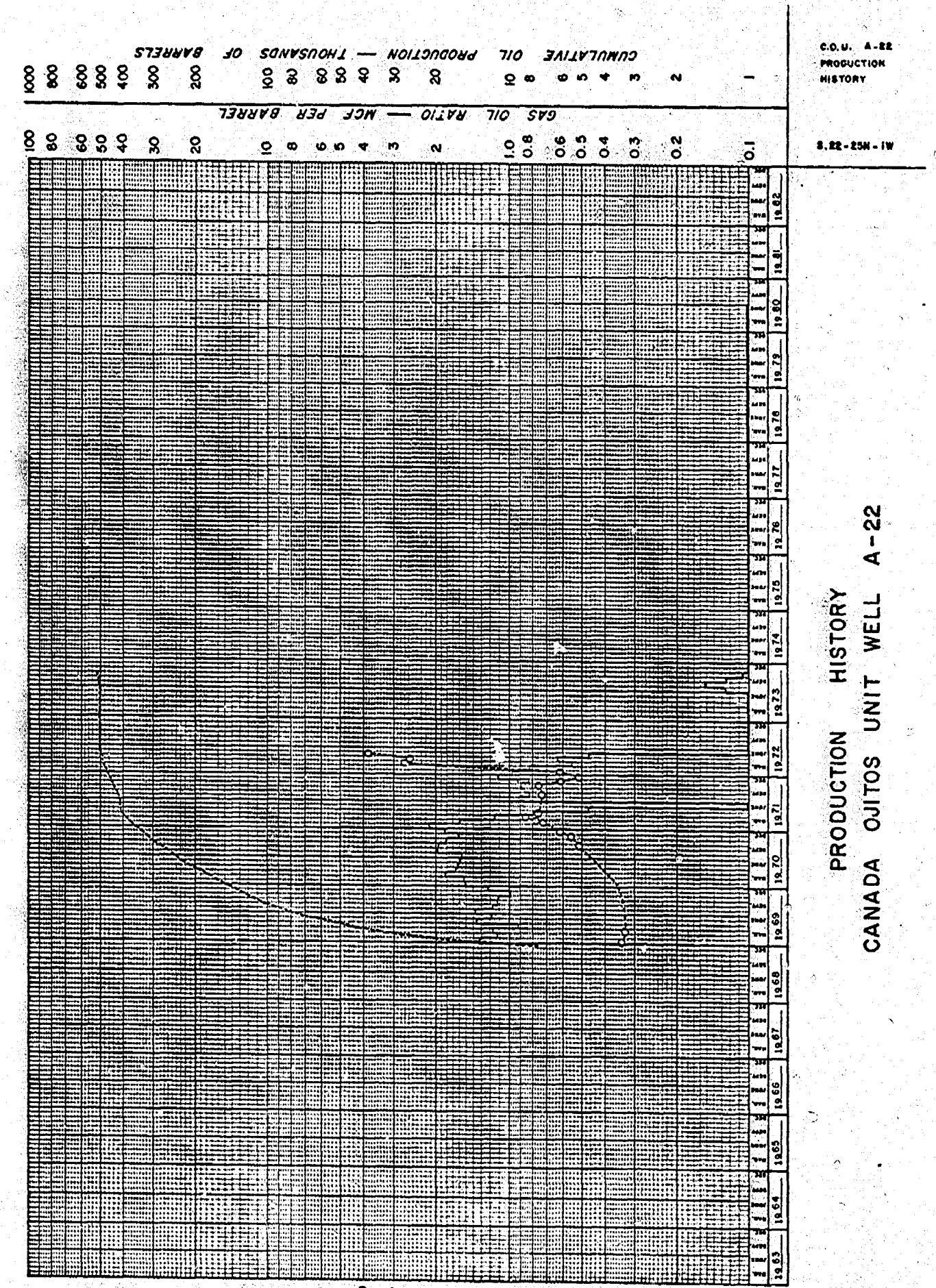
PRODUCTION HISTORY
CANADA OJITOS UNIT WELL P-11



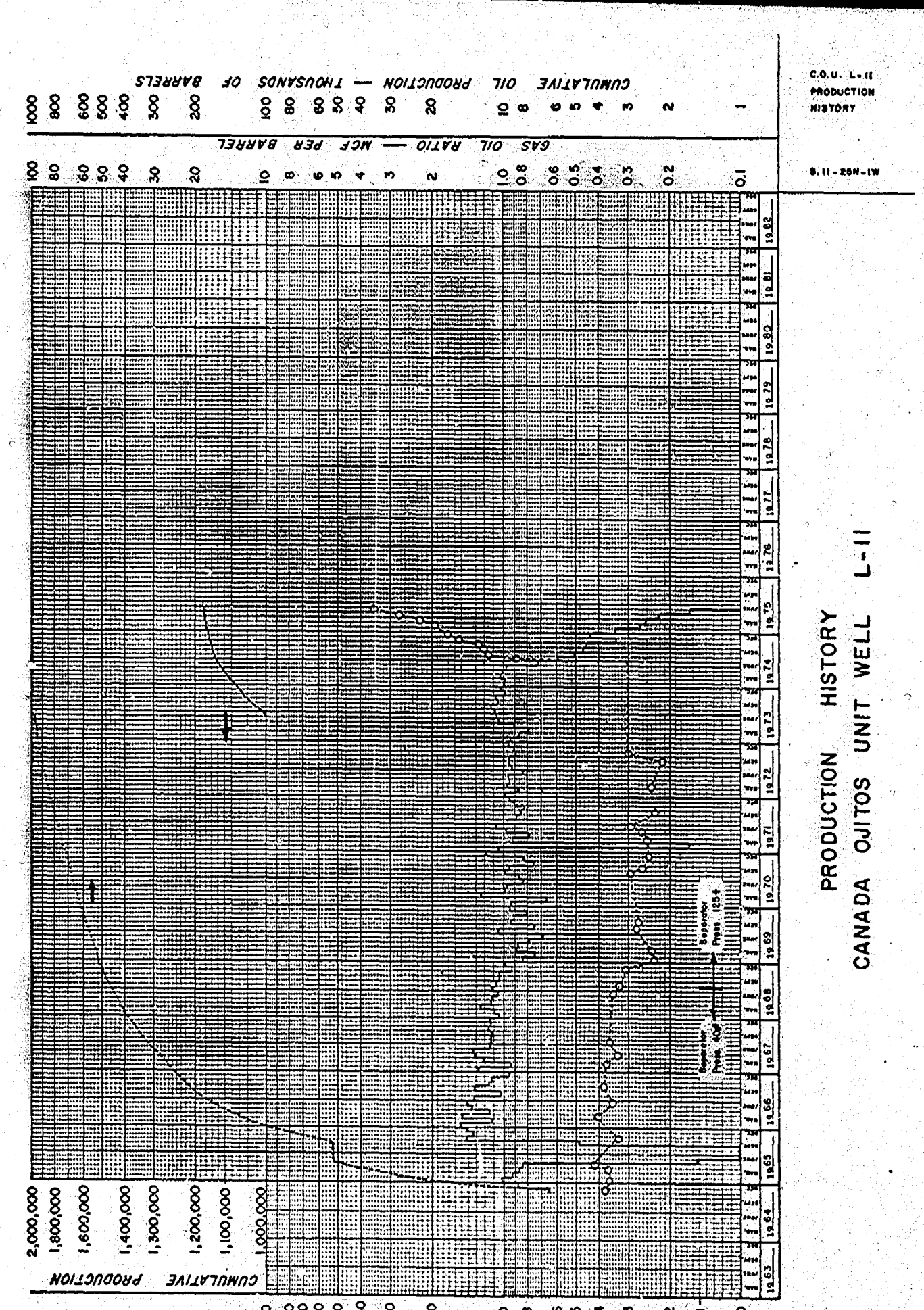
C.O.U. P-11
PRODUCTION
HISTORY

S.9-25N-1W

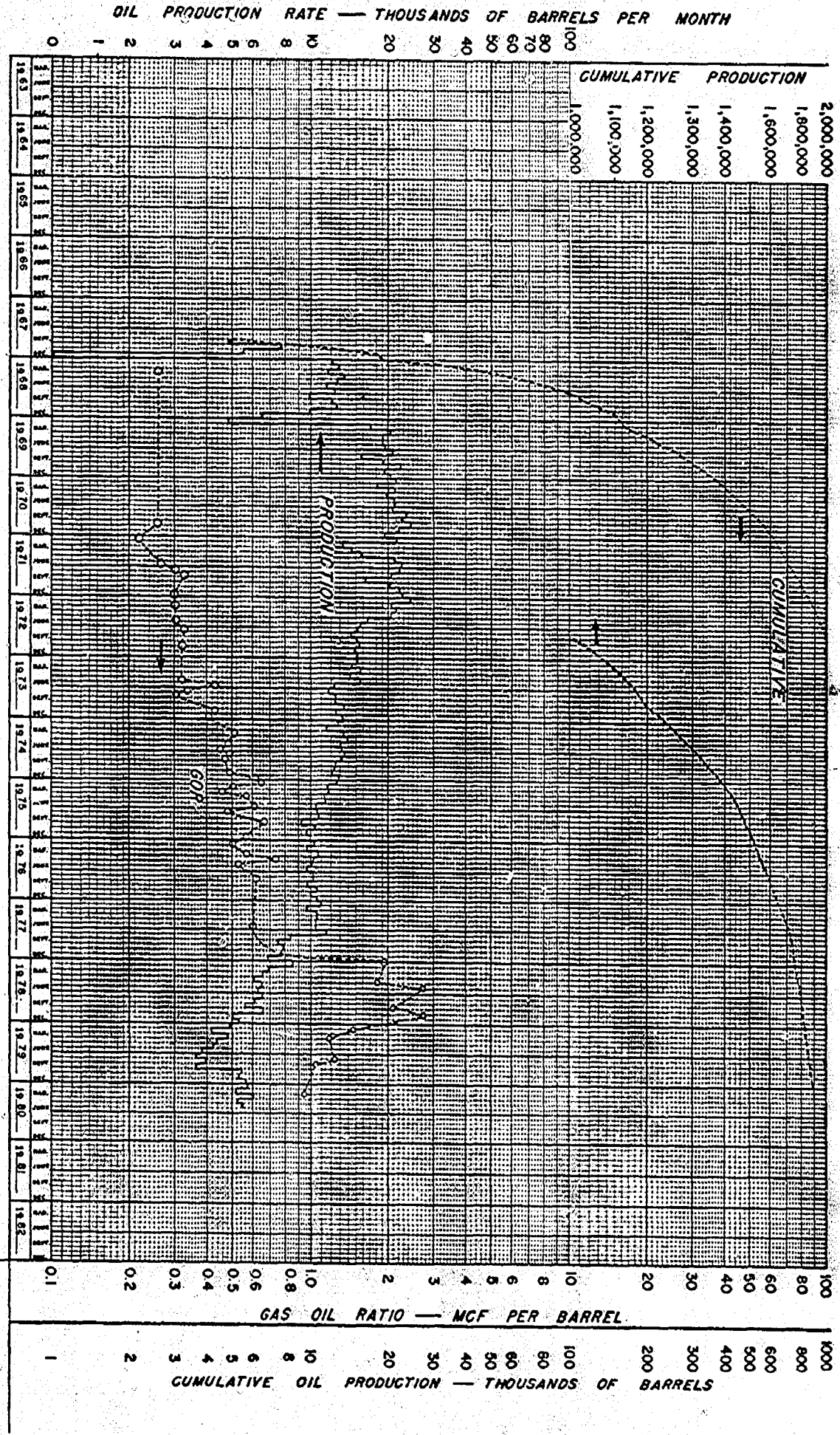
PRODUCTION HISTORY
CANADA OJITOS UNIT WELL A-22



PRODUCTION HISTORY
CANADA OJITOS UNIT WELL L-11



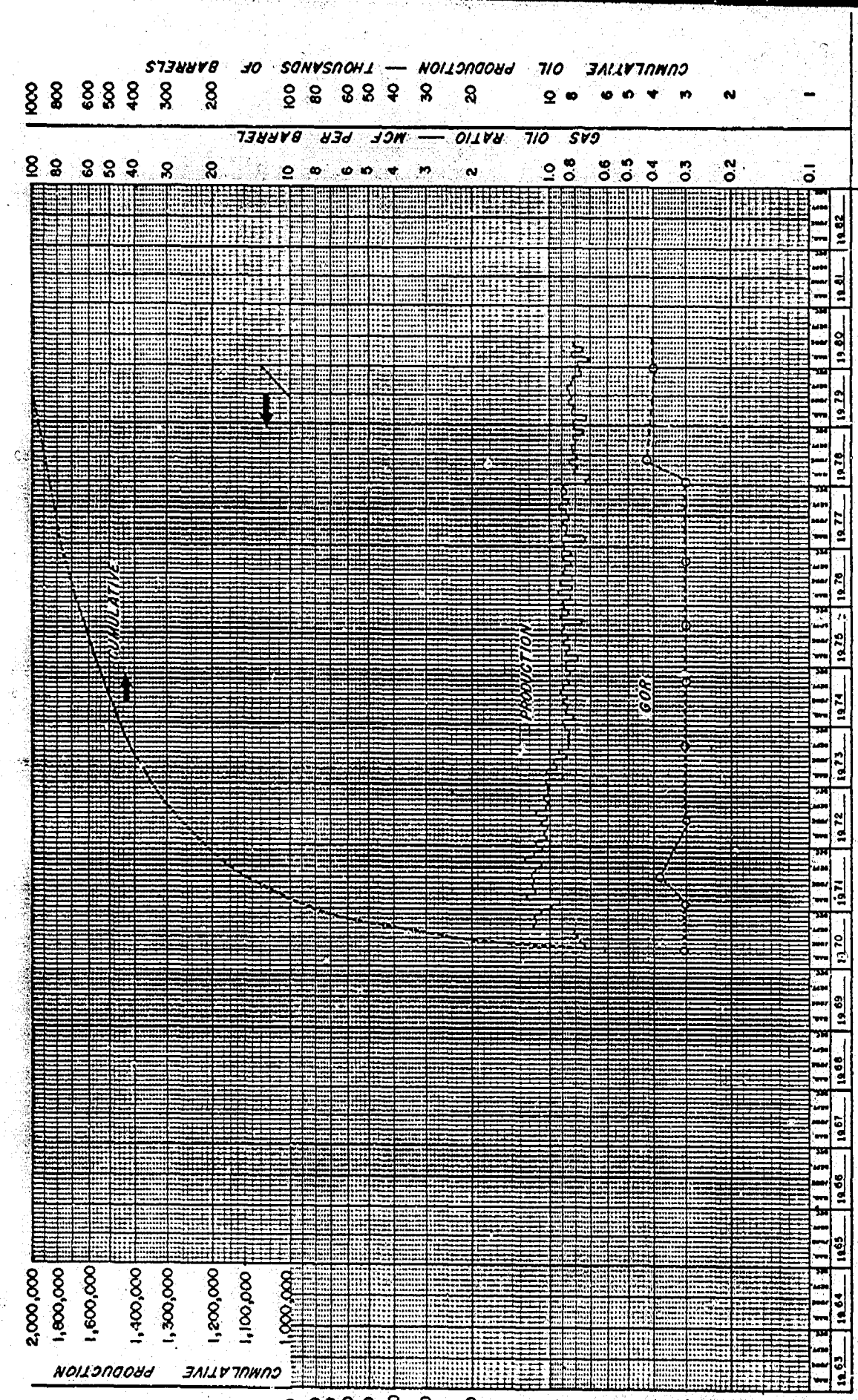
PRODUCTION HISTORY
CANADA QUITOS UNIT WELL E-10



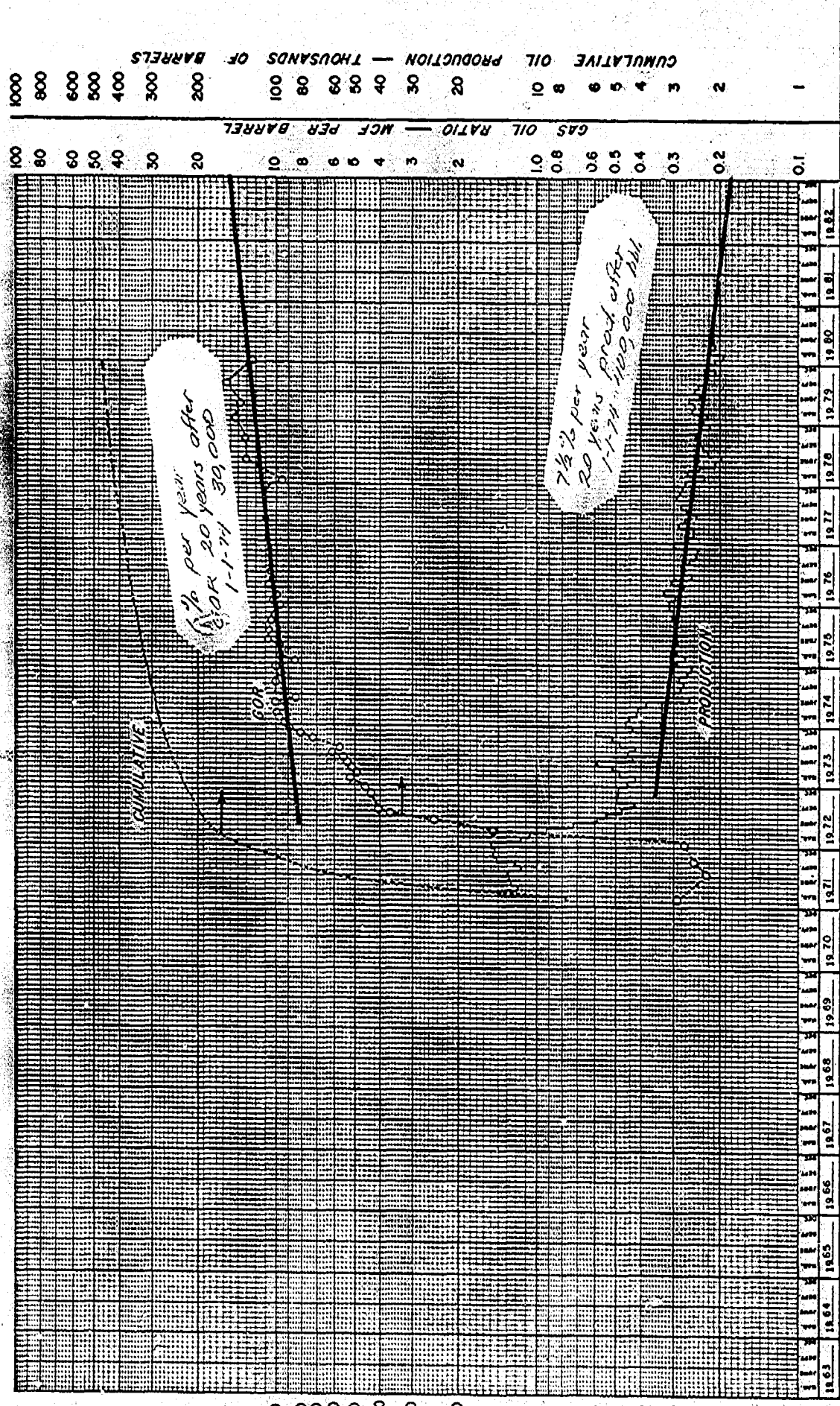
S.10-25N-1W

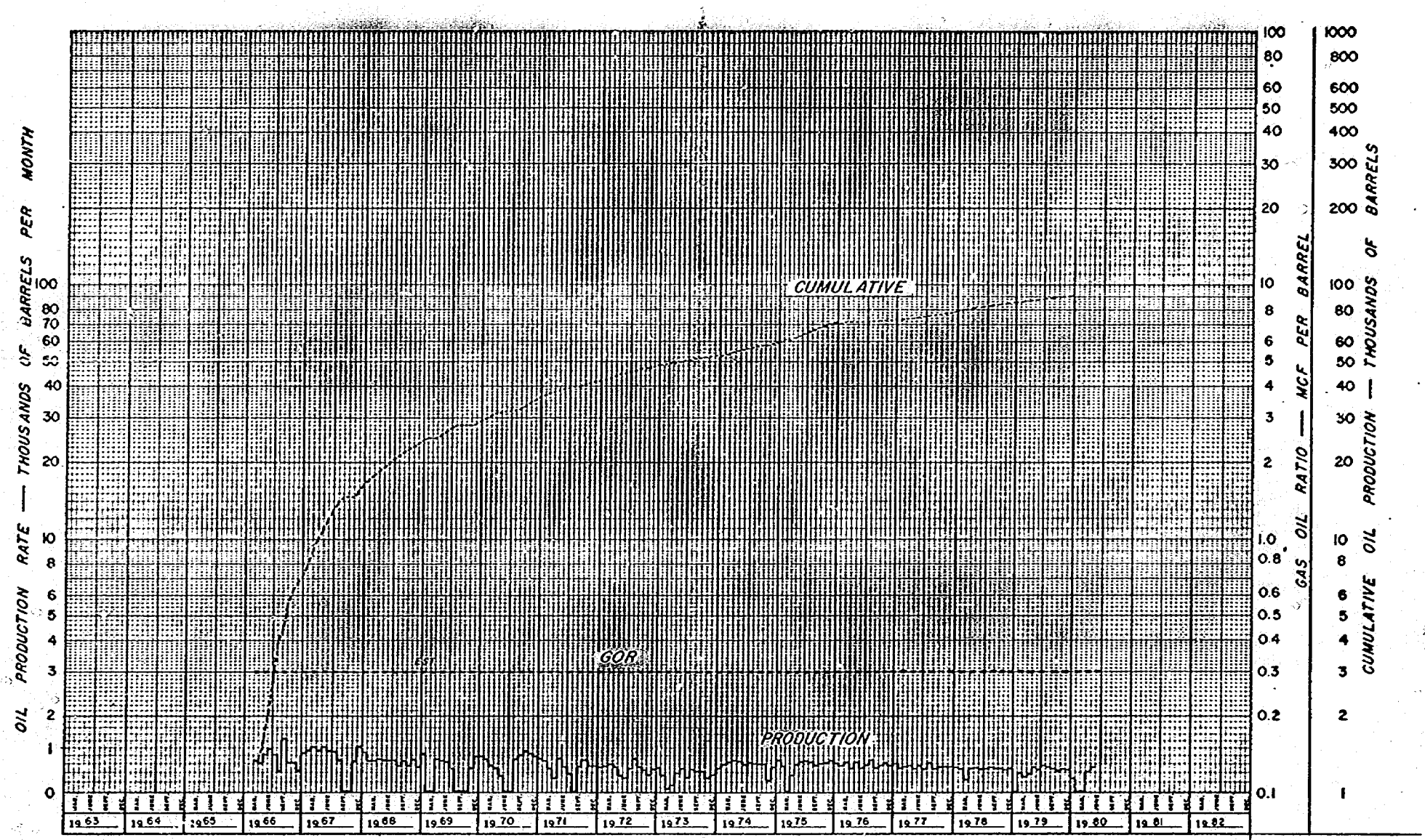
C.O.U. E-10
PRODUCTION
HISTORY

PRODUCTION HISTORY
CANADA OJITOS UNIT WELL L-27



PRODUCTION HISTORY
CANADA OJITOS UNIT WELL C-34



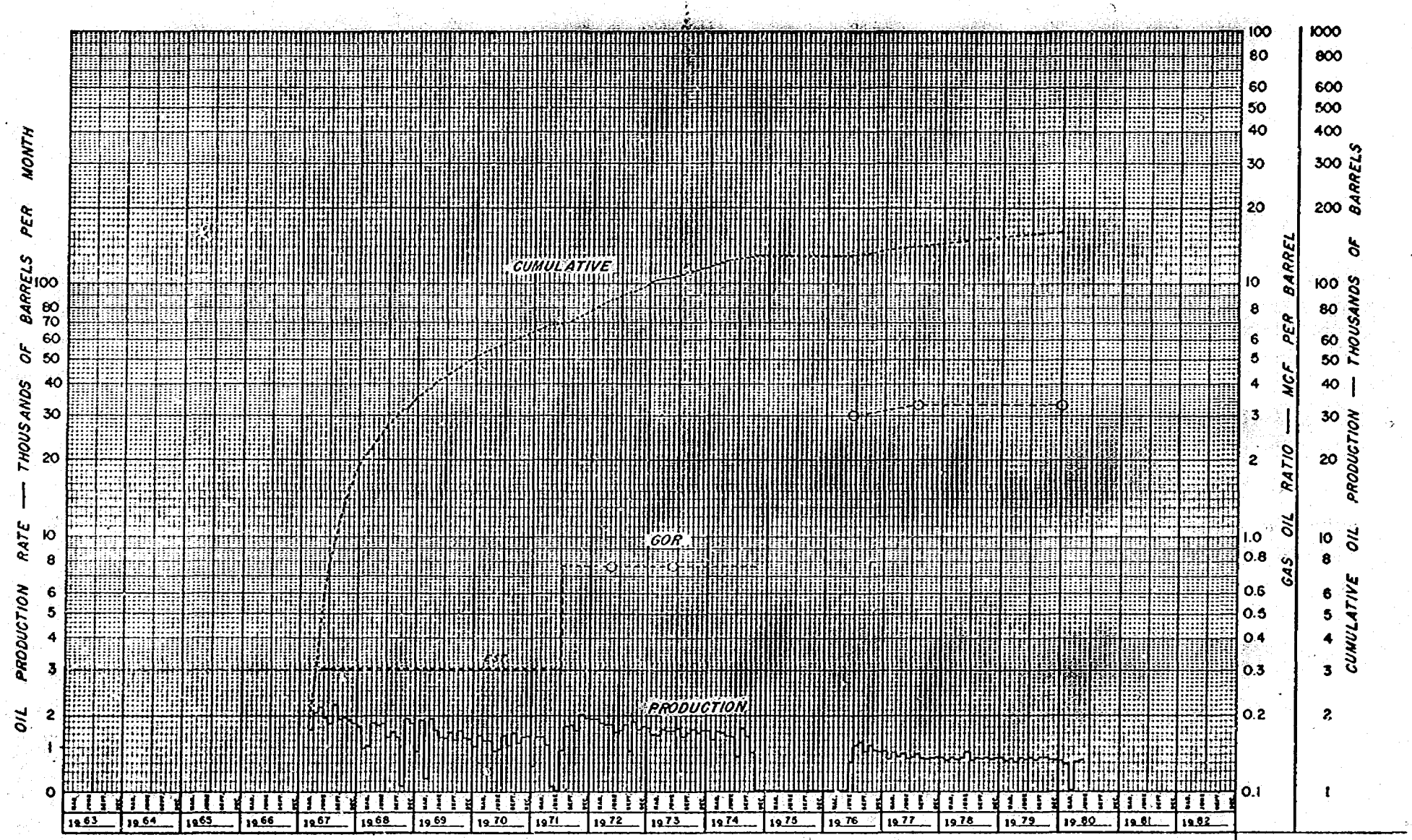


PRODUCTION HISTORY

CANADA OJITOS UNIT WELL A-16

S-19-S32-W4

C.O.U. A-16 PRODUCTION HISTORY

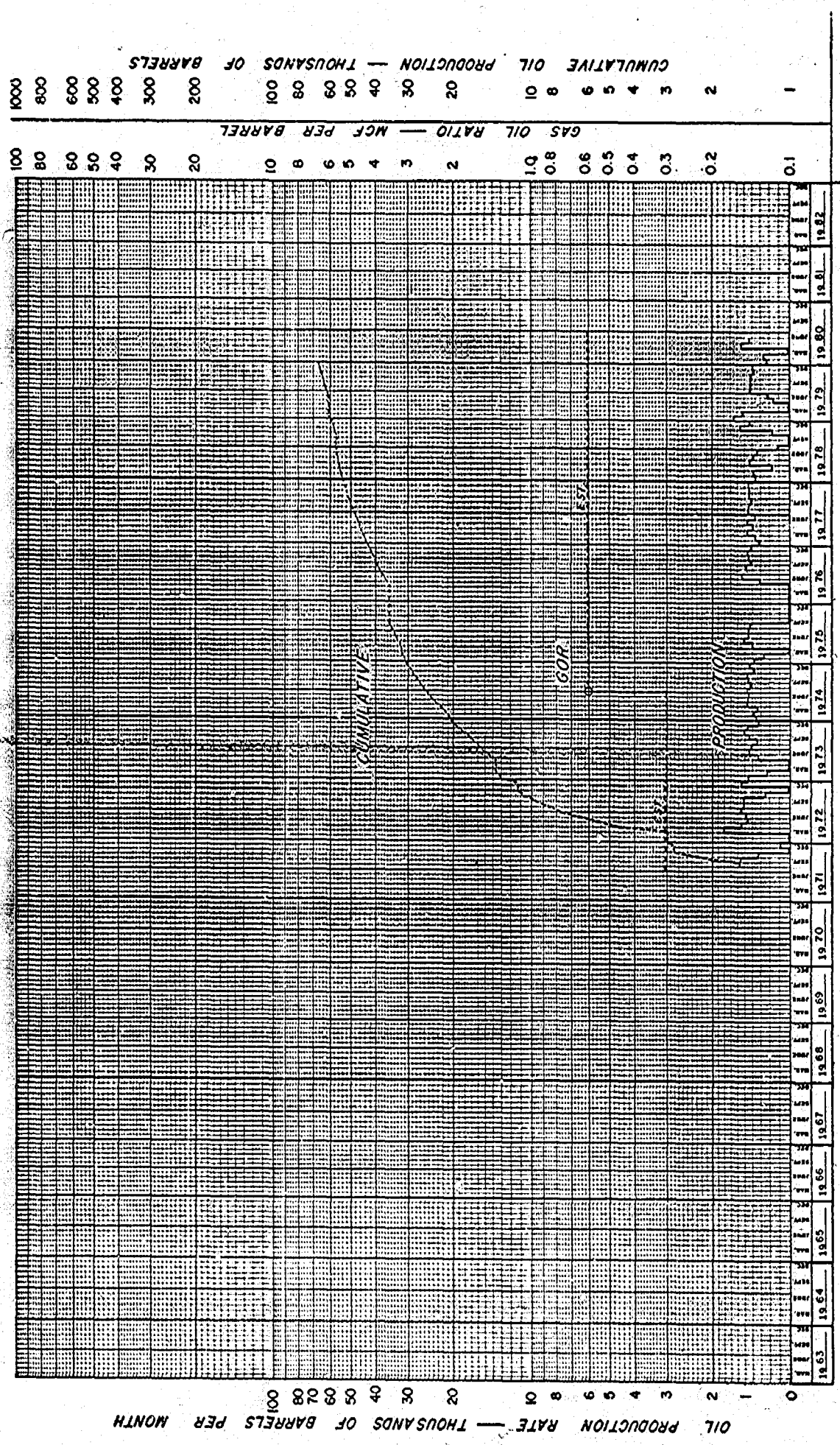


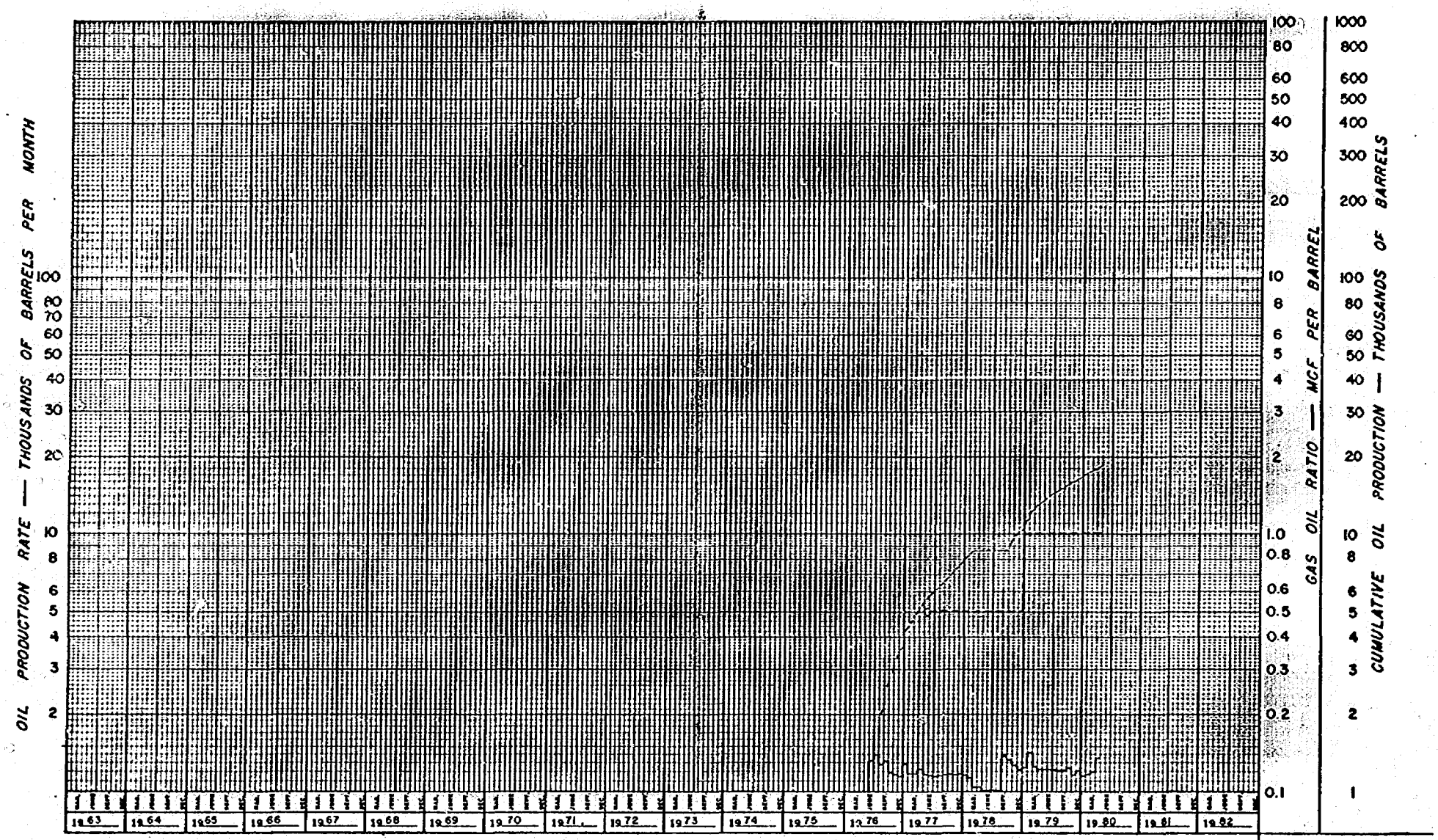
PRODUCTION HISTORY

CANADA OJITOS UNIT WELL O-33

COLO. O-33
PRODUCTION HISTORY
S.33-28N-1W

PRODUCTION HISTORY
CANADA OJITOS UNIT WELL L-3



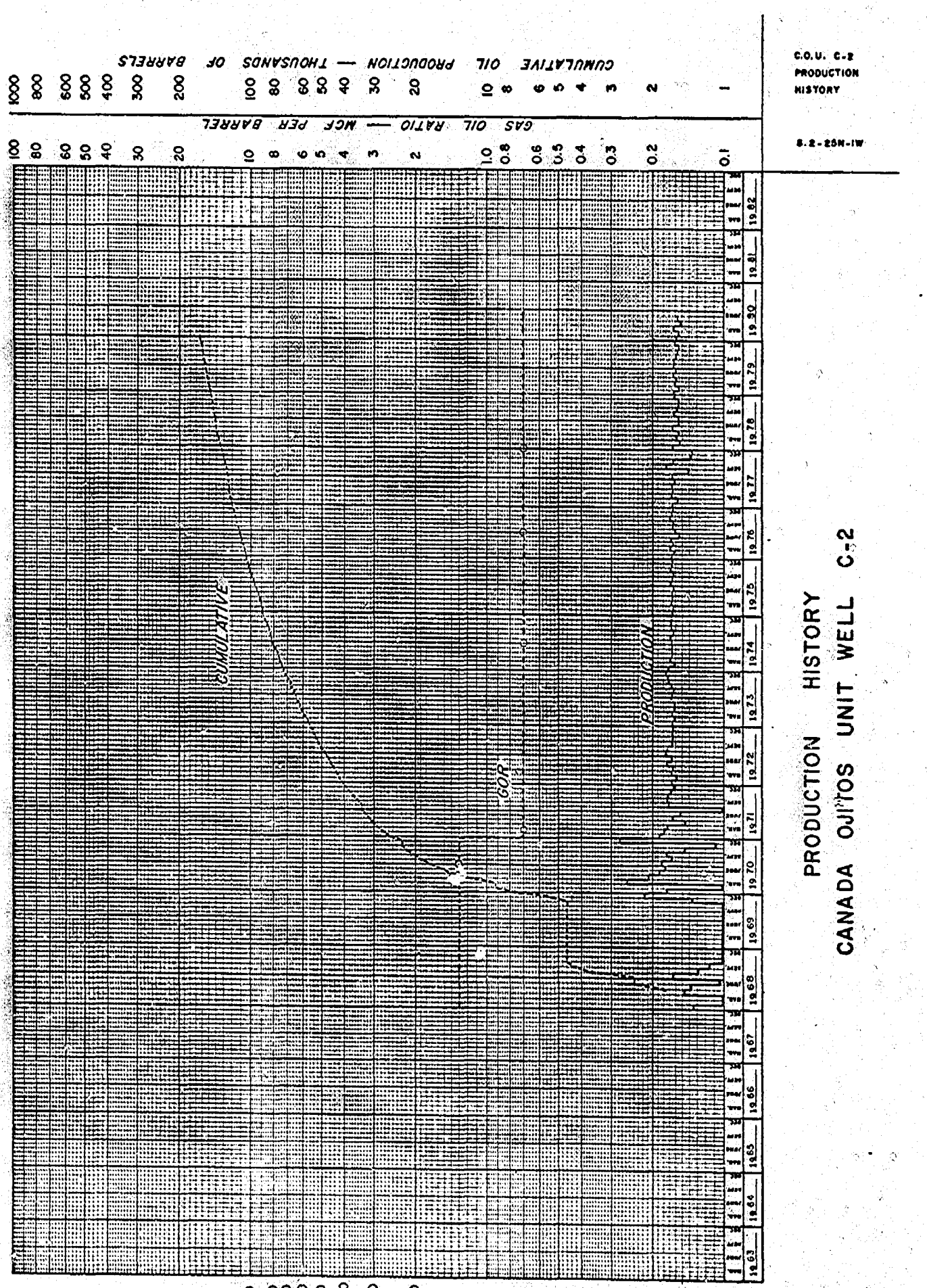


PRODUCTION HISTORY

CANADA OJITOS UNIT WELL O-9

C.O.U. O-9 PRODUCTION HISTORY

PRODUCTION HISTORY
CANADA OJITOS UNIT WELL C-2



PRESSURE MAINTENANCE VOLUMES REQUIRED
FOR GAS CAP PRESSURE OF 1400 PSIG* AND DIPPING RESERVOIR AND OIL PRODUCED BY GRAVITY DRAINAGE

1. Effective atmospheres: $\left(\frac{V_2}{V_1}\right) = \left(\frac{P_1}{P_2}\right)\left(\frac{Z_2}{Z_1}\right)\left(\frac{T_2}{T_1}\right) = \frac{1412}{15.025}\ \frac{1}{.85}\ \frac{520}{615} = 93.5$

2. For every barrel of oil produced, reservoir space voided is (5.615 cf)(1.29) = 7.24 cf

3. Gas volume required to replace 1 S.T. barrel of oil produced and maintain gas cap pressure: (7.24)(93.5) = 677 SCF

4. Gas cap volume at time 6,500,000 barrels oil produced:

   a. (6,500 M bbls)(7.24)(93.5) = 4.4 BCF plus
   b. Shrinkage of oil left in reservoir .7 BCF to 1 BCF depending on oil volume = Total $\pm$ 5.2 BCF

5. Additional gas volume required to increase gas cap pressure to overcome the decrease in oil zone pressure caused by downdip displacement of gas-oil contact. Assume average recovery at gas-oil contact in high capacity system to be at rate of 250 barrels/acre and that structure dips at 200′ and 400′ per mile:
   (Consider a one-mile wide segment of the reservoir running downdip and that it contains 1/10 (one mile out of 10 along the strike) of the gas cap gas of + .5 BCF for the segment)

   a. At 400′/mile
      Recoverable oil volume per section: (250 BOPA)(540 acres) = 160,000 BO
      Drop in gas-oil contact with production of 1 barrel:
      $\frac{1 \text{ bbl}}{160{,}000 \text{ bbls/mile}}$ (400′/mile) = .0025 ft = (.0025 ft)(.312 psi/ft) = .00078 psi, which translates to:

      $\frac{.00078}{1412}$ (.52 BCF) = 287 cf/bbl

   b. At 200′/mile: 1/2 x 287 = 143 cf/bbl

   Note: If bulk of gas cap volume is concentrated in 5 mile area along strike and bulk of oil produced here, volumes required to raise gas cap pressure could be twice those shown above ("high" estimate in following table).

6. Summary:

	For 250 BOPA reservoir voidage and structure of:			
	400′/Mile		200′/Mile	
	High Est. (cf/bbl)	Low Est. (cf/bbl)	High Est. (cf/bbl)	Low Est. (cf/bbl)
a. Per barrel volume of gas required to replace oil and maintain existing gas cap pressure	677	677	677	677
b. Additional per barrel volume of gas required to raise pressure to equivalent initial oil zone pressure	574	287	286	143
c. Totals (for "complete" pressure maintenance)	1251	964	963	820
d. "Makeup" gas required if 300 cf/bbl saved from produced oil and reinjected (for "complete" pressure maintenance)	950	660	960	520

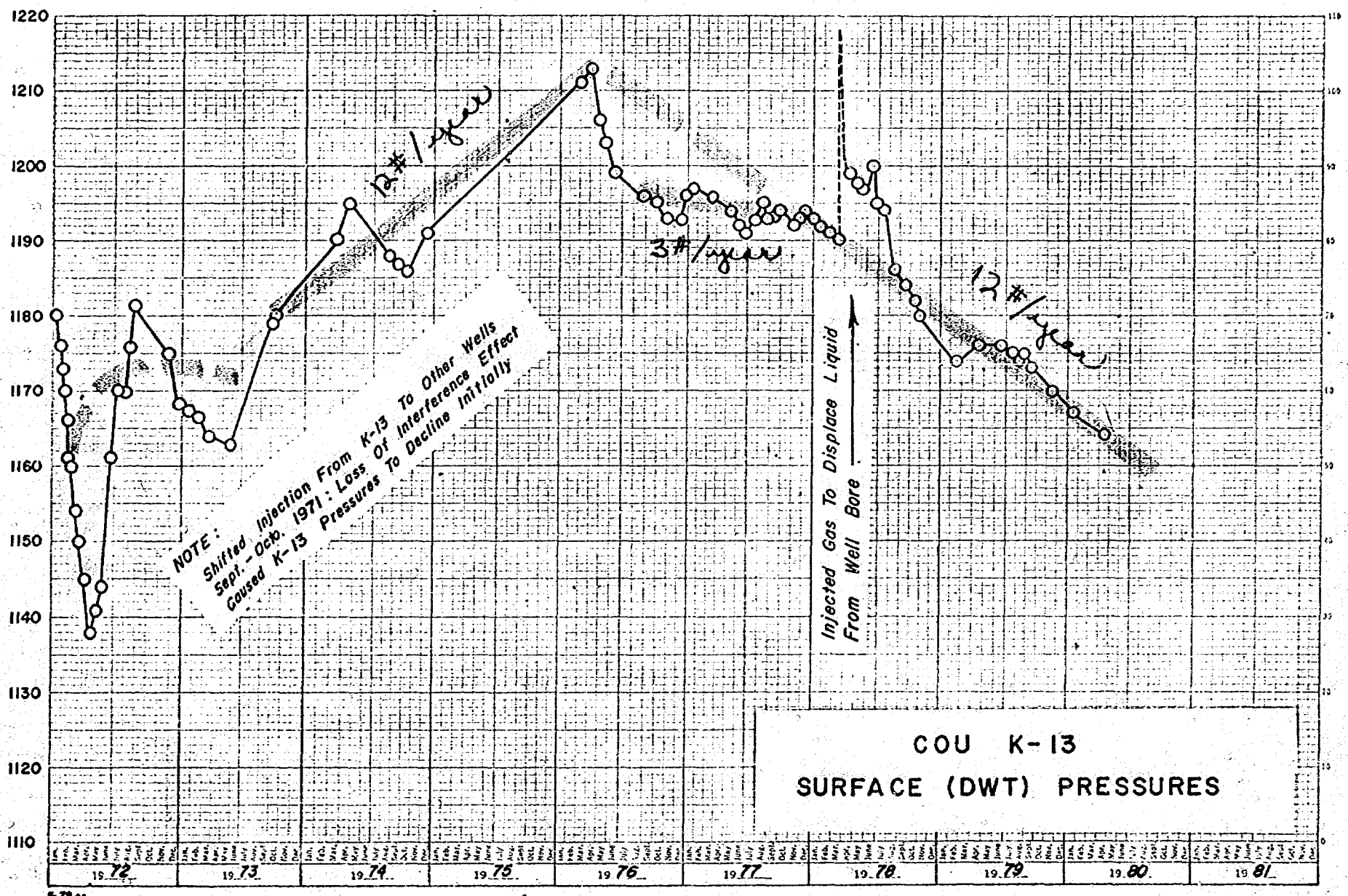
* For surface pressure of 1165# gauge and 6000′ average depth of gas cap.

NOTE: All of above applies to the simplified systems indicated to arrive at volumes for complete pressure maintenance. For less than complete pressure maintenance determination of actual pressures is more complicated.

RELATIVE COST OF "MAKEUP" GAS AS FUNCTION OF OIL PRICE *

Average oil price after windfall taxes ($/bbl)	$6.25	$10.00	$20.00	$30.00
Less 20% royalty and lease burdens ($/bbl)	5.00	8.00	16.00	24.00
Less 7 1/2% production taxes ($/bbl)	4.62	7.40	14.80	22.20
Less $2.00/bbl operating expenses (including fuel for compressors) ($/bbl)	2.62	5.40	12.80	20.20
(Net operating income except for makeup gas) ($/bbl)	2.62	5.40	12.80	20.20
Makeup gas @ .7 MCF/bbl and $2.00/MCF ($/bbl)	1.40	1.40	1.40	1.40
Net income ($/bbl)	1.22	4.00	11.40	18.80
Cost of makeup gas as % of income before makeup gas cost	53%	26%	11%	7%

* For "complete" pressure maintenance


SURFACE PRESSURE
1220
1210
1200
1190
1180
1170
1160
1150
1140
1130
1120
1110
2#/year
3#/year
12#/year
NOTE: Shifted Injection From K-13 To Other Wells Sept.-Octb. 1971: Loss Of Interference Effect Caused K-13 Pressures To Decline Initially
Injected Gas To Displace Liquid From Well Bore
COU K-13
SURFACE (DWT) PRESSURES
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981

CANADA OJITOS UNIT

APPROXIMATE EQUIVALENT VOLUMES OF MAKEUP GAS
EXPRESSED AS CUBIC FEET PER BARREL OF OIL PRODUCED

Year	Makeup Gas Purchased (MCF)	Estimated Consumption for Fuel * (MCF)	Makeup Volume less Consumption (2) - (3) (MCF)	Oil Production (M bbl)	Makeup Volume less Consumption per Barrel of Production (4) (5) (cf/bbl)
(1)	(2)	(3)	(4)	(5)	(6)
1972	264,267	70,000	194,267	620.8	313
1973	306,197	70,000	236,197	494.5	478
1974	385,615	70,000	315,615	427.0	740
1975	346,449	70,000	276,449	308.0	897
1976	194,737	70,000	124,737	300.1	416
1977	177,850	70,000	107,850	295.1	365
1978	113,765	70,000	43,765	236.9	185
1979	98,353	60,000	28,353	218.9	130

NOTE: Above are only equivalent volumes. Operator considers all purchased gas to be injected in reservoir. Fuel used is deemed to derive from gas produced with the oil.

* Fuel consumption estimated at

(1) 19 MCF/day/compressor for 8 compressors until 1979 when changed from carburetors to fuel injection, for last 3/4 yr: 14 MCF/day/compressor.

(2) 1% of 1,000 MCF/day for 1st dehydrator 10 MCF/day
& 1% of 2,000 MCF/day for 2nd dehydrator 20 MCF/day
TOTAL 30 MCF/day

(3) Camp fuel 4 MMCF/year.

APPROXIMATE RESERVOIR PRESSURE DECLINE
RESULTING FROM VERTICAL DROP IN GAS-OIL CONTACT "SURFACE"

and

HORIZONTAL DISPLACEMENT OF OIL IN "HIGH CAPACITY FRACTURE SYSTEM"

BO/ACRE IN PLACE (AVERAGE) (1)	BO/ACRE IN HIGH CAP.SYSTEM * (2)	BO/ACRE RECOVERY AT 50% EFFICIENCY (3)	FOR RESERVOIR 10 MI LONG x 1 MI WIDE: TOTAL VOL. IN PLACE (M BBLS) (4)	FOR RESERVOIR 10 MI LONG x 1 MI WIDE: PRODUCTION FRACTION AT 230M BBLS/YR (5)	DROP OF GAS-OIL CONTACT (FT/YR) FOR STRUCTURE: 400'/MI (6)	DROP OF GAS-OIL CONTACT (FT/YR) FOR STRUCTURE: 200'/MI (7)	EQUIVALENT PRESSURE DROP ($/YR) FOR STRUCTURE: 400'/MI (8)	EQUIVALENT PRESSURE DROP ($/YR) FOR STRUCTURE: 200'/MI (9)	PRESSURE DROP AS % OF 1400# FOR STRUCTURE: 400'/MI (10)	PRESSURE DROP AS % OF 1400# FOR STRUCTURE: 200'/MI (11)	TOTAL DOWN-DIP LINEAR MILES DISPLACED FOR 6500 M BBLS CUM. (12)
2000	1000	500	3200	.0718	28.7	14.3	9#	4.5#	0.6%	0.3%	2.0 **
1000	500	250	1600	.1436	57.0	28.6	18#	9.0#	1.2%	0.6%	4.0 **

* Assuming 50% of total initial oil in place to be in high capacity fracture system.

** For reservoir 10 miles long, this is the down-dip length of the reservoir from which oil has been displaced from the high capacity fracture system.

GRAVITY DRAINAGE RATES
WEST PUERTO CHIQUITO
FOR CONDITIONS OF:
OIL DENSITY 44.9#/cubic foot
GAS DENSITY 5.35#/cubic foot
OIL VISCOSITY .62 centipoises
FORMATION DIP 400 feet per mile

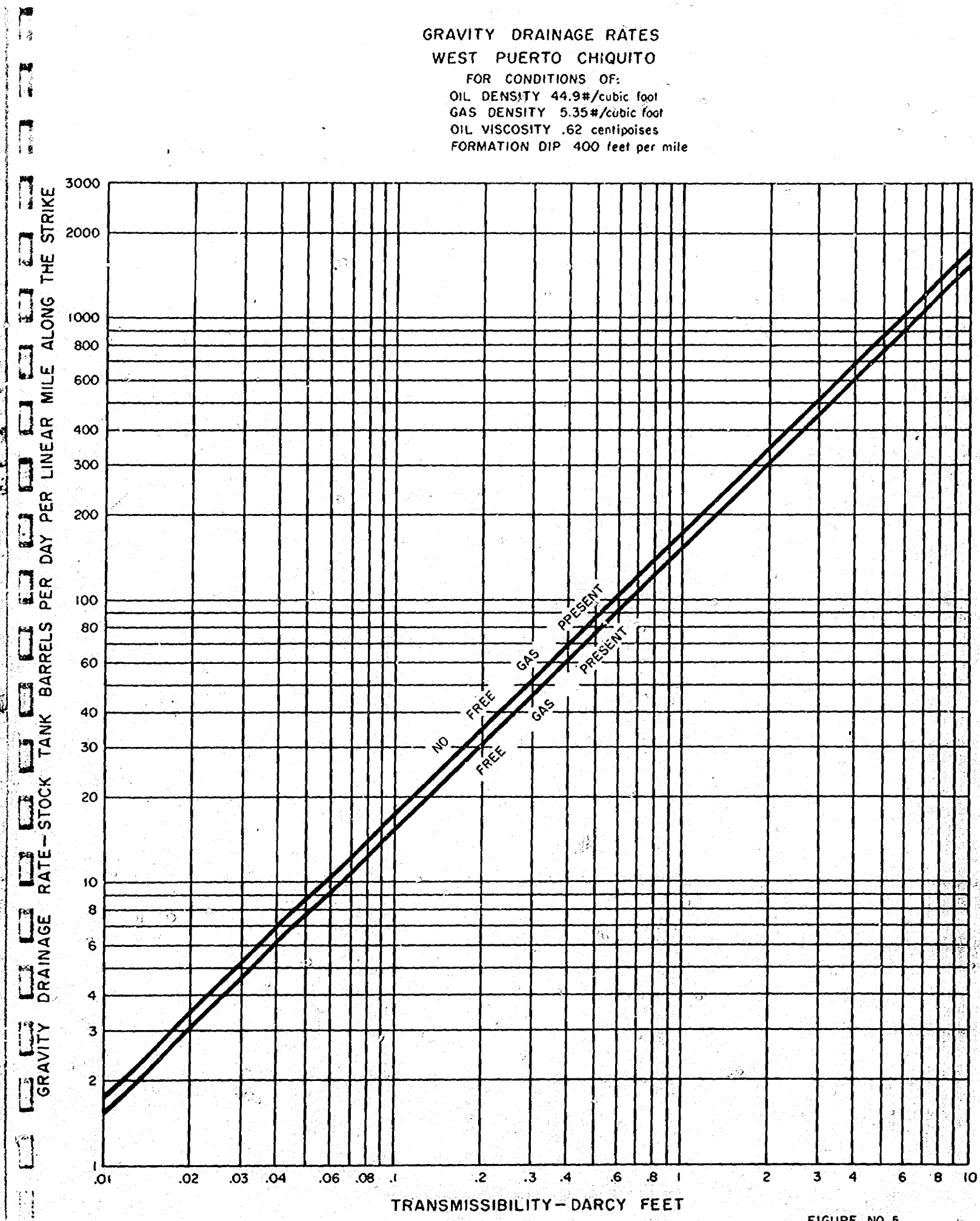
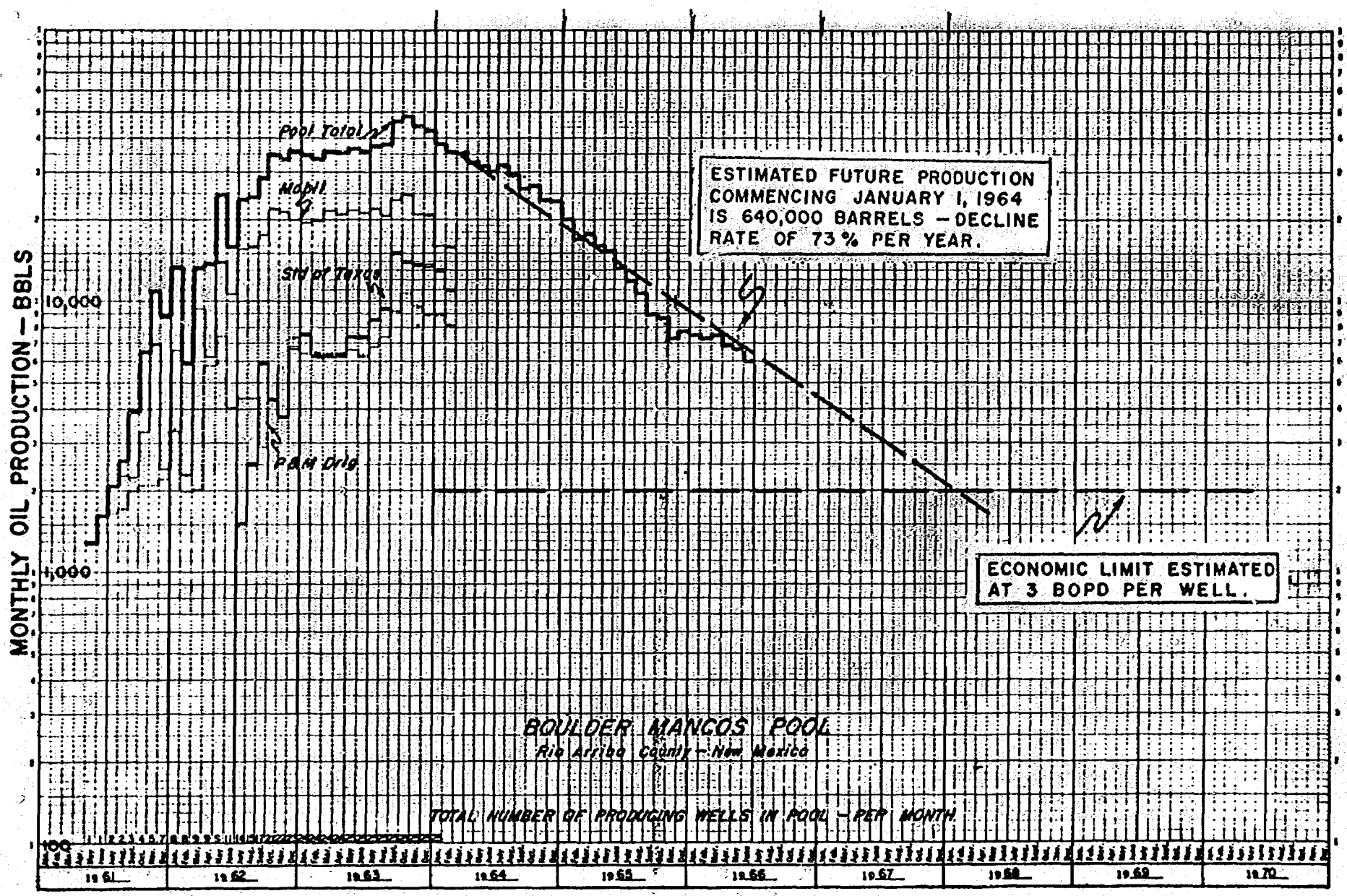
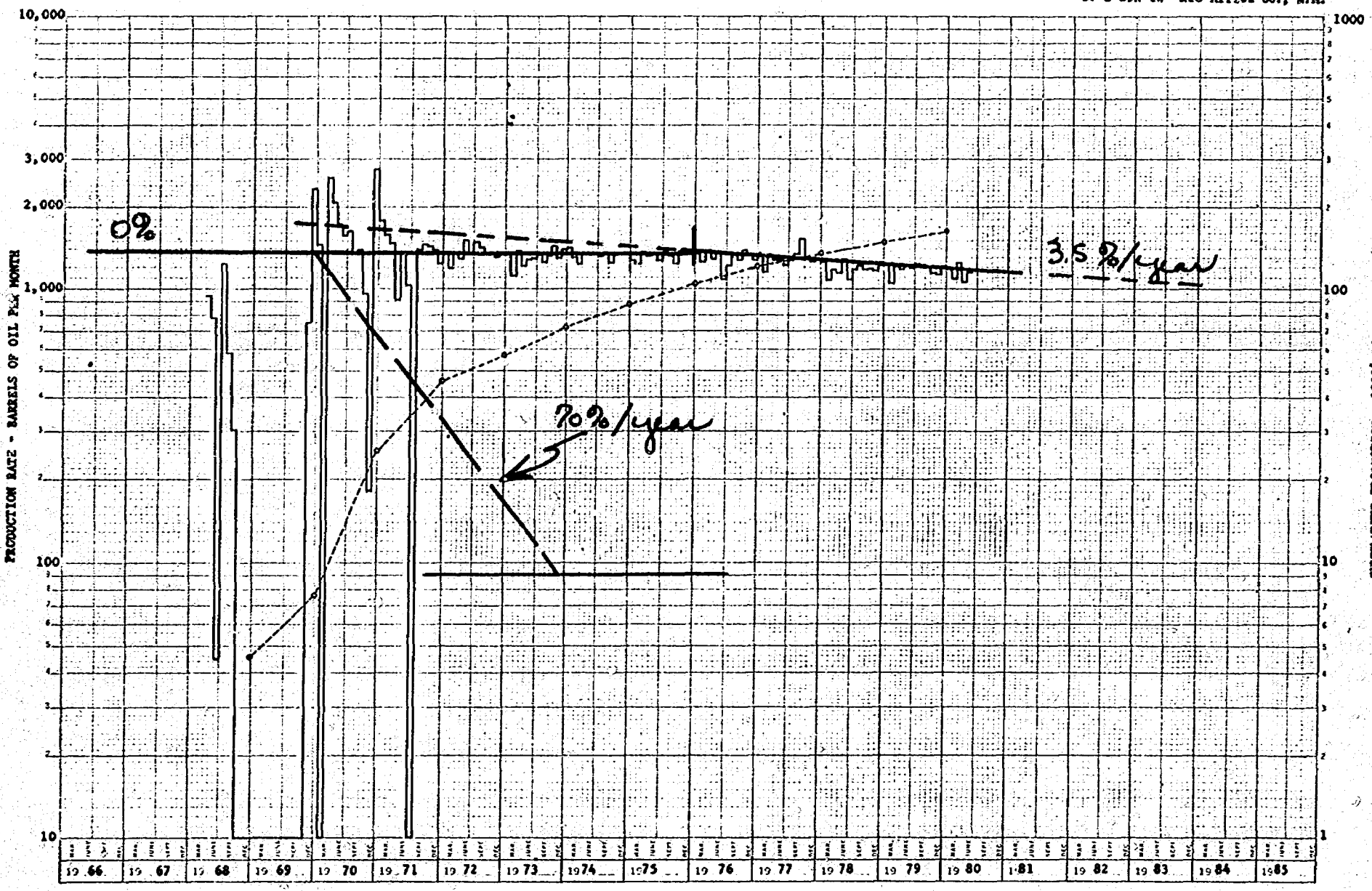


FIGURE NO. 5


ESTIMATED FUTURE PRODUCTION COMMENCING JANUARY 1, 1964 IS 640,000 BARRELS – DECLINE RATE OF 73 % PER YEAR.
Pool Total
Mapil
Std of Texas
PAM Orig
ECONOMIC LIMIT ESTIMATED AT 3 BOPD PER WELL.
MONTHLY OIL PRODUCTION – BBLS
10,000
1,000
100
BOULDER MANCOS POOL
Rio Arriba County – New Mexico
TOTAL NUMBER OF PRODUCING WELLS IN POOL – PER MONTH
1961
1962
1963
1964
1965
1966
1967
1968
1969
1970

BENSON-MONTIN-GREER DRILLING CORP.
CANADA OJITOS UNIT C-2
S. 2-25N-1W Rio Arriba Co., N.M.



K-E 20 YEARS BY MONTHS 359-215L
KEUFFEL & ESSER CO.

2/80

NOTES REGARDING PRODUCTION BEHAVIOR OF CANADA OJITOS UNIT C-2 AND AREA DRAINED BY WELL

1. For comparison a 70% decline rate (as was experienced by the Boulder Field wells) is indicated. For this well, C-2, produced to an economic limit of 3 BOPD, this 70% rate of decline would have resulted in a cumulative production of 22,100 bbls. (Actual cumulative to 1-1-80 is 164,000 bbls.)

2. Gravity Drainage Consideration: With the well's low initial stabilized production rate (approximately 45 BOPD) its immediate drainage area is too tight to permit substantial gravity drainage. The gravity drainage rate for a transmissibility supporting 45 BOPD and the dip of the formation of approximately 400' per mile would be approximately 8 BOPD per linear mile along the strike. For 640-acre spacing the maximum gravity drainage rate would then be about 8 BOPD.

3. Since approximately 80% of the well's production must come from something other than gravity drainage of its own immediate area, one must conclude that:

   (1) the well's production has resulted from its participation in the overall reservoir system as described by the "jigsaw" makeup of tight blocks and high capacity fracture system; and that the pressure and production in its immediate area has been maintained by the pressure maintenance system (nearest injection well approximately 3 miles away);

   or

   (2) if production is not supported by the system as described in 3(1) above and since 80% of the production must come from something other than gravity drainage, it would then have to be from solution-gas drive; and if we assume the reservoir it is draining would be of the same character as that in the vicinity of the well, and that the well would continue along its present 5% maximum rate of decline, then the ultimate recovery would be about 400,000 bbls. If 80% is from solution-gas drive this would mean 320,000 bbls. from this. At 50 bbls/acre (5% of 1,000 BOPA in place maximum estimate for tight reservoirs) this would indicate 6,400 acres being drained by the well.

4. Of the two possibilities, the most logical one is that the well is part of the overall drainage system as earlier described and is draining its share of several thousand acres. The fact that the well produced until 1976 with practically no decline coincides with the pressure maintenance which was rather "complete" for the period 1972 to 1976 in which the well had 0% annual rate of decline in production. In 1976 the well took on an increased rate of decline which is estimated to be in the range of 3.5% to 5% per year. The pressure decline in the gas cap (Section F-4 herein) of approximately 1% per year, along with possible additional decline in pressure as indicated in F-6 herein, would account for only 1% to 2% rate of reservoir pressure decline. The additional production decline rate could be the result of reduction in relative permeability to oil since pressure in the vicinity of the well is now probably below the bubble point. On the other hand, it has been observed in other wells in this area, and in other fractured Niobrara reservoirs, that productivity often drops at a much faster rate than can be accounted for by either or both pressure decline and decline in relative permeability to oil. It has been postulated that this could be the result of fractures squeezing together following pressure decline; and this could be a factor here.

5. Under any rational interpretation, however, the well must be draining several thousand acres.

BENSON-MONTIN-GREER DRILLING CORP.
CANADA OJITOS UNIT A-16
S. 16-25N-1W Rio Arriba Co., NM

10,000
1,000
800
600
400
200
100
10

1.3%/year

7%/year

70%

PRODUCTION RATE - BARRELS OF OIL PER MONTH

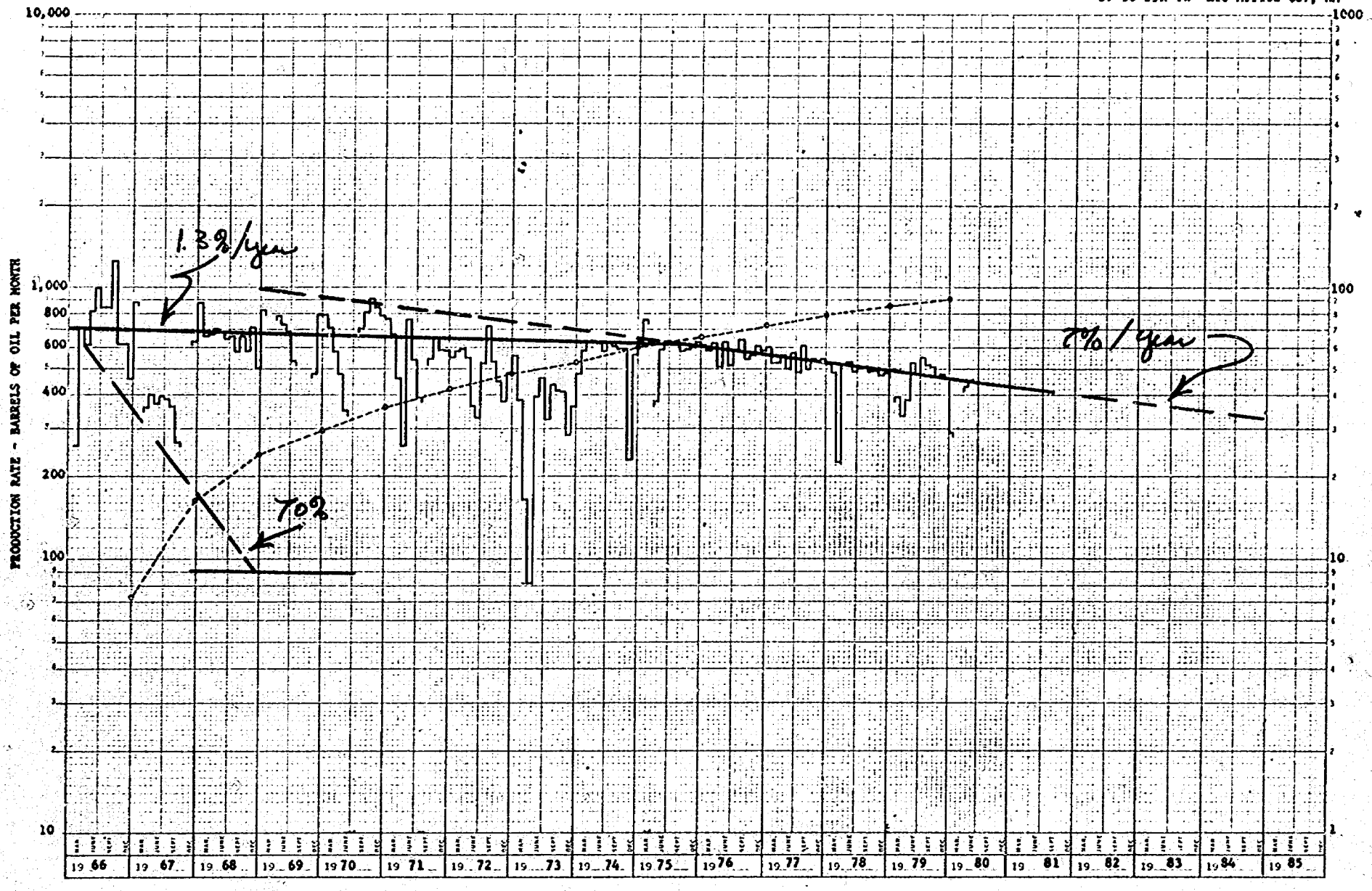
CUMULATIVE PRODUCTION - 1000's OF BARRELS

1000
100
10
1

19 66 | 19 67 | 19 68 | 19 69 | 19 70 | 19 71 | 19 72 | 19 73 | 19 74 | 19 75 | 19 76 | 19 77 | 19 78 | 19 79 | 19 80 | 19 81 | 19 82 | 19 83 | 19 84 | 19 85

2/80

BENSON-MONTIN-GREER DRILLING CORP.
CANADA OJITOS UNIT A-16
S. 16-25N-1W Rio Arriba Co., NM



PRODUCTION RATE - BARRELS OF OIL PER MONTH

CUMULATIVE PRODUCTION - 1000's OF BARRELS

K+E 10 YEARS BY MONTHS 359-215L
3 CYCLES
KEUFFEL & ESSER CO.

2/80

NOTES REGARDING PRODUCTION BEHAVIOR OF
CANADA OJITOS UNIT A-16
AND AREA DRAINED BY WELL

1. For comparison a 70% decline rate (as was experienced by the Boulder Field wells) is indicated. For this well, A-16, produced to an economic limit of 3 BOPD, this 70% rate of decline would have resulted in a cumulative production of 10,000 bbls. (Actual cumulative to 1-1-80 is 90,000 bbls.)

2. Gravity Drainage Consideration: With the well's low initial stabilized production rate (approximately 25 BOPD) its immediate drainage area is too tight to permit substantial gravity drainage. The gravity drainage rate for a transmissibility supporting 25 BOPD and the dip of the formation of approximately 100' per mile would be approximately 2 BOPD per linear mile along the strike. For 640-acre spacing the maximum gravity drainage rate would then be about 2 BOPD.

3. Since approximately 90% of the well's production must come from something other than gravity drainage of its own immediate area, one must conclude that:

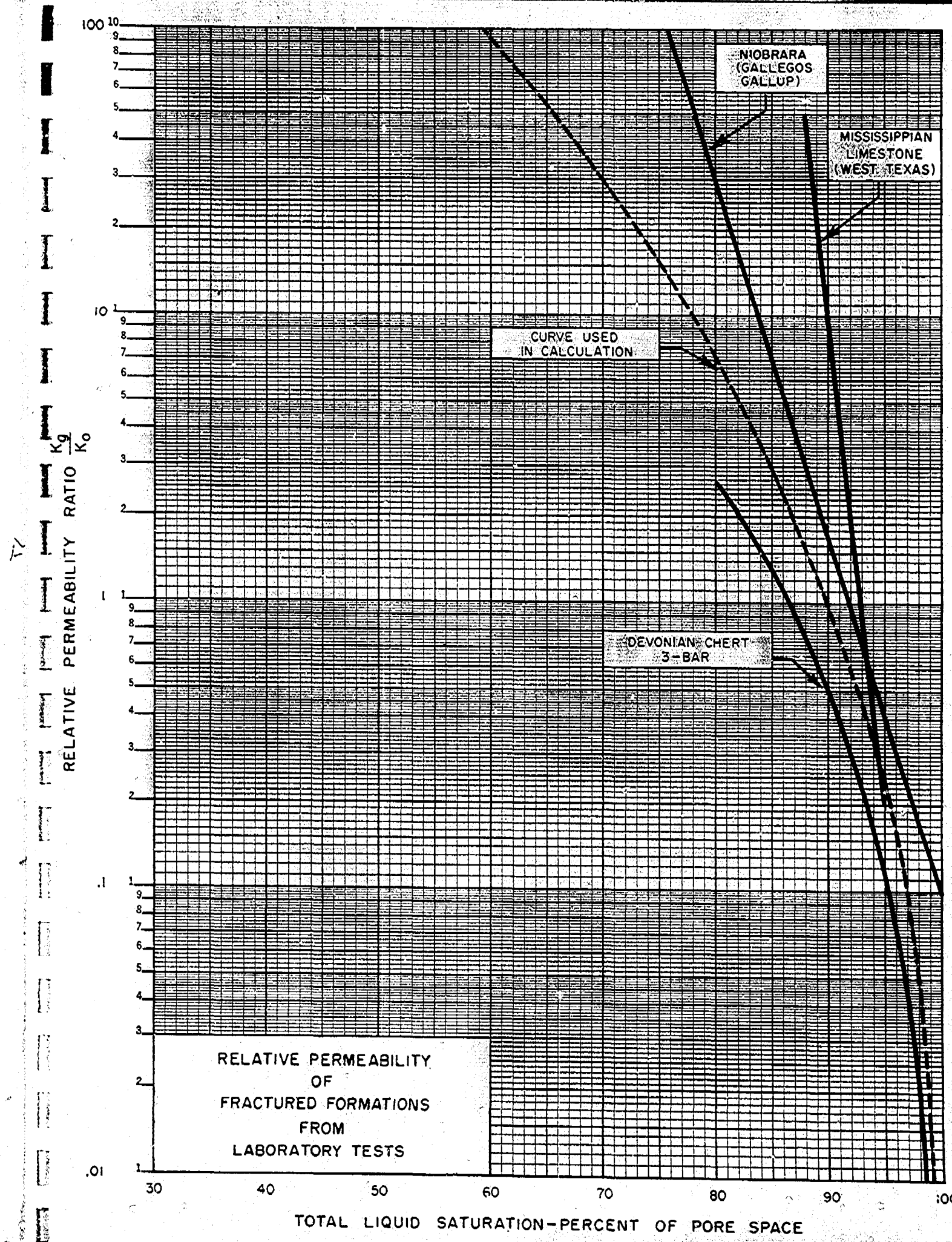
   (1) the well's production has resulted from its participation in the overall reservoir system as described by the "jigsaw" makeup of tight blocks and high capacity fracture system; and that the pressure and production in its immediate area has been maintained by the pressure maintenance system (nearest injection well approximately 4 miles away);

   or

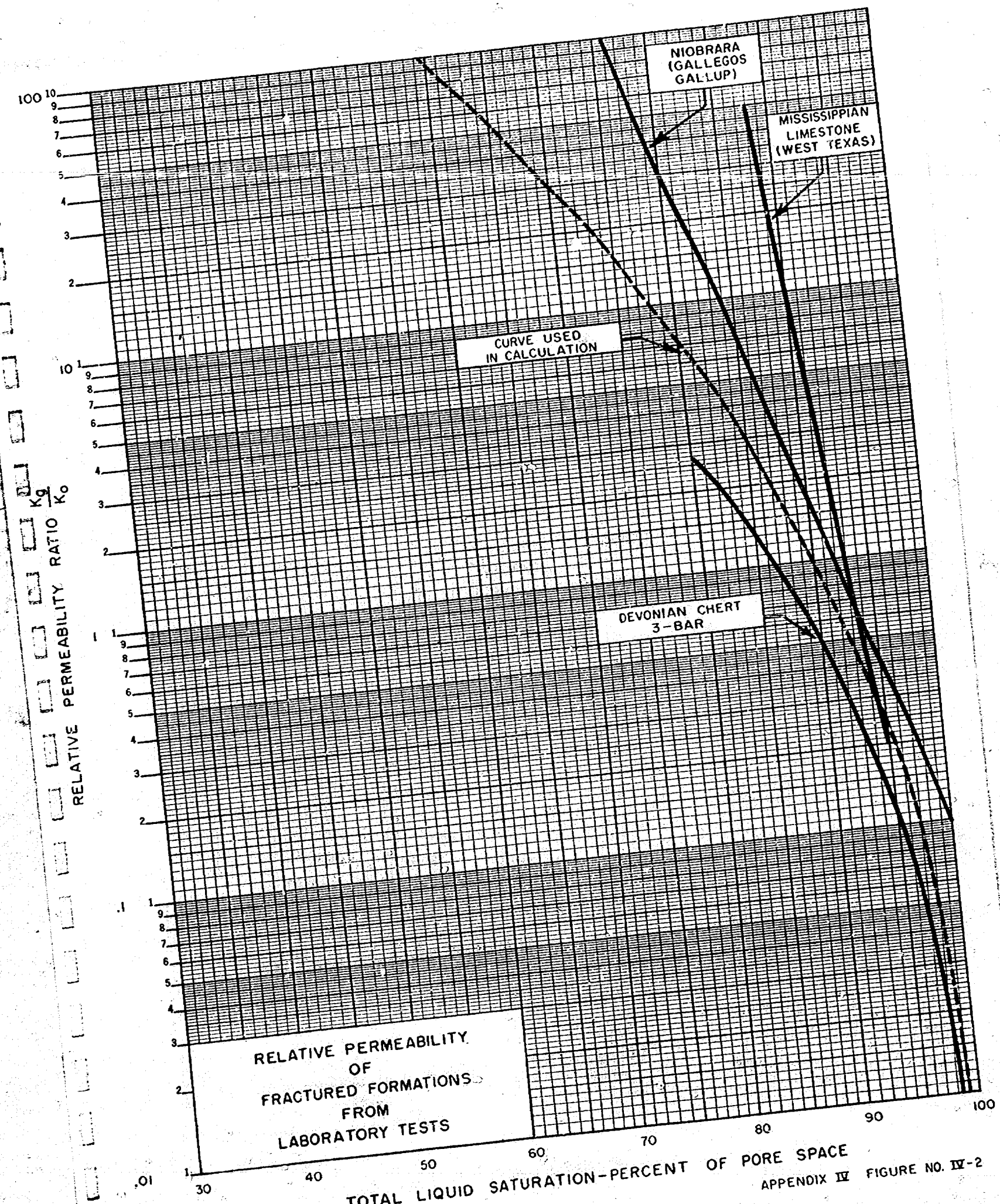
   (2) if production is not supported by the system as described in 3(1) above and since 90% of the production must come from something other than gravity drainage, it would then have to be from solution-gas drive; and if we assume the reservoir it is draining would be of the same character as that in the vicinity of the well, and that the well would continue along its present 7% maximum rate of decline, then the ultimate recovery would be about 190,000 bbls. If 90% is from solution-gas drive this would mean 170,000 bbls. from this. At 50 bbls/acre (5% of 1,000 BOPA in place maximum estimate for tight reservoirs) this would indicate 3,400 acres being drained by the well.

4. Of the two possibilities, the most logical one is that the well is part of the overall drainage system as earlier described and is draining its share of several thousand acres. The fact that the well produced until 1976 with minimal rate of decline coincides with the pressure maintenance which was rather "complete" for the period 1972 to 1976. In 1976 the well took on an increased rate of decline which is estimated to be about 7% per year. The pressure decline in the gas cap (Section F-4 herein) of approximately 1% per year, along with possible additional decline in pressure as indicated in F-6 herein, would account for only 1% to 2% rate of reservoir pressure decline. The additional production decline rate could be the result of unknown mechanical inefficiency, but is believed not to be the result of reduction in relative permeability to oil since pressure in the vicinity of the well is now probably still above the bubble point. On the other hand, it has been observed in other wells in this area, and in other fractured Niobrara reservoirs, that productivity often drops at a much faster rate than can be accounted for by either or both pressure decline and decline in relative permeability to oil. It has been postulated that this could be the result of fractures squeezing together following pressure decline; and this could be a factor here.

5. Under any rational interpretation, however, the well must be draining several thousand acres.

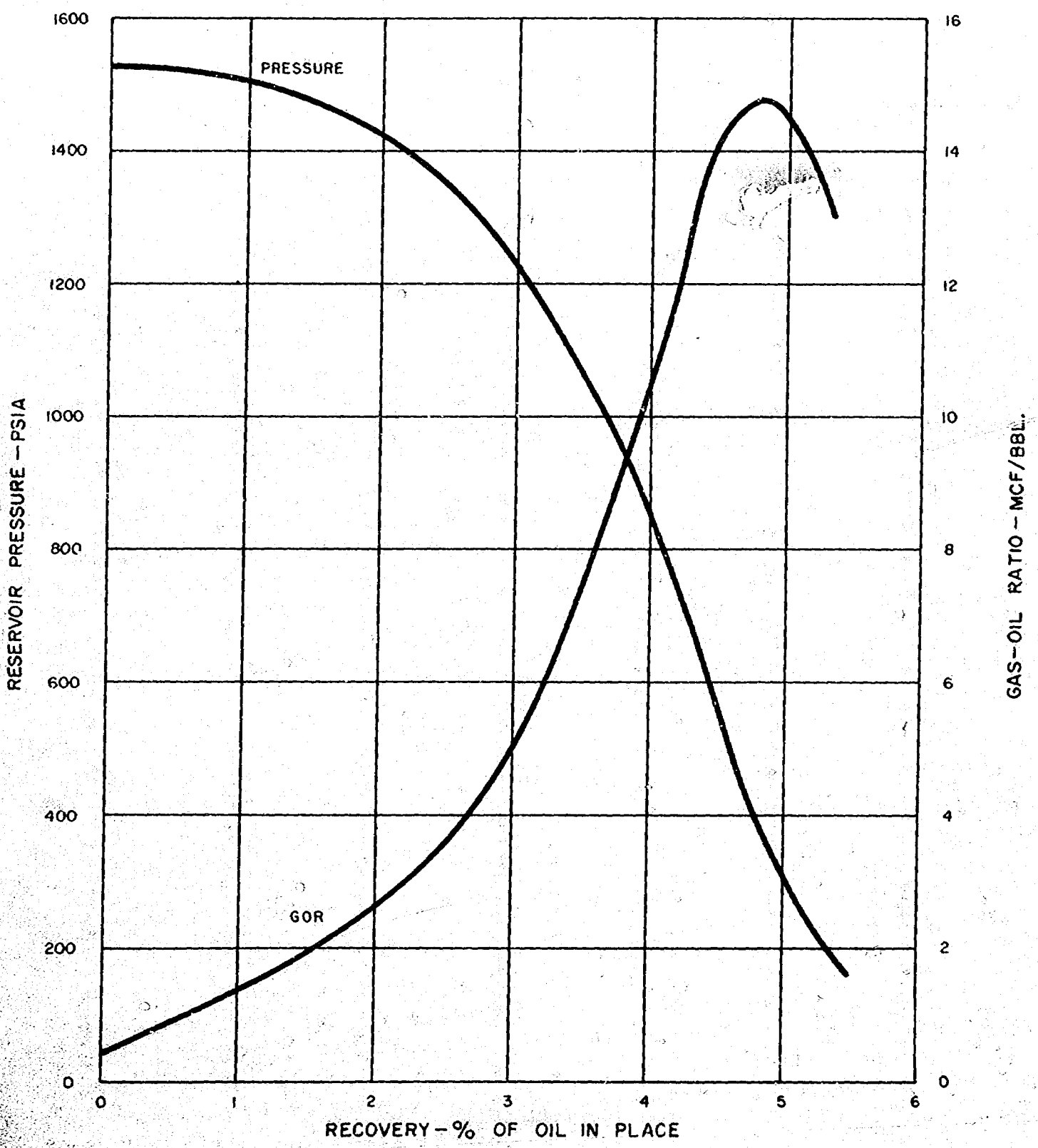


APPENDIX IV, FIGURE NO. IV-2



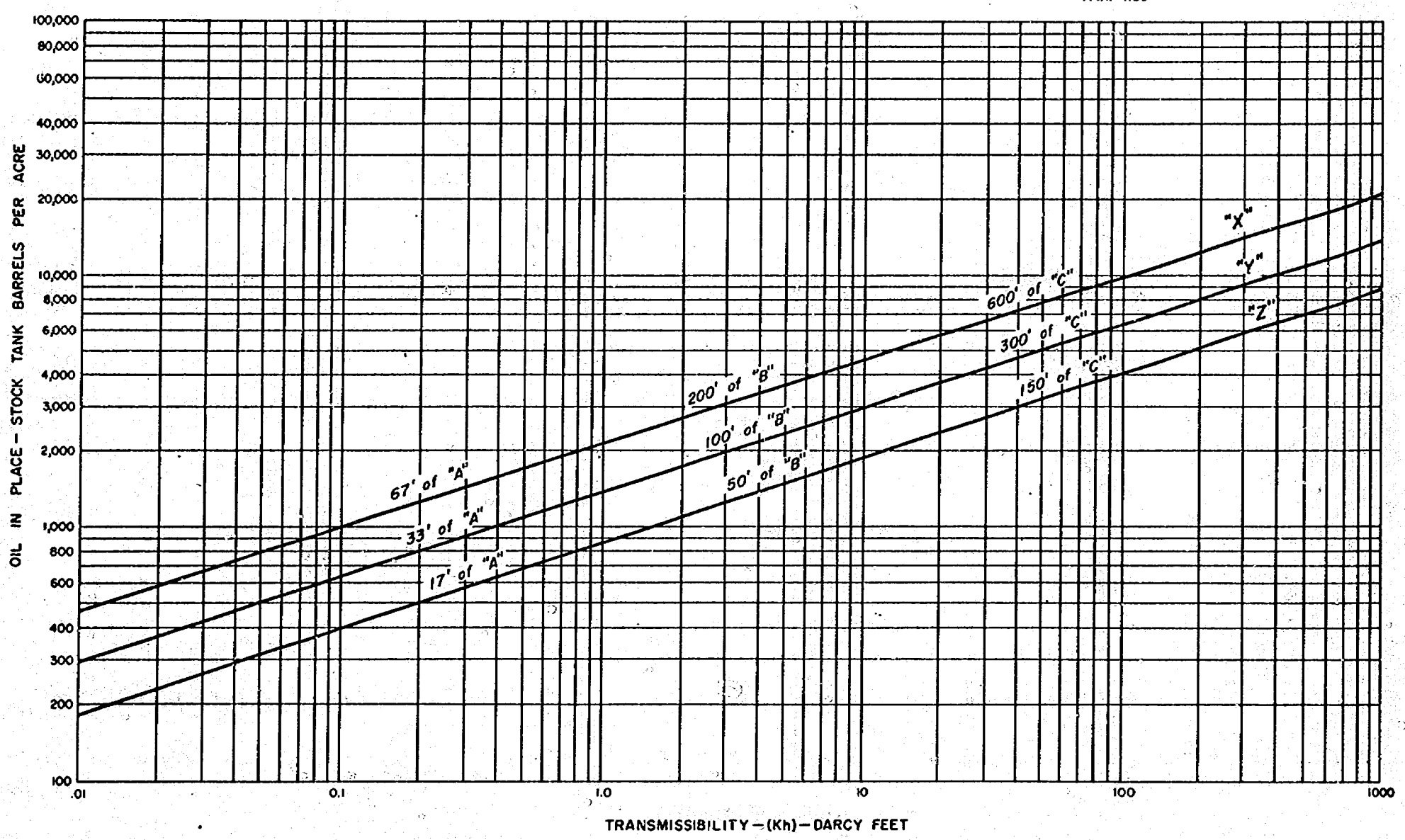
APPENDIX IV FIGURE NO. IV-2

SOLUTION GAS DRIVE
PRODUCTION HISTORY
CALCULATED FOR CONDITIONS OF:
WEST PUERTO CHIQUITO
PVT DATA
AND
K_g/K_o ESTIMATED FROM LABORATORY
DATA FOR FRACTURED FORMATIONS



APPENDIX IV FIGURE NO. IV-3

RELATION OF OIL IN PLACE
TO
TRANSMISSIBILITY
FOR
POROSITY-PERMEABILITY RELATIONS
"A", "B" & "C"
AND FOR
RESERVOIR THICKNESSES SHOWN
F.V.F = 1.29



FILE: 13 A

APPENDIX III FIGURE NO. III-5

OIL VALUES
WEST PUERTO CHIQUITO POOL

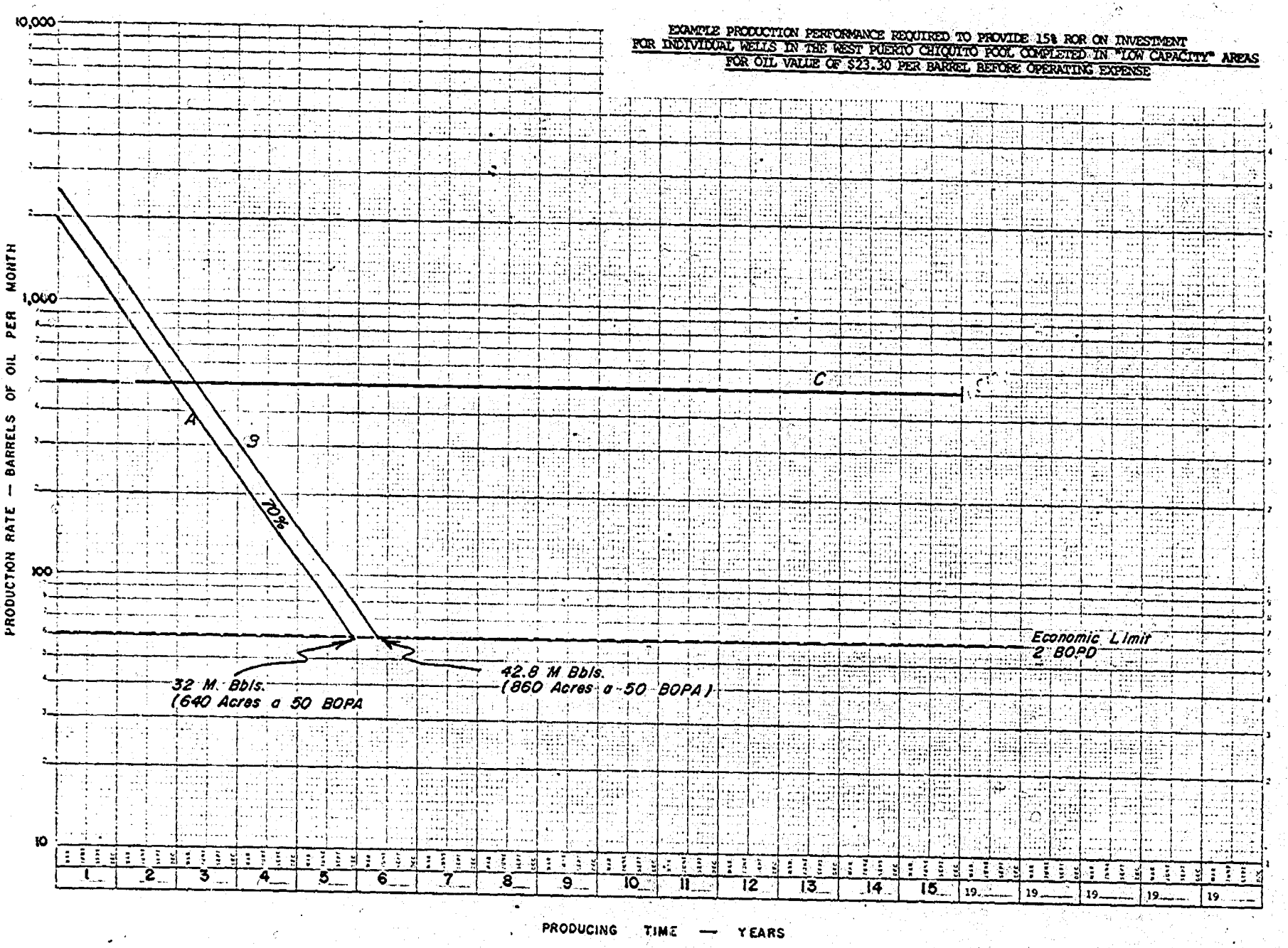
Estimated for October, 1981 using 1980 market price of $39.00
and approximate 1980 base prices

(Existing production is nearly all lower tier, which is approximately $6.00/bbl, depending on rate, BPCL, etc.)

	EXISTING PRODUCTION FOR UNITIZED AND CURRENTLY PRODUCING LEASES		NEWLY DISCOVERED OIL
	Integrated oil company	Qualified Independent Working Interest	All Owners
	($/bbl)	($/bbl)	($/bbl)
MARKET PRICE	39.00	39.00	39.00
BASE PRICE APPROX.	13.00	13.00	18.00
WFPT APPROX.	18.20	13.00	6.30
REMAINDER	20.80	26.00	31.70
LESS ROYALTY AND LEASE BURDENS OF 17% to 23% *	17.20	21.60	25.20
LESS PRODUCTION TAXES OF 7-1/2%	15.90	20.00	23.30
NET TO WORKING INTEREST BEFORE OPERATING EXPENSE	15.90	20.00	23.30

* Average lease burdens assumed higher (23%) on newly discovered leases.

EXAMPLE PRODUCTION PERFORMANCE REQUIRED TO PROVIDE 15% ROR ON INVESTMENT
FOR INDIVIDUAL WELLS IN THE WEST PUERTO CHIQUITO POOL COMPLETED IN "LOW CAPACITY" AREAS
FOR OIL VALUE OF $23.30 PER BARREL BEFORE OPERATING EXPENSE



EXAMPLE PRODUCTION PERFORMANCE REQUIRED TO PROVIDE 15% ROR ON INVESTMENT
FOR INDIVIDUAL WELLS IN THE WEST PUERTO CHIQUITO POOL COMPLETED IN "LOW CAPACITY" AREAS
FOR OIL VALUE OF $23.30 PER BARREL BEFORE OPERATING EXPENSE

Curve	Initial Production Rate (BOPD)	Decline Rate Percent/Year	Cumulative Production (M bbls)	Cumulative Operating * Expense at 2 BOPD (M Bbls)	Cumulative Production After Operating Expense (M bbls)	VALUE		
						Undiscounted Cumulative After Operating Expense ($M)	Average Discount	Present Worth at 15% ($M) after discounting
A	63.4	70	32.0	3.6	28.4	662	.72	475
B	84.0	70	42.8	3.8	39.0	905	.83	750
C	16.7	0	91.4	10.9	80.5	1875	.40	750

A (1) Solution gas drive performance: 50 BO/acre recovery
(2) 640-acre spacing and 70%/year production decline rate (Note: PW of production less than well cost)

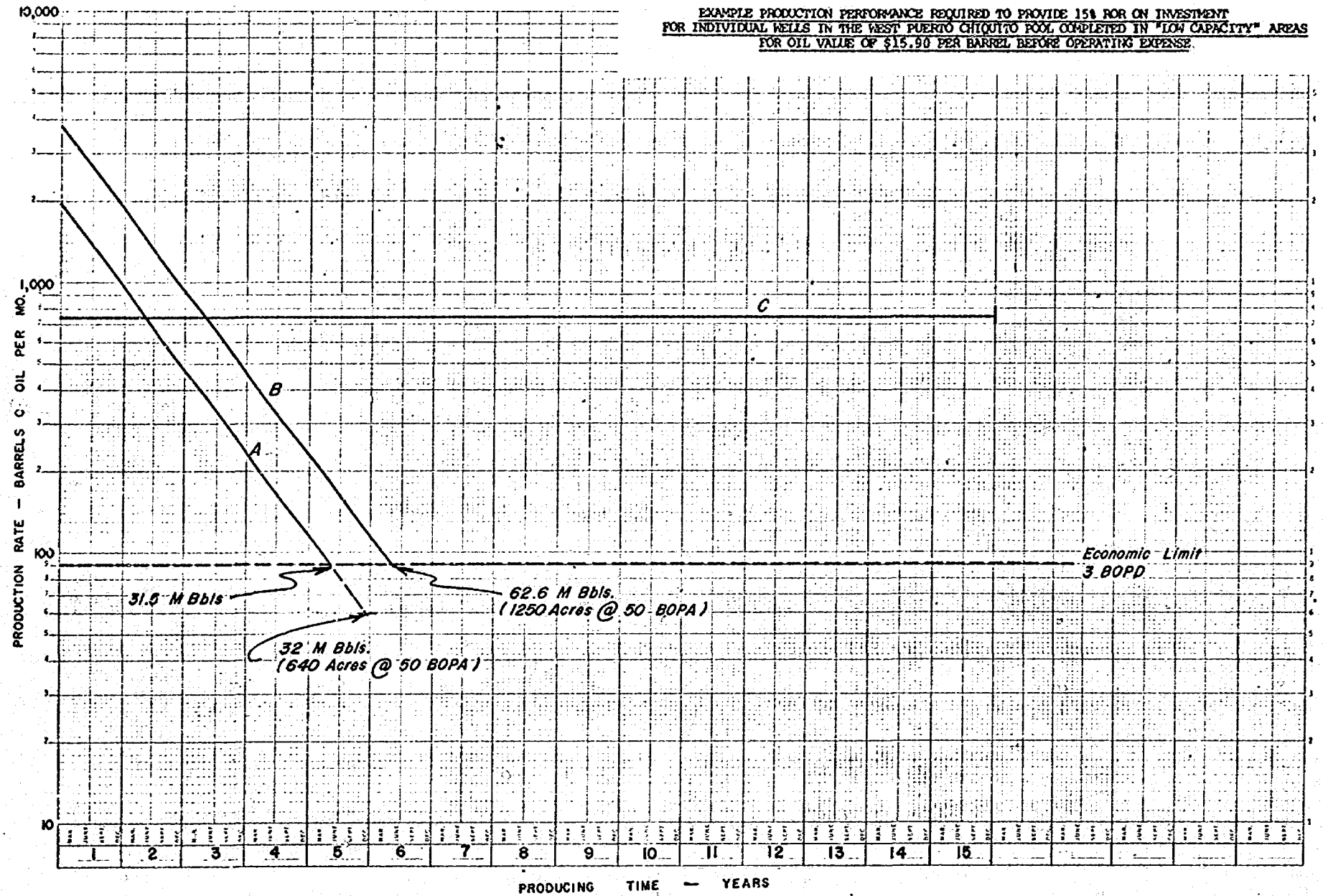
B (1) Solution gas drive performance, 50 BO/acre recovery
(2) Spacing and initial productivity required (860 acres and 84 BOPD) at 70%/year decline rate to permit 15% ROR on $750M well cost

C Minimum production rate (16.7 BOPD) required for 0% decline and 15 years production to yield 15% ROR on $750M well cost

* Cost of pressure maintenance by gas injection and cost of make-up gas not included. These costs are anticipated to be recovered at a later date when gas is sold.

NOTE
1. Minimum well cost of $750M used here. Costs could be as high as $1,000M/well
2. For wells capable of producing 15% ROR on cost of $750M, the initial productivity (84 BOPD) required means that the reservoir transmissibility must be high enough to support such a well; which in turns means a transmissibility high enough to support 640 acre (plus) per well drainage.

EXAMPLE PRODUCTION PERFORMANCE REQUIRED TO PROVIDE 15% ROR ON INVESTMENT
FOR INDIVIDUAL WELLS IN THE WEST PUERTO CHIQUITO POOL COMPLETED IN "LOW CAPACITY" AREAS
FOR OIL VALUE OF $15.90 PER BARREL BEFORE OPERATING EXPENSE



EXAMPLE PRODUCTION PERFORMANCE REQUIRED TO PROVIDE 15% ROR ON INVESTMENT
FOR INDIVIDUAL WELLS IN THE WEST PURRTO CHIQUITO POOL COMPLETED IN "LOW CAPACITY" AREAS
FOR OIL VALUE OF $15.90 PER BARREL BEFORE OPERATING EXPENSE

Curve	Initial Production Rate (BOPD)	Decline Rate Percent/Year	Cumulative Production (M bbls)	Cumulative Operating Expense at 3 BOPD (M Bbls)	Cumulative Production After Operating Expense (M bbls)	VALUE: Undiscounted Cumulative After Operating Expense ($M)	VALUE: Average Discount	VALUE: Present Worth at 15% ($M) after discounting
A	63.4	70	31.5	4.8	26.7	425	.78	330
B	123.0	70	62.6	5.8	56.8	903	.83	750
C	24.5	0	134.4	16.4	118.0	1875	.40	750

A (1) Solution gas drive performance: 50 BO/acre recovery
(2) 640-acre spacing and 70%/year production decline rate (Note: PW of production less than well cost)

B (1) Solution gas drive performance, 50 BO/acre recovery
(2) Spacing and initial productivity required (1,250 acres and 123 BOPD) at 70%/year decline rate to permit 15% ROR on $750M well cost

C Minimum production rate (24.5 BOPD) required for 0% decline and 15 yuears production to yield 15% ROR on $750M well cost

* Cost of pressure maintenance by gas injection and cost of make-up gas not included.
These costs are anticipated to be recovered at a later date when gas is sold.

NOTE 1. Minimum well cost of $750M used here. Costs could be as high as $1,000M/well

2. For wells capable of producing 15% ROR on cost of $750M, the initial productivity (123 BOPD) required means that the reservoir transmissibility must be high enough to support such a well; which in turn means a transmissibility high enough to support 640 acre (plus) per well drainage.

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. 6997
Order No. R-6469

APPLICATION OF BENSON-MONTIN-GREER
DRILLING CORPORATION FOR AMENDMENT
OF POOL RULES, RIO ARRIBA COUNTY,
NEW MEXICO.

ORDER OF THE DIVISION

BY THE DIVISION:

This cause came on for hearing at 9 a.m. on August 6, 1980, at Santa Fe, New Mexico, before Examiner Daniel S. Nutter.

NOW, on this 10th day of September, 1980, 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 by Order No. R-2565-B, entered November 28, 1966, in Case 3455, the Division created and defined the West Puerto Chiquito-Mancos Oil Pool, Rio Arriba County, New Mexico, and promulgated temporary Special Rules and Regulations therefor, including a provision for 320-acre spacing and proration units.

(3) That by Order No. R-2565-C, entered January 6, 1970, said temporary Special Rules and Regulations were made permanent until further order of the Division.

(4) That the original applicant in Case No. 3455, Benson-Montin-Greer Drilling Corporation, now seeks the amendment of said special rules and regulations to provide for 640-acre spacing and proration units and specified well locations and also seeks the establishment of certain non-standard proration units.

(5) That the geological and engineering data presented at the hearing indicate that the wells in the West Puerto Chiquito-Mancos Oil Pool are in fact draining 640 acres or more, and that the amendment of the special rules and regulations for said pool to provide for 640-acre spacing and proration units will not cause waste nor impair correlative rights.

(6) That the well location requirements for said 640-acre units should specify that no well be located closer than 660 feet to the outer boundary of the section, nor closer than 330 feet to a quarter section line, nor closer than 10 feet to a quarter-quarter section line.

(7) That the following non-standard units should be approved:

TOWNSHIP 24 NORTH, RANGE 1 WEST, NMPM

a 320-acre unit comprising	Section 1:	N/2;
a 640-acre unit comprising	Section 23:	N/2
	Section 24:	N/2;
a 640-acre unit comprising	Section 23:	S/2
	Section 24:	S/2;

TOWNSHIP 24 NORTH, RANGE 1 EAST, NMPM

a 640-acre unit comprising	Section 7:	E/2
	Section 8:	W/2;
a 640-acre unit comprising	Section 17:	W/2
	Section 18:	E/2;
a 480-acre unit comprising	Section 19:	N/2
	Section 20:	NW/4;
a 480-acre unit comprising	Section 19:	S/2
	Section 20:	SW/4;

TOWNSHIP 25 NORTH, RANGE 1 EAST, NMPM

a 640-acre unit comprising	Section 29:	W/2
	Section 30:	E/2;

TOWNSHIP 26 NORTH, RANGE 1 WEST, NMPM

a 640-acre unit comprising	Section 5:	W/2
	Section 8:	W/2;
a 640-acre unit comprising	Section 5:	E/2
	Section 8:	E/2;
a 640-acre unit comprising	Section 17:	W/2
	Section 20:	W/2;
a 640-acre unit comprising	Section 17:	E/2
	Section 20:	E/2;

TOWNSHIP 26 NORTH, RANGE 1 EAST, NMPM

a 640-acre unit comprising Section 19: E/2
Section 20: W/2;

TOWNSHIP 27 NORTH, RANGE 1 WEST, NMPM

a 640-acre unit comprising Section 1: W/2
Section 12: W/2;
a 640-acre unit comprising Section 13: W/2
Section 24: W/2;
a 600-acre unit comprising Section 25: W/2
Section 26: All;
a 600-acre unit comprising Section 27: All
Section 28: E/2;
a 600-acre unit comprising Section 28: W/2
Section 29: All;
and a 400-acre unit comprising Section 30: All.

(8) That the amount of acreage contained in the above described non-standard units is approximate, and the exact acreage in each should be determined when it is actually dedicated to a well.

(9) That an order embodying the above findings is in the interest of conservation, will prevent waste and protect correlative rights, and should be approved.

IT IS THEREFORE ORDERED:

(1) That Rules 2, 3, and 5 of the Special Rules and Regulations governing the West Puerto Chiquito-Mancos Oil Pool, Rio Arriba County, New Mexico, promulgated by Order No. R-2565-B, and as amended by Order No. R-2565-C, are hereby amended to read in their entirety as follows:

RULE 2. Each well completed or recompleted in the West Puerto Chiquito-Mancos Oil Pool shall be located on a standard spacing or proration unit consisting of approximately 640 acres which shall comprise a single governmental section, being a legal subdivision of the United States Public Land Surveys. For purposes of these rules, a spacing or proration unit consisting of between 632 and 648 contiguous surface acres shall be considered a standard spacing or proration unit. No non-standard spacing or proration unit shall be authorized except after notice and hearing.

RULE 3. Each well completed or recompleted in the West Puerto Chiquito-Mancos Oil Pool shall be located no nearer than 660 feet to the outer boundary of the proration unit nor closer than 330 feet to a quarter section line nor closer than 10 feet to a quarter-quarter section line; provided however that nothing contained herein shall be construed as permitting the drilling of more than one well on a spacing or proration unit.

RULE 5. A standard spacing or proration unit in the West Puerto Chiquito-Mancos Oil Pool (632 through 648 acres) shall be assigned a 640-acre depth bracket allowable of 640 barrels of oil per day. Any non-standard spacing or proration unit containing less than 632 acres or more than 648 acres shall be assigned a depth bracket allowable in the same ratio to 640 as the acreage in the unit bears to 640.

(2) That the Special Rules and Regulations governing the West Puerto Chiquito-Mancos Oil Pool, Rio Arriba County, New Mexico, promulgated by Order No. R-2565-B as amended by Order No. R-2565-C and as further amended by this order are hereby continued in full force and effect until further order of the Division.

(3) That the following non-standard proration units are hereby approved:

TOWNSHIP 24 NORTH, RANGE 1 WEST, NMPM

a 320-acre unit comprising	Section 1:	N/2;
a 640-acre unit comprising	Section 23:	N/2
	Section 24:	N/2;
a 640-acre unit comprising	Section 23:	S/2
	Section 24:	S/2;

TOWNSHIP 24 NORTH, RANGE 1 EAST, NMPM

a 640-acre unit comprising	Section 7:	E/2
	Section 8:	W/2;
a 640-acre unit comprising	Section 17:	W/2
	Section 18:	E/2;
a 480-acre unit comprising	Section 19:	N/2
	Section 20:	NW/4;
a 480-acre unit comprising	Section 19:	S/2
	Section 20:	SW/4;

TOWNSHIP 25 NORTH, RANGE 1 EAST, NMPM

a 640-acre unit comprising Section 29: W/2
Section 30: E/2;

TOWNSHIP 26 NORTH, RANGE 1 WEST, NMPM

a 640-acre unit comprising Section 5: W/2
Section 8: W/2;

a 640-acre unit comprising Section 5: E/2
Section 8: E/2;

a 640-acre unit comprising Section 17: W/2
Section 20: W/2;

a 640-acre unit comprising Section 17: E/2
Section 20: E/2;

TOWNSHIP 26 NORTH, RANGE 1 EAST, NMPM

a 640-acre unit comprising Section 19: E/2
Section 20: W/2;

TOWNSHIP 27 NORTH, RANGE 1 WEST, NMPM

a 640-acre unit comprising Section 1: W/2
Section 12: W/2;

a 640-acre unit comprising Section 13: W/2
Section 24: W/2;

a 600-acre unit comprising Section 25: W/2
Section 26: All;

a 600-acre unit comprising Section 27: All
Section 28: E/2;

a 600-acre unit comprising Section 28: W/2
Section 29: All;

and a 400-acre unit comprising Section 30: All.

PROVIDED HOWEVER, that the amount of acreage in the above-described non-standard proration units is approximate, and the exact amount of acreage in each unit shall be determined when the unit is actually dedicated to a well.

(4) That, pursuant to Paragraph A. of Section 70-2-18, NMSA 1978, existing wells in the West Puerto Chiquito-Mancos Oil Pool shall have dedicated thereto 640 acres, in accordance with the foregoing pool rules or, pursuant to Paragraph C. of said Section 70-2-18, existing wells may have non-standard spacing or proration units established by the Division and dedicated thereto.

Failure to file new Forms C-102 with the Division dedicating 640 acres to a well or to obtain a non-standard unit approved by the Division within 60 days from the date of this order shall subject the well to cancellation of allowable.

(5) That Orders Nos. (2), (3), and (5) of "IT IS FURTHER ORDERED" in Division Order No. R-2565-B are hereby rescinded.

(6) 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 herein-above designated.

STATE OF NEW MEXICO
OIL CONSERVATION DIVISION

JOE D. RAMEY
Director

SEAL

fd/

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

September 12, 1980

Mr. Thomas Kellahin
Kellahin & Kellahin
Attorneys at Law
Post Office Box 1769
Santa Fe, New Mexico

Re: CASE NO. 6997
ORDER NO. ~~R-6469~~

Applicant:

~~Benson-Montin-Greer Drilling~~
Corporation

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

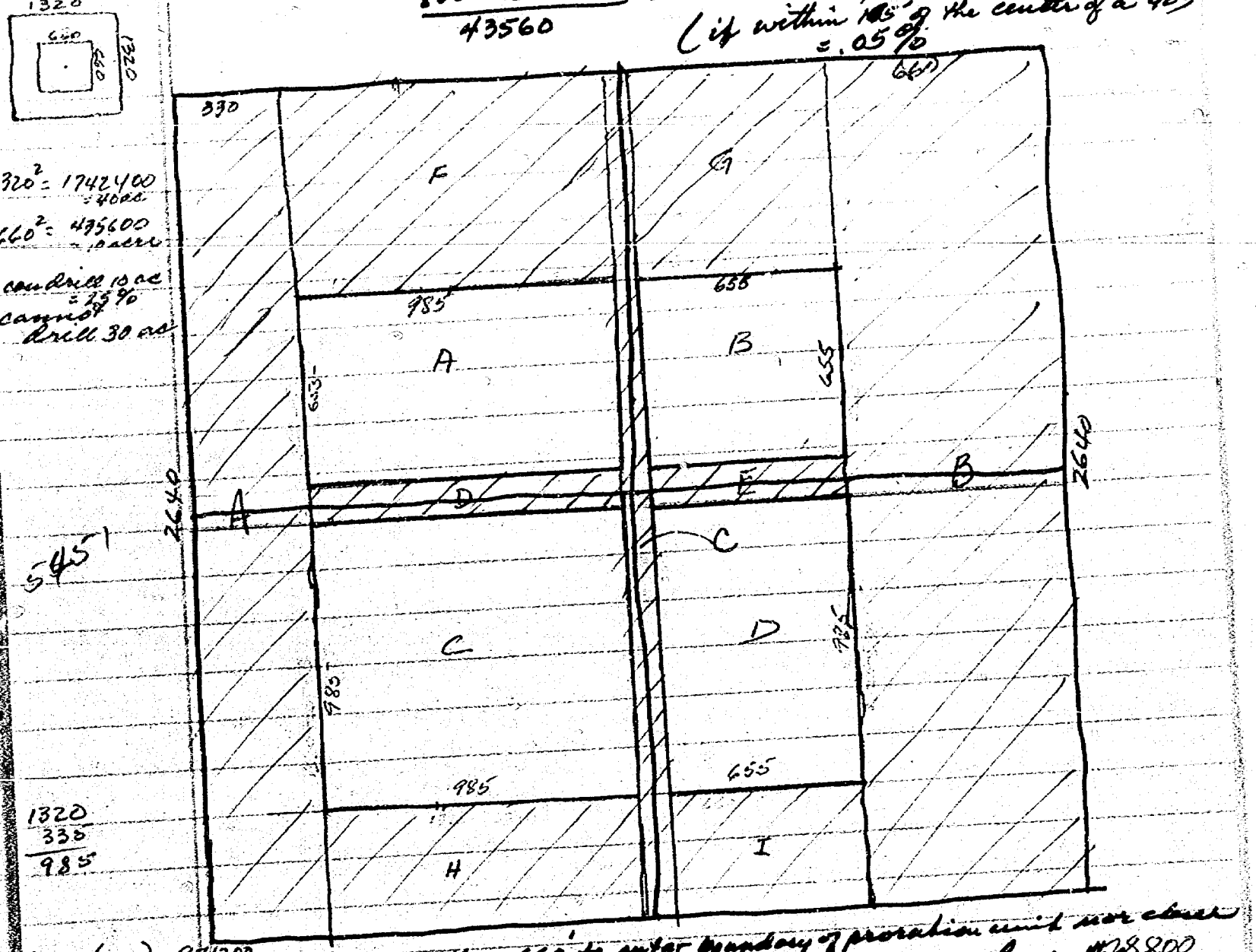
Copy of order also sent to:

Hobbs OCD x
Artesia OCD x
Aztec OCD x

Other _____

$A = \pi r^2 = \pi 165^2 = 85529.86$

$\frac{85529.86 \times 16}{43560} = 31.42$ acres/section can drill
(if within 165' of the center of a 40)
$= .05\%$



$1320^2 = 1742400 = 40$ ac

$660^2 = 435600 = 10$ acre

can drill 10 ac $= 25\%$

cannot drill 30 ac

$\frac{1320}{330}$
$\frac{985}{}$

A: 330(2640) = 871200

B: 660(2640) = 1742400

C: 10×2640 = 26400

D: 10×985 = 9850

E: 10×655 = 6550

F: 660(985) 650100

G: 660(655) 432300

H: 330(985) 325050

I: 330(655) 216150

$\frac{428800}{1} \times 4 = 17120000 = 393.02$ acres
cannot drill

Not closer than 660' to outer boundary of proration unit nor closer than 330' to interior quarter section line nor closer than 5' to interior quarter-quarter section line

$A = 655 \times 985 = 645175$

$B = 655 \times 655 = 429025$

$C = 985 \times 985 = 970225$

$D = 655 \times 985 = 655025$

2700300

2689600

2787800 total square feet in section

~~$\times 4 = 10853200 = 248.99$~~

$\times 4 = 10758400 \rightarrow 246.98$ acres

17120000

27,878,400

can drill $= 38.6\%$

CASE 6992: Application of Amoco Production Company for an NGPA determination, Lea County, New Mexico. Applicant, in the above-styled cause, seeks a new onshore reservoir determination in the Morrow formation for its Anderson 3 Com. Well No. 1 in Unit R of Section 3, Township 16 South, Range 32 East.

CASE 6956: (Continued from July 9, 1980, Examiner Hearing)

Application of Amoco Production Company for an NGPA determination, Lea County, New Mexico. Applicant, in the above-styled cause, seeks a new onshore reservoir determination in the Morrow formation for its State "GH" Well No. 1 located in Unit F of Section 21, Township 16 South, Range 35 East.

CASE 6957: (Continued from July 9, 1980, Examiner Hearing)

Application of Amoco Production Company for an NGPA determination, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks a new onshore reservoir determination in the Morrow formation for its State HK Com Well No. 1 located in Unit L of Section 6, Township 24 South, Range 25 East.

CASE 6993: Application of Tom Bolack for compulsory pooling, San Juan County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests in the Dakota formation underlying the S/2 of Section 1, Township 30 North, Range 12 West, 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 6994: Application of Enserch Exploration, Inc. for compulsory pooling, Lea County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests in the Wolfcamp thru Siluro-Devonian formations underlying the N/2 of Section 14, Township 25 South, Range 34 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 6995: Application of Petro-Lewis Corporation for downhole commingling, Lea County, New Mexico. Applicant, in the above-styled cause, seeks approval for the downhole commingling of Penrose Skelly, Blinebry, and Drinkard production in the wellbore of its L. G. Warlick Well No. 2 located in Unit B of Section 19, Township 21 South, Range 37 East.

CASE 6996: Application of John E. Schalk for compulsory pooling, Rio Arriba County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests in the Blanco Mesaverde Pool underlying the NE/4 of Section 8, Township 25 North, Range 3 West, 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 6982: (Continued from July 23, 1980, Examiner Hearing)

In the matter of the hearing called by the Oil Conservation Division on its own motion to permit Aminoil USA to appear and show cause why its 1980 Plan of Operation/Development for its Willow Lake Unit Area, Eddy County, New Mexico, should not be disapproved.

CASE 6997: Application of Benson-Montin-Greer Drilling Corporation for amendment of pool rules, Rio Arriba County, New Mexico. Applicant, in the above-styled cause, seeks the amendment of the Special Rules and Regulations for the West Puerto Chiquito-Mancos Oil Pool, as promulgated by Order No. R-2565-B, which currently prescribe 320-acre spacing for pool.

Applicant proposes that said rules be amended to provide for 640-acre spacing units with wells to be located within 165 feet of the center of a governmental quarter section.

Applicant further seeks approval for the following non-standard spacing units in Township 24 North, Range 1 East: two 640-acre units being the E/2 of Section 7 and W/2 of 8, and the W/2 of Section 17 and E/2 of 18; and two 480-acre units being the N/2 of Section 19 and NW/4 of 20, and the S/2 of Section 19 and SW/4 of 20; in Township 24 North, Range 1 West: a 320-acre unit being the N/2 of Section 1 and two 640-acre units being the N/2 of Sections 23 and 24, and the S/2 of Sections 23 and 24; also the following eight 640-acre units: the W/2 of Section 29 and E/2 of 30, Township 25 North, Range 1 East; the E/2 of Section 19 and W/2 of 20, Township 26 North, Range 1 East; the E/2 of Sections 5 and 8; the W/2 of Sections 5 and 8; the E/2 of Sections 17 and 20; and the W/2 of Sections 17 and 20, all in Township 26 North, Range 1 West; the W/2 of Sections 1 and 12, and the W/2 of Sections 13 and 24, all in Township 27 North, Range 1 West; also three 600-acre units being the W/2 of Section 25 and all of 26; all of Section 27 and the E/2 of 28; and the W/2 of Section 28 and all of 29, Township 27 North, Range 1 West; and one 400-acre unit in the same township comprising all of Section 30.

Docket No. 24-80

Dockets Nos. 26-80 and 27-80 are tentatively set for August 20 and September 3, 1980. Applications for hearing must be filed at least 22 days in advance of hearing date.

DOCKET: COMMISSION HEARING - TUESDAY - AUGUST 5, 1980

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

CASE 6848: (DE NOVO)

Application of Petroleum Development Corporation for pool contraction and creation, Lea County, New Mexico. Applicant, in the above-styled cause, seeks the contraction of the Querecho Plains-Bone Spring Pool to comprise the Upper Bone Spring formation only, from 8390 feet to 8680 feet on the log of its McKay West Federal Well No. 1 located in Unit F of Section 34, Township 18 South, Range 32 East, and the creation of the Querecho Plains-Lower Bone Spring Pool to comprise said formation from 8680 feet to the base of the Bone Spring underlying the NW/4 of said Section 34.

Upon application of Petroleum Development Corporation this case will be heard De Novo pursuant to the provisions of Rule 1220.

CASE 6987: Application of Getty Oil Company for statutory unitization, Lea County, New Mexico. Applicant, in the above-styled cause, seeks an order unitizing, for the purpose of continued secondary recovery operations, all mineral interests from a point 100 feet above the base of the Seven Rivers formation down to the base of the Queen formation underlying the Myers Langlie Mattix Unit Area, which encompasses 9360 acres, more or less, being all or portions of the following lands in Lea County, New Mexico: Sections 25 and 36, Township 23 South, Range 36 East; Sections 28 thru 34, Township 23 South, Range 37 East; Sections 1 and 12, Township 24 South, Range 36 East; and Sections 2 thru 11, Township 24 South, Range 37 East.

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 a 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 wells 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.

****

Docket No. 25-80

DOCKET: EXAMINER HEARING - WEDNESDAY - AUGUST 6, 1980

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

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

CASE 6988: In the matter of the hearing called by the Oil Conservation Division on its own motion to permit Bennett Petroleum Corporation, The Travelers Indemnity Company, and all other interested parties to appear and show cause why the Phelps Dodge Well No. 2 in Unit J of Section 4 and Wells Nos. 3 in Unit P and 3Y in Unit I of Section 9, all in Township 28 North, Range 21 East, and No. 5 in Unit P of Section 24, Township 28 North, Range 20 East, Colfax County, should not be plugged and abandoned in accordance with a Division-approved plugging program.

CASE 6989: Application of Read & Stevens, Inc. for a unit agreement, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks approval for the Lancaster Spring Unit Area, comprising 960 acres, more or less, of State, Federal, and fee lands in Township 22 South, Range 26 East.

CASE 6990: Application of Read & Stevens, Inc. for a unit agreement, Chaves County, New Mexico. Applicant, in the above-styled cause, seeks approval for the North Haystack Unit Area, comprising 4800 acres, more or less, of State, Federal, and fee lands in Township 5 South, Range 26 East.

CASE 6991: Application of Amoco Production Company for salt water disposal, Lea County, New Mexico. Applicant, in the above-styled cause, seeks authority to dispose of produced salt water into the San Andres formation in a 100 foot perforated interval between 4400 feet and 4800 feet in its South Hobbs Unit Well No. 103 in Unit B of Section 15, Township 19 South, Range 38 East, Hobbs Grayburg-San Andres Pool.

Enclosed with this docket is one copy each of recently revised Forms C-132 and C-132-A. You may wish to keep these forms in your files for reproduction and use in filing for NGPA gas well price determinations.

RECEIVED
AUG 0 3 1980
OIL CONSERVATION DIVISION
SANTA FE

SUPRON ENERGY CORPORATION
BLDG. V, FIFTH FLOOR
10300 NORTH CENTRAL EXPRESSWAY
DALLAS, TEXAS 75231

HASKELL "HACK" FLEETWOOD
VICE PRESIDENT
DRILLING & PRODUCTION

TELEPHONE (214) 691-9141
TWX (910) 861-9117
SUPCO DAL

August 1, 1980

New Mexico Oil Conservation Division
Post Office Box 2088
Santa Fe, New Mexico 87501

File

Re: Application of Benson-Montin-Greer Drilling Corp.
West Puerto Chiquito Mancos Pool
Case No. 6997

Gentlemen:

It has been brought to our attention that Benson-Montin-Greer Drilling Corp. has made an Application to the New Mexico Oil Conservation Division for an amendment of the Special Pool Rules and Regulations for the West Puerto Chiquito Mancos Oil Pool, Rio Arriba County, New Mexico.

We have had the opportunity to review the Application of the Benson-Montin-Greer Drilling Corp. and this letter shall constitute our concurrence of the Application.

Very truly yours,

Haskell Fleetwood

Haskell Fleetwood

HF:lou

cc: Benson-Montin-Greer Drilling Corp.
221 Petroleum Center Building
Farmington, New Mexico 87401

T E L E X

RECEIVED
AUG 0 6 1980
OIL CONSERVATION DIVISION
SANTA FE

NEW MEXICO OIL CONSERVATION DEPARTMENT
SANTA FE, NEW MEXICO

RE: CASE NO. 6997
WEST PUERTO CHIQUITO MANCOS POOL
APPLICATION FOR 640-ACRE SPACING
RIO ARRIBA COUNTY, NEW MEXICO

PLEASE BE ADVISED THAT SUN OIL COMPANY (DELAWARE), AS A WORKING INTEREST PARTNER IN THE CANADA OJITOS UNIT, SUPPORTS AND CONCURS WITH THE APPLICATION OF APPLICANT BENSON-MONTIN-GREER DRILLING CORPORATION FOR AN AMENDMENT OF THE SPECIAL POOL RULES AND REGULATIONS RELATIVE TO THE ABOVE-REFERENCED POOL.

MICAH J. LESLIE
REGULATORY ATTORNEY
SUN GAS COMPANY, A DIVISION OF SUN OIL COMPANY (DELAWARE)
P. O. BOX 20
DALLAS, TX 75221

dugan production corp.

July 22, 1980

RECEIVED
JUL 25 1980
OIL CONSERVATION DIVISION
SANTA FE

New Mexico Oil Conservation Division
Box 2088
Santa Fe, New Mexico 87501

Re: In the matter of the Application of Benson-Montin-Greer Drilling Corp. for amendment of the special Pool Rules and Regulations for the West Puerto Chiqito Mancos Oil Pool, including 640 acre spacing and proration units, ~~Rio Arriba~~ County, New Mexico
Case # 6997

File

Gentlemen:

Dugan Production Corporation is the owner of certain oil and gas interests underlying lands affected by the above referenced Application. As an interested party, we wish to advise you of our concurrence with the request contained in the Application.

Thank you for your consideration.

Sincerely,

Tommy Roberts

Tommy Roberts

TR:nw

cc: Al Greer

709 BLOOMFIELD RD. • P. O. BOX 208 • FARMINGTON, NEW MEXICO 87401 • PHONE: 505-325-0238

HOME OFFICE
JACKSON, MICHIGAN

DIVISION OFFICES
BILLINGS, MONTANA
BLOOMFIELD HILLS, MICHIGAN
DENVER, COLORADO
HOUSTON, TEXAS
JACKSON, MISSISSIPPI
LAFAYETTE, LOUISIANA
NEW YORK, NEW YORK
MIDLAND, TEXAS
OKLAHOMA CITY, OKLAHOMA
WITCHITA, KANSAS

Patrick Petroleum Company
Suite 1655, Colorado National Bank Building
950 Seventeenth Street
Denver, Colorado 80202

Area Code 303
Telephone 573-1207

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JUL 29 1980
OIL CONSERVATION DIVISION
SANTA FE

July 25, 1980

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JUL 2[illegible] 1980
OIL CONSERVATION DIVISION
SANTA FE

File Case 6997

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

RE: Approval for 640 acre spacing
W. Puerto Chiquito Mancos Pool
Rio Arriba County, New Mexico

Gentlemen:

Please be advised that Patrick Petroleum Corporation of Michigan concurs with Benson-Montin-Greer Drilling Corporation's application for 640.0 acre spacing in the captioned area.

Very truly yours,

Randall H. Moke

RHM/de
cc: Benson-Montin-Greer Drilling Corp.
221 Petroleum Center Bldg.
Farmington, New Mexico 87401

Oil Conservation Division Office
for Northwest New Mexico
1000 Rio Brazos Road
Aztec, New Mexico 87401

Barrett W. Pierce
Oil & Gas Exploration & Production

Inland Oil Building
Suite 1008 - 302 S. Polk
Amarillo, Texas 79101
(806) 373-5554

RECEIVED
JUL 29 1980
OIL CONSERVATION DIVISION
SANTA FE

July 24, 1980

File Case 6997

New Mexico Oil Conservation Division
Box 20088
Santa Fe, New Mexico 87501

Re: Case #6997, Application
for 640 acre spacing.
West Puerto Chiquito Mancos Pool
Rio Arriba County, New Mexico

Gentlemen:

I have reviewed Benson-Montin-Greer Drilling Corporation's application for 640 acre spacing in the West Puerto Chiquito Mancos Pool which has been designated case #6997. Furthermore, I am the owner of a lease within the West Puerto Chiquito Mancos Pool.

I fully concur with Benson-Montin-Greer Drilling Corporation's application and request that you consider the matter and approve the rule changes as requested. I believe 640 acre spacing and proration units will assure orderly and efficient development of the pool. In addition 640 acre units will result in adequate economic incentive to develop the pool. Once developed on 640 acre spacing, the new core, well log and production data can be evaluated and a program of enhanced recovery considered. The certain non-standard units set forth in the application should protect the correlative rights of the parties involved in those units.

I urge you to consider my support of the referenced application and grant approval of the requested rule change.

Yours very truly,

Barrett W. Pierce

Barrett W. Pierce

:mk

cc: Mr. Albert R. Greer, President
Benson-Montin-Greer Drilling Corp.

JACK LONDON, JR.
101 PARK AVENUE
SUITE 310
OKLAHOMA CITY, OKLAHOMA 73102

July 23, 1980

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JUL 25 1980
OIL CONSERVATION DIVISION
SANTA FE

State of New Mexico
Department of Energy and Minerals
Oil Conservation Division
Santa Fe, New Mexico

File

Re: Case #6997
West Puerto Chiquito Mancos Pool
Application for 640 Acre Spacing

Gentlemen:

The undersigned is a substantial working interest owner in the above referenced pool, holding interests in both the Canada Ojitos Unit, and in the area immediately west of the Unit.

Please be advised that I wholeheartedly support the applicant in this case.

Yours truly,

Jack London, Jr.

JL,Jr./ns

WM. V. MONTIN, INC.

101 PARK AVENUE
OKLAHOMA CITY, OKLAHOMA 73102
TELEPHONE 232-3174

July 23, 1980

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JUL 28 1980
OIL CONSERVATION DIVISION
SANTA FE

File

State of New Mexico
Department of Energy and Minerals
Oil Conservation Division
Santa Fe, New Mexico

Re: Case #6997
~~West~~ Puerto Chiquito Mancos Pool
Application for 640 Acre Spacing

Gentlemen:

The undersigned is a substantial working interest owner in the above referenced pool, holding interests in both the Canada Ojitos Unit, and in the area immediately west of the Unit.

Please be advised that we wholeheartedly support the applicant in this case.

Yours truly,

WM. V. MONTIN, INC.

By _____
Jack London, Jr.

JL,Jr./ns

MONTIN-HARBERT PIPELINE CONSTRUCTION CO., INC.
101 PARK AVENUE, SUITE 310
OKLAHOMA CITY, OKLAHOMA 73102
PHONE 232-3174

July 23, 1980

State of New Mexico
Department of Energy and Minerals
Oil Conservation Division
Santa Fe, New Mexico

Re: Case #6997
West Puerto Chiquito Mancos Pool
Application for 640 Acre Spacing

Gentlemen:

The undersigned is a substantial working interest owner in the above referenced pool, holding interests in both the Canada Ojitos Unit, and in the area immediately west of the Unit.

Please be advised that we wholeheartedly support the applicant in this case.

Yours truly,

MONTIN-HARTERT PIPELINE
CONSTRUCTION CO., INC.

By John Lowlon Jr.

JL,Jr./ns

KOCH
EXPLORATION COMPANY

August 1, 1980

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

RECEIVED
AUG 05 1980
OIL CONSERVATION DIVISION
SANTA FE

RE: Benson-Montin-Greer Drilling Corp.
West Puerto Chiquito Mancos Pool
Application for special rules and
regulations for the West Puerto
Chiquito Mancos Oil Pool.
Case No. 6997

File

Dear Mr. Ramey:

Benson-Montin-Greer Drilling Corp. has applied for amendment to Rule 2 of Order No. R-2565-C for Pool Rules and Regulations for the West Puerto Chiquito Mancos Oil Pool; Rio Arriba County, New Mexico. In their application, Benson-Montin-Greer apply for 640 acre spacing and proration units assigned to any well drilled in this pool, for approval of certain non-standard proration units, and for well location rules.

The Koch Industries, Inc. engineering staff has reviewed data collected by the applicant from certain wells in the West Puerto Chiquito Mancos Oil Pool. Data from these wells show they will effectively drain a section and that one well per section will result in an orderly development of the pool. Koch Industries, Inc. supports the applicants position on one well per section spacing.

The well location request for wells to be drilled within 165 feet from the center of any governmental quarter quarter section gives a very small "drilling window" in an area of difficult topography. We would support wells drilled anywhere in a quarter section located not closer than 330 feet from the quarter section boundry. As a last alternative, Koch will accept wells located not closer than 330 feet from the quarter quarter section line.

Yours very truly,

R. G. Walton

R. G. Walton, Vice-President - Exploration
Koch Exploration Company
A Division of Koch Industries, Inc.

RGW:dh

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AUG 04 1980
OIL CONSERVATION DIVISION
SANTA FE

MOUNTAIN FUEL SUPPLY COMPANY

180 EAST FIRST SOUTH • P.O. BOX 11368 • SALT LAKE CITY, UTAH 84139 • PHONE (801) 534-5555

July 31, 1980

State of New Mexico
Department of Energy and Minerals
Oil Conservation Commission
P.O. Box 2088
Santa Fe, NM 87501

Gentlemen:

Re: West Puerto Chiquito
Mancos Pool
640.00 Acre Spacing
Case No. 6997

Mountain Fuel Supply Company is the working interest owner under several leases included in the captioned Application for Spacing. We support this Application but request that consideration be given for a larger tolerance on the location requirements set forth in Paragraph 8 of this Application.

Very truly yours,

R. E. Pittam
Staff Landman

REP:wb

STATE OF NEW MEXICO

DEPARTMENT OF ENERGY AND MINERALS

OIL CONSERVATION DIVISION

IN THE MATTER OF THE APPLICATION OF)
BENSON-MONTIN-GREER DRILLING CORPORATION)
FOR AMENDMENT OF THE SPECIAL POOL RULES)
AND REGULATIONS FOR THE WEST PUERTO)
CHIQUITO-MANCOS OIL POOL, INCLUDING 640)
ACRE SPACING AND PRORATION UNITS, RIO)
ARRIBA COUNTY, NEW MEXICO.)

RECEIVED
JUL 15 1980
OIL CONSERVATION DIVISION
SANTA FE

Case 6997

APPLICATION

COMES NOW BENSON-MONTIN-GREER DRILLING CORPORATION, and applies to the New Mexico Oil Conservation Division for amendment to the Special Pool Rules and Regulations for the West Puerto Chiquito-Mancos Oil Pool, Rio Arriba County, New Mexico, to provide for 640-acre spacing and proration units assigned to any well drilled in this pool, for approval of certain non-standard proration units, and for well location rules, and in support thereof would show:

1. That the Applicant, Benson-Montin-Greer Drilling Corporation is the owner of leases in the West Puerto Chiquito-Mancos Oil Pool, Rio Arriba County, New Mexico, and is the operator of the voluntary Canada Ojitos Unit which covers most of such pool.

2. That heretofore the New Mexico Oil and Gas Conservation Commission, by Order No. R-2565-B, created the West Puerto Chiquito-Mancos Oil Pool consisting of the Niobrara member of the Mancos Formation covering the following described lands:

WEST PUERTO CHIQUITO-MANCOS OIL POOL:

RIO ARRIBA COUNTY, NEW MEXICO

TOWNSHIP 24 NORTH, RANGE 1 EAST, NMPM
Sections 6, 7, 18, 19 and 30: All
Section 8: W/2
Section 17: W/2
Section 20: W/2

TOWNSHIP 24 NORTH, RANGE 1 WEST, NMPM
Sections 1 through 36: All

TOWNSHIP 25 NORTH, RANGE 1 EAST, NMPM
Sections 5 through 8 and
Sections 17 through 20, and
Sections 30 and 31: All
Section 29: W/2

TOWNSHIP 25 NORTH, RANGE 1 WEST, NMPM
Sections 1 through 36: All

TOWNSHIP 26 NORTH, RANGE 1 EAST, NMPM
Section 19: All
Section 20: W/2
Sections 29 through 32: All

TOWNSHIP 26 NORTH, RANGE 1 WEST, NMPM
Sections 1 through 36: All

TOWNSHIP 27 NORTH, RANGE 1 WEST, NMPM
Section 1: W/2
Sections 2 through 11: All
Section 12: W/2
Section 13: W/2
Sections 14 through 23: All
Section 24: W/2
Section 25: W/2
Sections 26 through 30: All

3. That said Order promulgated rules for the orderly development of the pool and provided in Rule 2 for temporary 320-acre spacing and proration units and then on the 6th day of January, 1970, the Oil and Gas Conservation Commission, by Order No. R-2565-C, made such 320-acre spacing or proration units permanent.

4. That present available information indicates that one well will economically and efficiently drain and develop a spacing and proration unit of 640-acres.

5. That in order to prevent the drilling of unnecessary wells and to provide for the orderly development of said pool, the spacing and proration units for this pool be changed from 320 acres to 640 acres per unit.

6. Because of the existence of certain sections containing only 400 acres each, being the South edge of Township 27 North, Range 1 West (Sections 25 through 30) and to protect the correlative rights of the owners involved in those areas, said sections should be granted exceptions to the 640-acre spacing and proration unit rule so that Section 27 be combined with Section 28 and 29 be combined with Section 30 to form two units of approximately 800-acre each while Section 26 be combined with the West Half (W/2) of Section 25 to form a unit of approximately 600-acres.

7. That in order to fix the equities of the parties, and in order to protect correlative rights, it is necessary to further create twenty-four (24) non-standard proration and spacing units as follows:

(a) T24N, R1E, NMPM

Section 7 and the
W/2 of Section 8
consisting of 960 acres

(b) T24N, R1E, NMPM

Section 18 and the
N/2 of Section 19
consisting of 960 acres

(c) T24N, R1E, NMPM

All of Section 30 and the
S/2 of Section 19 and the
SW/4 of Section 20
consisting of 1120 acres

(d) T24N, R1E, NMPM

W/2 of Section 17 and the
NW/4 of Section 20
consisting of 960 acres

(e) T24N, R1W, NMPM

All of Section 14 and the
N/2 of Section 23
consisting of 960 acres

(f) T24N, R1W, NMPM

All of Section 26 and the
S/2 of Section 23
consisting of 960 acres

(g) T24N, R1W, NMPM

All of Section 25 and the
S/2 of Section 24
consisting of 960 acres

(h) T24N, R1W, NMPM

All of Section 12 and the
S/2 of Section 1
consisting of 960 acres

(i) T25N, R1W, NMPM

All of Section 36 and the
N/2 of Section 1 in T24N, R1W
consisting of 960 acres

(j) T24N, R1W, NMPM

All of Section 13 and the
N/2 of Section 24
consisting of 960 acres

(k) T25N, R1E, NMPM

Section 30 and the W/2
of Section 29
consisting of 960 acres

(l) T26N, R1E, NMPM

Section 19 and the
W/2 of Section 20
consisting of 960 acres

(m) T26N, R1W, NMPM

Section 4 and the
E/2 of Section 5
consisting of 960 acres

(n) T26N, R1W, NMPM

Section 9 and the
E/2 of Section 8
consisting of 960 acres

(o) T26N, R1W, NMPM

Section 16 and the
E/2 of Section 17
consisting of 960 acres

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Section 21 and the
E/2 of Section 20
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Section 6 and the
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Section 11 and the
W/2 of Section 12
consisting of 960 acres

(w) T27N, R1W, NMPM

Section 14 and the
W/2 of Section 13
consisting of 960 acres

(x) T27N, R1W, NMPM

Section 23 and the
W/2 of Section 24
consisting of 960 acres

8. The applicant further requests that the unit wells in the new units be drilled within 165 feet from the center of any governmental quarter quarter section.

9. That heretofore the owners of oil and gas leases covering 87 sections in the West Puerto Chiquito-Mancos Oil Pool formed the Canada Ojitos Unit; that this unit has conducted orderly development of the field and has instituted a pressure maintenance program for the pool which has greatly enhanced the ultimate recovery of hydrocarbons from the formation and by orderly development and scientific pressure maintenance is recovering the greatest possible amount of oil from the formation as to the lands within the unit. That continued orderly development of the pool is necessary in order to prevent waste but that Rule 2 as presently constituted will permit the drilling of unnecessary wells; that the drilling of such unnecessary wells will create waste and should not be permitted. That, therefore, Rule 2 should be

amended as suggested in the preceding paragraph to provide for 640-acre spacing and proration units with the exceptions as set out above.

WHEREFORE, Applicant prays that this application be set for hearing before the Division Examiner and that after notice and hearing as provided by law, the Division issue an Order amending Rule 2 of Order No. R-2565-C to provide that all units in the West Puerto Chiquito-Mancos Oil Pool should consist one governmental section of 640 acres except for the non-standard units as outlined above; and further granting Applicant such other and further relief which it might be justly entitled to receive.

Respectfully submitted,

BENSON-MONTIN-GREER DRILLING CORPORATION

By _____
W. Thomas Kellahin
Kellahin & Kellahin
P.O. Box 1769
Santa Fe, New Mexico 87501

By _____
Geo. L. Verity
Attorney at Law
501 N. W. 13th Street
Oklahoma City, Oklahoma 73103

KELLAHIN and KELLAHIN
Attorneys at Law
500 Don Gaspar Avenue
Post Office Box 1769
Santa Fe, New Mexico 87501

Jason Kellahin
W. Thomas Kellahin
Karen Aubrey

Telephone 982-4285
Area Code 505

July 15, 1980

M. Joe Ramey
Oil Conservation Division
P.O. Box 2088
Santa Fe, New Mexico 87501

RECEIVED
JUL 15 1980
OIL CONSERVATION DIVISION
SANTA FE

RE: Benson-Montin- Greer

Case 6997

Dear Joe:

Please set the enclosed application for hearing on August 6, 1980.

Very truly yours,

W. Thomas Kellahin

Enclosure
cc: Mr. Al Greer
Mr. George Verity
WIK:jm

STATE OF NEW MEXICO

DEPARTMENT OF ENERGY AND MINERALS

OIL CONSERVATION DIVISION

IN THE MATTER OF THE APPLICATION OF)
BENSON-MONTIN-GREER DRILLING CORPORATION)
FOR AMENDMENT OF THE SPECIAL POOL RULES)
AND REGULATIONS FOR THE WEST PUERTO)
CHIQUITO-MANCOS OIL POOL, INCLUDING 640)
ACRE SPACING AND PRORATION UNITS, RIO)
ARRIBA COUNTY, NEW MEXICO.)

RECEIVED
JUL 15 1980
OIL CONSERVATION DIVISION
SANTA FE

Case 6997

APPLICATION

COMES NOW BENSON-MONTIN-GREER DRILLING CORPORATION, and applies to the New Mexico Oil Conservation Division for amendment to the Special Pool Rules and Regulations for the West Puerto Chiquito-Mancos Oil Pool, Rio Arriba County, New Mexico, to provide for 640-acre spacing and proration units assigned to any well drilled in this pool, for approval of certain non-standard proration units, and for well location rules, and in support thereof would show:

1. That the Applicant, Benson-Montin-Greer Drilling Corporation is the owner of leases in the West Puerto Chiquito-Mancos Oil Pool, Rio Arriba County, New Mexico, and is the operator of the voluntary Canada Ojitos Unit which covers most of such pool.

2. That heretofore the New Mexico Oil and Gas Conservation Commission, by Order No. R-2565-B, created the West Puerto Chiquito-Mancos Oil Pool consisting of the Niobrara member of the Mancos Formation covering the following described lands:

WEST PUERTO CHIQUITO-MANCOS OIL POOL:

RIO ARRIBA COUNTY, NEW MEXICO

TOWNSHIP 24 NORTH, RANGE 1 EAST, NMPM
Sections 6, 7, 18, 19 and 30: All
Section 8: W/2
Section 17: W/2
Section 20: W/2

TOWNSHIP 24 NORTH, RANGE 1 WEST, NMPM
Sections 1 through 36: All

TOWNSHIP 25 NORTH, RANGE 1 EAST, NMPM
Sections 5 through 8 and
Sections 17 through 20, and
Sections 30 and 31: All
Section 29: W/2

TOWNSHIP 25 NORTH, RANGE 1 WEST, NMPM
Sections 1 through 36: All

TOWNSHIP 26 NORTH, RANGE 1 EAST, NMPM
Section 19: All
Section 20: W/2
Sections 29 through 32: All

TOWNSHIP 26 NORTH, RANGE 1 WEST, NMPM
Sections 1 through 36: All

TOWNSHIP 27 NORTH, RANGE 1 WEST, NMPM
Section 1: W/2
Sections 2 through 11: All
Section 12: W/2
Section 13: W/2
Sections 14 through 23: All
Section 24: W/2
Section 25: W/2
Sections 26 through 30: All

3. That said Order promulgated rules for the orderly development of the pool and provided in Rule 2 for temporary 32-acre spacing and proration units and then on the 6th day of January, 1970, the Oil and Gas Conservation Commission, by Order No. R-2565-C, made such 320-acre spacing or proration units permanent.

4. That present available information indicates that one well will economically and efficiently drain and develop a spacing and proration unit of 640-acres.

5. That in order to prevent the drilling of unnecessary wells and to provide for the orderly development of said pool, the spacing and proration units for this pool be changed from 320 acres to 640 acres per unit.

6. Because of the existence of certain sections containing only 400 acres each, being the South edge of Township 27 North, Range 1 West (Sections 25 through 30) and to protect the correlative rights of the owners involved in those areas, said sections should be granted exceptions to the 640-acre spacing and proration unit rule so that Section 27 be combined with Section 28 and 29 be combined with Section 30 to form two units of approximately 800-acre each while Section 26 be combined with the West Half (W/2) of Section 25 to form a unit of approximately 600-acres.

7. That in order to fix the equities of the parties, and in order to protect correlative rights, it is necessary to further create twenty-four (24) non-standard proration and spacing units as follows:

(a) T24N, R1E, NMPM

Section 7 and the
W/2 of Section 8 consisting of 960 acres

(b) T24N, R1E, NMPM

Section 18 and the
N/2 of Section 19

consisting of 960 acres

(c) T24N, R1E, NMPM

All of Section 30 and the
S/2 of Section 19 and the
SW/4 of Section 20

consisting of 1120 acres

(d) T24N, R1E, NMPM

W/2 of Section 17 and the
NW/4 of Section 20

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All of Section 25 and the
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(h) T24N, R1W, NMPM

All of Section 12 and the
S/2 of Section 1

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(i) T25N, R1W, NMPM

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8. The applicant further requests that the unit wells in the new units be drilled within 165 feet from the center of any governmental quarter quarter section.

9. That heretofore the owners of oil and gas leases covering 87 sections in the West Puerto Chiquito-Mancos Oil Pool formed the Canada Ojitos Unit; that this unit has conducted orderly development of the field and has instituted a pressure maintenance program for the pool which has greatly enhanced the ultimate recovery of hydrocarbons from the formation and by orderly development and scientific pressure maintenance is recovering the greatest possible amount of oil from the formation as to the lands within the unit. That continued orderly development of the pool is necessary in order to prevent waste but that Rule 2 as presently constituted will permit the drilling of unnecessary wells; that the drilling of such unnecessary wells will create waste and should not be permitted. That, therefore, Rule 2 should be

amended as suggested in the preceding paragraph to provide for 640-acre spacing and proration units with the exceptions as set out above.

WHEREFORE, Applicant prays that this application be set for hearing before the Division Examiner and that after notice and hearing as provided by law, the Division issue an Order amending Rule 2 of Order No. R-2565-C to provide that all units in the West Puerto Chiquito-Mancos Oil Pool should consist one governmental section of 640 acres except for the non-standard units as outlined above; and further granting Applicant such other and further relief which it might be justly entitled to receive.

Respectfully submitted,

BENSON-MONTIN-GREER DRILLING CORPORATION

By _____
W. Thomas Kellahin
Kellahin & Kellahin
P.O. Box 1769
Santa Fe, New Mexico 87501

By _____
Geo. L. Verity
Attorney at Law
501 N. W. 13th Street
Oklahoma City, Oklahoma 73103

STATE OF NEW MEXICO

DEPARTMENT OF ENERGY AND MINERALS

OIL CONSERVATION DIVISION

IN THE MATTER OF THE APPLICATION OF)
BENSON-MONTIN-GREER DRILLING CORPORATION)
FOR AMENDMENT OF THE SPECIAL POOL RULES)
AND REGULATIONS FOR THE WEST PUERTO)
CHIQUITO-MANCOS OIL POOL, INCLUDING 640)
ACRE SPACING AND PRORATION UNITS, RIO)
ARRIBA COUNTY, NEW MEXICO.)

RECEIVED
JUL 15 1980
OIL CONSERVATION DIVISION
SANTA FE

Case 6997

A P P L I C A T I O N

COMES NOW BENSON-MONTIN-GREER DRILLING CORPORATION, and applies to the New Mexico Oil Conservation Division for amendment to the Special Pool Rules and Regulations for the West Puerto Chiquito-Mancos Oil Pool, Rio Arriba County, New Mexico, to provide for 640-acre spacing and proration units assigned to any well drilled in this pool, for approval of certain non-standard proration units, and for well location rules, and in support thereof would show:

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2. That heretofore the New Mexico Oil and Gas Conservation Commission, by Order No. R-2565-B, created the West Puerto Chiquito-Mancos Oil Pool consisting of the Niobrara member of the Mancos Formation covering the following described lands:

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Sections 6, 7, 18, 19 and 30: All
Section 8: W/2
Section 17: W/2
Section 20: W/2

TOWNSHIP 24 NORTH, RANGE 1 WEST, NMPM
Sections 1 through 36: All

TOWNSHIP 25 NORTH, RANGE 1 EAST, NMPM
Sections 5 through 8 and
Sections 17 through 20, and
Sections 30 and 31: All
Section 29: W/2

TOWNSHIP 25 NORTH, RANGE 1 WEST, NMPM
Sections 1 through 36: All

TOWNSHIP 26 NORTH, RANGE 1 EAST, NMPM
Section 19: All
Section 20: W/2
Sections 29 through 32: All

TOWNSHIP 26 NORTH, RANGE 1 WEST, NMPM
Sections 1 through 36: All

TOWNSHIP 27 NORTH, RANGE 1 WEST, NMPM
Section 1: W/2
Sections 2 through 11: All
Section 12: W/2
Section 13: W/2
Sections 14 through 23: All
Section 24: W/2
Section 25: W/2
Sections 26 through 30: All

3. That said Order promulgated rules for the orderly development of the pool and provided in Rule 2 for temporary 32-acre spacing and proration units and then on the 6th day of January, 1970, the Oil and Gas Conservation Commission, by Order No. R-2565-C, made such 320-acre spacing or proration units permanent.

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6. Because of the existence of certain sections containing only 400 acres each, being the South edge of Township 27 North, Range 1 West (Sections 25 through 30) and to protect the correlative rights of the owners involved in those areas, said sections should be granted exceptions to the 640-acre spacing and proration unit rule so that Section 27 be combined with Section 28 and 29 be combined with Section 30 to form two units of approximately 800-acre each while Section 26 be combined with the West Half (W/2) of Section 25 to form a unit of approximately 600-acres.

7. That in order to fix the equities of the parties, and in order to protect correlative rights, it is necessary to further create twenty-four (24) non-standard proration and spacing units as follows:

(a) T24N, R1E, NMPM

Section 7 and the
W/2 of Section 8
consisting of 960 acres

(b) T24N, R1E, NMPM

Section 18 and the
N/2 of Section 19
consisting of 960 acres

(c) T24N, R1E, NMPM

All of Section 30 and the
S/2 of Section 19 and the
SW/4 of Section 20
consisting of 1120 acres

(d) T24N, R1E, NMPM

W/2 of Section 17 and the
NW/4 of Section 20
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(e) T24N, R1W, NMPM

All of Section 14 and the
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S/2 of Section 1
consisting of 960 acres

(i) T25N, R1W, NMPM

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N/2 of Section 1 in T24N, R1W
consisting of 960 acres

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All of Section 13 and the
N/2 of Section 24
consisting of 960 acres

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Section 30 and the W/2
of Section 29
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Section 2 and the
W/2 of Section 1
consisting of 960 acres

(v) T27N, R1W, NMPM

Section 11 and the
W/2 of Section 12
consisting of 960 acres

(w) T27N, R1W, NMPM

Section 14 and the
W/2 of Section 13
consisting of 960 acres

(x) T27N, R1W, NMPM

Section 23 and the
W/2 of Section 24
consisting of 960 acres

8. The applicant further requests that the unit wells in the new units be drilled within 165 feet from the center of any governmental quarter quarter section.

9. That heretofore the owners of oil and gas leases covering 87 sections in the West Puerto Chiquito-Mancos Oil Pool formed the Canada Ojitos Unit; that this unit has conducted orderly development of the field and has instituted a pressure maintenance program for the pool which has greatly enhanced the ultimate recovery of hydrocarbons from the formation and by orderly development and scientific pressure maintenance is recovering the greatest possible amount of oil from the formation as to the lands within the unit. That continued orderly development of the pool is necessary in order to prevent waste but that Rule 2 as presently constituted will permit the drilling of unnecessary wells; that the drilling of such unnecessary wells will create waste and should not be permitted. That, therefore, Rule 2 should be

amended as suggested in the preceding paragraph to provide for 640-acre spacing and proration units with the exceptions as set out above.

WHEREFORE, Applicant prays that this application be set for hearing before the Division Examiner and that after notice and hearing as provided by law, the Division issue an Order amending Rule 2 of Order No. R-2565-C to provide that all units in the West Puerto Chiquito-Mancos Oil Pool should consist one governmental section of 640 acres except for the non-standard units as outlined above; and further granting Applicant such other and further relief which it might be justly entitled to receive.

Respectfully submitted,

BENSON-MONTIN-GREER DRILLING CORPORATION

By _____
W. Thomas Kellahin
Kellahin & Kellahin
P.O. Box 1769
Santa Fe, New Mexico 87501

By _____
Geo. L. Verity
Attorney at Law
501 N. W. 13th Street
Oklahoma City, Oklahoma 73103

ROUGH

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. 6997

Order No. R-6469

Application of Benson-Montin-Greer Drilling Corporation for amendment of pool rules, Rio Arriba County, New Mexico.

ORDER OF THE DIVISION

BY THE DIVISION:

This cause came on for hearing at 9 a.m. on August 6, 1980, at Santa Fe, New Mexico, before Examiner DSN.

NOW, on this _____ day of August, 1980, 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 by Order No. R-2565-B, entered November 28, 1966, in Case 3465, the Division created and defined the West Puerto Chiquito-Mancos Oil Pool, Rio Arriba County, New Mexico, and promulgated Temporary Special Rules and Regulations therefor, including a provision for 320-acre spacing and proration units.

(3) That ~~said temporary special rules were made permanent~~ by Order No. R-2565-C, entered January 6, 1970, said temporary special rules and regulations were made permanent until further order of the Division.

(4) That the original applicant in Case No. 3455, Benson-Montin-Greer Drilling Corporation, now seeks the amendment of said special rules and regulations to provide for 640-acre spacing and proration units and specified well locations and also seeks the establishment of certain non-standard proration units.

(5) That the geological and engineering data presented at the hearing indicate that ~~the~~ the wells in the West Puerto Chiquito-Mancos Oil Pool are in fact draining 640 acres or more, and that the amendment of the special rules and regulations for said pool to provide for 640-acre spacing and proration units will not cause waste nor impair correlative rights.

(6) That the well location requirements for said 640-acre units should specify that no well be located closer than 660 feet to the outer boundary of the section nor closer than 330 feet to a quarter section line, nor closer than 10 feet to a quarter-quarter section line

(7) That the following non-standard units should be approved:

TOWNSHIP 29 NORTH, RANGE 1 WEST, NMPM

a 320-acre unit comprising	Section 1: N/2;
a 640-acre unit comprising	Section 23: N/2 Section 24: N/2;
a 640-acre unit comprising	Section 23: S/2 Section 24: S/2;

TOWNSHIP 24 North, Range 1 EAST, WMPM

a 640-acre unit comprising Section 7: E/2
Section 8: W/2;

a 640-acre unit comprising Section 17: W/2
Section 18: E/2;

a 480-acre unit comprising Section 19: N/2
Section 20: NW/4;

a 480-acre unit comprising Section 19: S/2
Section 20: SW/4;

TOWNSHIP 25 NORTH, RANGE 1 EAST, NMPM

a 640-acre unit comprising Section 29: W/2
Section 30: E/2;

TOWNSHIP 26 NORTH, RANGE 1 WEST, NMPM

a 640-acre unit comprising Section 5: W/2
Section 8: W/2;

a 640-acre unit comprising Section 5: E/2
Section 8: E/2;

a 640-acre unit comprising Section 17: W/2
Section 20: W/2;

a 640-acre unit comprising Section 17: E/2
Section 20: E/2;

TOWNSHIP 26 NORTH, RANGE 1 EAST, NMPM

a 640-acre unit comprising Section 19: E/2
20: W/2;

TOWNSHIP 27 NORTH, RANGE 1 WEST, NMPM

a 640-acre unit comprising Section 1: W/2
Section 12: W/2;

a 640-acre unit comprising Section 13: W/2
Section 24: W/2;

a 600-acre unit comprising Section 25: W/2
Section 26: All;

a 600-acre unit comprising Section 27: All
Section 28: E/2;

a 600 acre unit comprising Section 28: W/2
Section 29: All;

and a 400-acre unit comprising Section 30: All.

(8) That the amount of acreage contained in the above described non-standard units is approximate, and the exact acreage in each should be determined ~~by the survey~~ when it is actually dedicated to a well.

(9) That an order embodying the above findings is in the interest of conservation, will prevent waste and protect correlative rights, and should be approved.

IT IS THEREFORE ORDERED: and as amended by Order No. R-2565-C,

(1) That Rules 2, 3, and 5 of the Special Rules and Regulations governing the West Puerto Chiquito-Mancos Oil Pool, Rio Arriba County, New Mexico, promulgated by Order No. R-2565-B, A are hereby amended to read in their entirety as follows:

RULE 2. Each well completed or recompleted in the West Puerto Chiquito-Mancos Oil Pool shall be located on a standard spacing or proration unit consisting of approximately 640 acres which shall comprise ~~any two contiguous quarter sections of~~ a single governmental section, being a legal subdivision ~~(half section)~~ of the United States Public Land Surveys. For purposes of these rules, a spacing or proration unit consisting of between 632 and 648 contiguous surface acres shall be considered a standard spacing or proration unit. No non-standard spacing or proration unit shall be authorized except after notice and hearing.

RULE 3. Each well completed or recompleted in the West Puerto Chiquito-Mancos Oil Pool shall be located no nearer than 660 feet to the outer boundary of the proration unit nor closer than 330 feet to a quarter-section line nor closer than 10 feet to a quarter-quarter section line; provided however that nothing contained herein shall be construed as permitting the drilling of more than one well on a spacing or proration unit.

RULE 5. A standard spacing or proration unit in the West Puerto Chiquito-Mancos Oil Pool (632 through 648 acres) shall be assigned a 640-acre depth bracket allowable of 640 barrels of oil per day. Any non-standard spacing or proration unit containing less than 632 acres or more than 648 acres shall be assigned a depth bracket allowable in the same ratio to 640 as the acreage in the unit bears to 640.

(2) That the Special Rules and Regulations governing the West Puerto Chiquito-Mancos Oil Pool, Rio Arriba County, New Mexico, promulgated by Order No. R-2565-B, as amended by Order No. R-2565-C and as further amended by this order are hereby continued in full force and effect until further order of the ~~commission~~ Division.

(3) That the following non-standard proration units are hereby approved:

TOWNSHIP 24 NORTH, RANGE 1 WEST, NMPM

a 320-acre unit comprising	Section 1: N/2;
a 640-acre unit comprising	Section 23: N/2 Section 24: N/2;
a 640-acre unit comprising	Section 23: S/2 Section 24: S/2;

TOWNSHIP 24 North, Range 1 EAST, NMPM

a 640-acre unit comprising	Section 7: E/2 Section 8: W/2;
a 640-acre unit comprising	Section 17: W/2 Section 18: E/2;
a 480-acre unit comprising	Section 19: N/2 Section 20: NW/4;
a 480-acre unit comprising	Section 19: S/2 Section 20: SW/4;

TOWNSHIP 25 NORTH, RANGE 1 EAST, NMPM

a 640-acre unit comprising	Section 29: W/2 Section 30: E/2;

TOWNSHIP 26 NORTH, RANGE 1 WEST, NMPM

a 640-acre unit comprising	Section 5: W/2 Section 8: W/2;
a 640-acre unit comprising	Section 5: E/2 Section 8: E/2;
a 640-acre unit comprising	Section 17: W/2 Section 20: W/2;
a 640-acre unit comprising	Section 17: E/2 Section 20: E/2;

TOWNSHIP 26 NORTH, RANGE 1 EAST, NMPM

a 640-acre unit comprising Section 19: E/2
20: W/2 ;

TOWNSHIP 27 NORTH, RANGE 1 WEST, NMPM

a 640-acre unit comprising Section 1: W/2
Section 12: W/2 ;

a 640-acre unit comprising Section 13: W/2
Section 24: W/2 ;

a 600-acre unit comprising Section 25: W/2
Section 26: All ;

a 600-acre unit comprising Section 27: All
Section 28: E/2 ;

a 600 acre unit comprising Section 28: W/2
Section 29: All ;

and a 400-acre unit comprising Section 30: All.

PROVIDED HOWEVER, that the amount of acreage in the above-described non-standard proration units is approximate, and the exact amount of acreage in each unit shall be determined when the unit is actually dedicated to a well.

(4) That, pursuant to Paragraph A. of Section 70-2-18, NMSA 1978, existing wells in the West Puerto Chiquito-Mancos Oil Pool shall have dedicated thereto 640 acres, in accordance with the foregoing pool rules or, pursuant to Paragraph C. of said Section 70-2-18, existing wells may have non-standard spacing or proration units established by the Division and dedicated thereto.

Failure to file new Forms C-102 with the Division dedicating 640 acres to a well or to obtain a non-standard unit approved by the Division within 60 days from the date of this order shall subject the well to cancellation of allowable.

(5) 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.

(6) That Ordering Paragraphs (2), (3), and (5) of "IT IS FURTHER ORDERED" in Division Order No. R-2565-B are hereby rescinded.

STATE OF NEW MEXICO
OIL CONSERVATION DIVISION

JOE D. RAMEY
Director