

**DEARNLEY-MEIERS REPORTING SERVICE, Inc.**

PHONE CH 3-6691

ALBUQUERQUE, NEW MEXICO

BEFORE THE  
OIL CONSERVATION COMMISSION  
SANTA FE, NEW MEXICO  
JULY 13, 1961

IN THE MATTER OF:

- CASE 2012      In the matter of the application of Max Pray for the establishment of 80-acre oil proration units in the Southwest Gladiola-Devonian Pool, Lea County, New Mexico.
- CASE 2135      In the matter of the application of Nearburg & Ingram for the establishment of 80-acre oil proration units in the Southwest Gladiola-Pennsylvanian Pool, Lea County, New Mexico.

TRANSCRIPT OF HEARING





west Gladiola-Devonian Pool, Lea County, New Mexico.

MR. CAMPBELL: If the Commission please, Jack M. Campbell, Campbell & Russell, Roswell, New Mexico. In this case, I would like to enter an appearance for Max Pray, Cities Service Petroleum Company, Moss Petroleum Company, and Nearburg & Ingram. At this time I would also like to move that Case No. 2012 and Case No 2135 be consolidated for the purpose of hearing only.

MR. PORTER: If there is no objection to the consolidation of the Cases, the Commission will consolidate the two Cases.

MR. CAMPBELL: In regard to Case No. 2135, my appearance is for Nearburg & Ingram only, as they're the only operators involved in that particular case at this time.

MR. PORTER: I would like to call for other appearances in either of the cases at this time.

MR. CHRISTIE: R. S. Christie of Amerada Petroleum. I would like to make a statement at the end of the case.

MR. PORTER: All right. Mr. Campbell, you may proceed.

MR. CAMPBELL: We have three witnesses that can be sworn.

(Witnesses sworn)

MR. CAMPBELL: I will call Mr. Pickering first.

WARREN PICKERING,

called as a witness, having been first duly sworn, testified as follows:

DIRECT EXAMINATION

BY MR. CAMPBELL:

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Q Will you state your name, please?

A My name is Warren Pickering.

Q Where do you live, Mr. Pickering?

A I reside in Oklahoma City, Oklahoma.

Q What is your profession?

A I'm a consulting geologist in the employ of Mr. Max Pray.

Q You testified previously in Case No. 2012 before an Examiner for this Commission, did you not?

A Yes, sir, that is correct. I believe I was the only witness that day.

Q Will you please briefly recite for the Commission your educational and professional background?

A I was schooled at the University of Minnesota, where I finished with a Master's degree in 1941. I have been in the employ of the Pure Oil Company, and the Standard Oil Company of California, namely, the California Company. The last seven years I have been an independent consulting geologist, and for the last five years representing Mr. Pray.

Q In connection with your representation of Mr. Pray, you are acquainted, I assume, with the development in the Southwest Gladiola-Devonian Pool, are you not?

A Yes, sir, that is correct.

Q Did Mr. Pray drill the first or discovery well in that Pool?

A The well drilled by Mr. Pray, known as Zealon Pray No. 1



was considered at the time of the hearing as the discovery well. However, there was another Devonian producer at that time, the Moss No. 3 Peck.

(Whereupon, Applicant's Exhibits 1,2,3 were marked for identification).

Q I refer you to what has been identified as Exhibit No. 1 in these consolidated cases, and ask you to state to the Commission what that is?

A This map is a plat intended to show all of the Devonian wells drilled in the area, whether they be producers or not, so that we might be brought up to date as to development in this area.

Q Will you point out on Exhibit 1 the wells again, the locations of the wells that were Devonian wells at the time of the original hearing on this matter one year ago?

A Yes, sir. The first well producing from the Devonian was drilled by the Moss Petroleum Company, their No. 3 Peck, located in the northwest, southwest of Section 26, Township 12 South, Range 37 East. That was completed in the Devonian in February of 1960. Therefore, subsequent to that, the Max Pray No. 1 Zealon Craig, located in the northeast of the southwest of Section 27, same Township, was completed in June. Those were the two wells producing at the time of the last hearing.

Q Your testimony at that hearing was confined primarily, was it not, to the completion date on the Max Pray Zealon Craig well?

A Yes, sir, that is correct.



Q Will you point out to the Commission, using Exhibit No. 1, the Devonian wells, whether producing wells or dry holes, that have been drilled during the approximate year that has elapsed since the last hearing?

A Yes, sir. I'd be glad to. As an introductory, I might say that there have been four completions in the Devonian and four dry holes, with one well now drilling. If the Commission please, and you'll follow with me, I will locate each of these wells in the order of their completion. Some were drilled simultaneously, but we will use the date of completion as chronological order.

Well No. 1 was drilled by Nearburg & Ingram, No. 1 Midhurst, located in the northwest, northwest of Section 35. I might say that all of these refer to the same Township. That was drilled to 12,228 feet. It was a successful Devonian producer, completed in September 30, 1960.

The next well drilled in the area was the Skelly No. 2 Foster, located in the northeast, southeast of Section 27. This was a dry hole at a total depth, 12,323, and completed as a dry hole on October 2, 1960.

The next was the Max Pray No. 1 Rufus R. Craig, located in the northeast, southwest of Section 27. This was a dry hole in the Devonian, one of the deepest in the area, drilled to 12,566 feet, abandoned on December 4th of 1960.

The fourth well drilled was Moss Petroleum No. 4 Peck, located in the southeast of the southwest of Section 26. This was a Devonian



producer at a total depth of 12,227, completed on December 28, 1960.

Cities Service then drilled the No. 1 Turner "D" located in the southeast, southwest of Section 27. This was a successful Devonian producer at a total depth, 12,203, completed on February 14, 1960.

Nearburg & Ingram, on their No. 1 Keating, located in the southeast of the northeast of Section 34, was dry in the Devonian, and a total depth of 12,263 abandoned on March 1st, 1961.

Nearburg & Ingram drilled their No. 2 Midhurst, located in the southeast, northwest of Section 35. This was a successful Devonian completion at a total depth of 12,230 feet, completed on June 1st, 1961. The most recent completion was a dry hole drilled by Moss Petroleum Company on their No. 7 Peck, located in the southwest of the northwest of Section 26. This well was abandoned on the 10th day of July this month, 1961 at a total depth of 12,274. You will note that that is given credit as a drilling well. Actually, the abandonment was so recent we haven't had a chance to put the spokes on the map. We are now in the process of drilling, I say we, Amer-ada Pray No. 1 Grady Lowe now drilling in the northeast of the northwest of Section 34, drilling below 8,000 feet this morning. Again, in summary, since our last hearing, there has been four producers, four dry holes, one well drilling.

Q What is the approximate cost of a dry hole to the Devonian in this Pool?

A My best figures come from our Rufus R. Craig where we did extensive drill stem testing. The figure there was \$198,000.

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Q If this figure is fairly representative of a cost of the dry hole to the Devonian, then there has been spent on dry holes in this area since the last hearing in the neighborhood of three-quarters of a million dollars, is that correct?

A Yes, sir. If you were to include the geophysical work and the exploratory figure, I imagine it would be close to a million dollars of expenditure.

Q What is the approximate cost of a well, a single completion to the Devonian?

A I believe the cost of \$250,000 to \$260,000 is appropriate.

Q So that insofar as the four producing wells are concerned, there has been approximately a million dollars spent in the area in the past year on producing Devonian wells, is that correct?

A That is correct.

Q Would you say, then, that the entry of the order for temporary 30-acre spacing has had any effect in delaying development or definition of this Pool?

A No, sir, on the contrary. We think that 30 acres would be permissible, it has encouraged drilling.

Q Would you point out to the Commission what this drilling has done with regards to defining the limits of this Devonian Pool?

A Actually, I think it's rather obvious that progressing to the north by virtue of the Rufus Craig drilled by Max Pray, the Foster well drilled by Skelly, and the now dry Moss No. 5 Peck well that we have very definitely limited the well to the north.

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We know from geophysical effort that the west dip is very severe to the west, and, therefore, we believe that we are limited on the west. The east has no dry holes unless you go to the Mc Allister Fuel location, which is to the northeast. However, there is a well on the Midhurst that's running low, and although we haven't actually drilled a dry hole, we are quite nervous about going any further to the east. This leaves only the south available for future expansion.

Q Is there any limitation with regard to the south on dry holes to the Devonian?

A Yes, sir. We have used these several dry holes to the Devonian that are rather expanded from the field, but you notice one drilled by the Lawton Oil Company in Section 3 at a location in the southeast, southeast of the northwest, which is a definite dry hole in the Devonian, so that most certainly will be the southern limit, if it doesn't occur before that point.

Q Are there not also dry holes delineating this field to the southeast in the Nearburg-Ingram area?

A Yes, sir. That is true. However, that is a condition that is unique to that particular well being a faulted well. It is dry in the Devonian, and we are counting it as a dry hole, but we are considering it a faulted well.

Q Considering the development that has taken place in the four Sections around 27, 26, 34 and 35, and referring to the Devonian only, how many dry holes have been drilled to the Devonian in



that area?

A There have been seven dry holes drilled in the area you described.

Q So that that would represent an investment of approximately a million and a quarter dollars in the dry Devonian holes in the entire four-section area, is that correct?

A Yes, sir, that would a conservative figure.

Q How many producing wells have been drilled to the Devonian in that area?

A There have been six producers in that four-section area.

Q So, your percentages of taking production from the Devonian in that area have been less than 50/50, is that correct?

A Yes, sir, at the present time.

Q At the last hearing, you testified with regard to the general geological situation in this particular area, as to the Devonian formation. Will you state whether or not the additional development has to any great extent clarified the geological situation in this area, or does it still remain as you testified previously in a considerably complicated situation, to say the least?

A The area was presented initially based on the two wells drilled, and the outlying dry holes coupled with geophysics, it was characterized as an extremely complex faulted Devonian area. We at that time presented a map showing numerous faults, which was the best interpretation we could derive at that time. These nine wells -- eight wells drilled, one now drilling, have tended to



compliment the complexity of this area. I wouldn't say that it has defined it a great deal more as regards to the position of faulting. We know very definitely that faults are there. As a matter of fact, we found additional small faults we knew not of when the first hearing was held. I feel that the area is not beyond contouring. On the contrary, each of us could make a geologic contour map on top of the Devonian. I dare say that no two of them would be alike. As a matter of fact, we have tried, the several companies in the area, to combine our efforts for geologic purposes, and make a common map. This cannot be done and honor all of the information presented by each of the several companies. It's an extremely complex geologic problem.

Q Now, since the last hearing, of course, you have had some production history for the Max Pray Zealon Craig well in the north-east quarter of the southeast quarter of Section 27, have you not?

A Yes, sir, that is correct.

Q Will you explain to the Commission what has occurred with regard to production from that well during this period of time?

A The Max Pray Zealon Craig well began producing in July of 1960, and looked for the first three months for all the world like it was going to make its allowable; water-free production, a very strong well. Its allowable was made on each of the first four months. However, in the month of October, it was reported, and we gauged 232 barrels of salt water along with our production. This was during the time that the north 40-acre offset, the Rufus Craig



was in the process of drilling, and needless to say, we were greatly concerned about the propriety of going ahead with the Craig well at that time because it was intended to be so much structurally lower. Back to the Zealon Craig. Then, the well continued to increase in its water content until the month of January, this year, when the water increased to the point where it would not flow of its own accord. We then put it on a Kobe pump on the 10th day of January, and also reduced forcibly and reduced by our own requirements the amount of production because of the water being produced, you might say, selfishly, too, because we own a half interest with the Cities Service to the south, and we weren't in a position to pull the water in, if that was being done. Therefore, we did curtail voluntarily our own production. It now makes 46 percent water per month with 4,000 barrels of net oil, which is well below its allowable.

Q In your opinion, if this well continues to act as it has been, will that well pay out, as far as an investment is concerned?

A For the last six months it's been holding rather constantly between 36 and 45 percent water production on the rate of pump that we have introduced. We feel, if this continues, it will pay out, but it's still a great question whether we can hold that water or not.

Q Would it be an over-all pay-out if it is considered in conjunction with the dry hole you have drilled to the north?

A No, sir, it will not pay for the dry hole we drilled.



Q You have stated, or indicated, that, in your opinion, this water situation has not been or was not the result of coning or pulling water into the well. What do you think has caused that water to come into this well?

A Indications are, and our reasoning is based entirely on the core analysis that we obtained from the Zealon Craig well. The method of completion included the drilling of the top 15 feet of the Devonian, at which time we ran a drill stem test to find that oil was present, and it was a commercial well. We then cut a 10-foot core on the bottom and had it carefully analyzed. There were 8 feet worthy of analysis, and the permeabilities ranged from 70, from as low as 73 to as high as 1966 millidarcies. Of the 8 feet, there were 3 feet that were very pronounced in high millidarcy feet, high permeability. It is my feeling, and the engineers seem to concur that this is not a coning effect by virtue of production, but it is actually depletion of these highly permeable zones; depletion of the oil first, and thence allowing avenue for water to encroach from the peripheral edge of the reservoir.

Q Now, at the last hearing you presented, as I recall it, the core analysis on this well, and you have recited here some of the permeabilities that were found in the core. Are you generally acquainted with the completion data on the wells that have been drilled to the Devonian since that time?

A Yes, generally speaking.

Q Has anything occurred to change the opinion that you ex-

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pressed at the time of the last hearing, that, in your opinion, a well here in the Devonian with this type of core that you found, would drain 80 acres?

A No, sir. I still believe the permeability is sufficient to drain the 80 acres.

MR. CAMPBELL: I would like to offer Exhibit No. 1 in evidence, and that's all the questions I have of this particular witness at this time.

MR. PORTER: Without objection, Exhibit No. 1 will be admitted.

(Whereupon, Applicant's Exhibit No. 1 was received in evidence).

MR. PORTER: Does anyone have a question of the witness? Mr. Nutter.

MR. NUTTER: Mr. Campbell, what aspects of this will the other two witnesses go into?

MR. CAMPBELL: The bottom hole pressure comparisons as the field has been developed. There will be one witness that will testify in connection with the core taken from the field.

MR. NUTTER: This is your only geologist?

MR. CAMPBELL: Yes. I have another one, but he's not going to testify to the geological features of the matter.

CROSS-EXAMINATION

BY MR. NUTTER:

Q As I understand it, now, there are two producing wells on

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the west side of the field, and four producing wells on the east side of the field; is that correct?

A Mr. Mutter, in the beginning, we prefer to call them two fields. It now appears that this is one extremely complex area, all producing from the Devonian.

Q Well, I said two on the east side, or two on the west side of the field, and four on the east side of the field, --

A That is correct.

Q -- referring to it as a single field?

A That is correct.

Q In the middle of the field there have been three dry holes drilled, is that correct?

A That is correct.

Q Do you believe there is any actual communication from the east side to the west side of the structure?

A I believe the engineers' evidence of bottom hole pressure indicate a similiarity. Geologically, it looks as though there should be a dissimiliarity. The only indication that we have geologically is perhaps a different water-oil contact in the two blocks. They seem to have a similar Genesis of evolution as regards commercial production, however.

Q Is there one main faulty block that has dropped in the center of the field, and you find these wells lower structurally than the wells to the east and west of it?

A - Mr. Mutter, I wish I could answer that and be sure of it.

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I cannot answer it with certainty. The well pattern would seem to indicate that. The disposition of the wells would seem to be like that, in that some of the geophysics and particularly the Skelly Oil Company do not trend their faults north-south at all; they prefer to trend them east-west, which gives you a mild evidence of the extreme complexity that we have introduced here in this picture.

Q Has any well that you know of actually cut a fault?

A Yes, sir. The well in the northwest of the northeast of 34, drilled on the Grady Lowe, actually cut a fault at the top of the Devonian. It also had some 3200 feet of clean oil on a drill stem test, but did not appear to be worthy of completion at its early date.

Q I see.

A May I proceed?

Q Yes, sir.

A There are other small faults. Our Rufus Craig, which you will find in the southeast of the northwest of 27, cut a fault of some 90 feet of throw which introduced an extra section of new Mississippian on top of that particular bed.

Q Which wasn't encountered in any other well?

A No, sir. We have not found the faults to be in any particular position in the lithologic column.

Q Now, how about your Lowe No. 1 in the northeast of the northwest of Section 34, which is drilling at the present time?



How is that running structurally?

A I have said we're below 8,000 feet, and the markers to that depth are unimportant, and you cannot depend on them, so we have no markers at the present time. I can tell you, though, that from the geophysical evidence, and the fact that the No. 1 Turner is higher than the Max Pray Zealon Craig, we are hoping with everything we have that it will be a high well, at least as high as the Turner 1 "D."

Q In going through the dry holes that have been drilled in there since the last hearing, you mentioned four, and it would appear from the map that Nearburg-Ingram Keating No. 1 was completed in March of '61. Was that a dry hole to the Devonian that was drilled since the last hearing, or did you mention that well?

A I mentioned it, and it was drilled since the last hearing. That was one of the four.

Q I have marked the four as being the No. 1 Moss Well up in Section 26, --

A Yes, sir.

Q -- the Skelly Well in 27, --

A Yes, sir.

Q -- the Max Pray Well in the northwest corner of 27, --

A Yes, sir.

Q -- and Nearburg-Ingram's No. 1 Well in the northwest of the northeast of 34?

A No, sir. The fourth well is the Keating No. 1, which is



in the southeast of the northeast of 34. The Nearburg & Ingram No. 2, and the Keating No. 1, which is located in the northwest of the northeast is an old hole drilled by Moss Petroleum Company, the No. 1 Lowe, it's date is correct, it was completed there on 4/5/54. It is the old hole in which we encountered a Devonian fault and was not completed.

Q It is dry in the Devonian?

A Yes, sir.

Q You haven't constructed any cross-section of this reservoir running from east to west to show the continuity or discontinuity of the formation, is that correct?

A No, sir. We have constructed such cross-sections, but we had not intended to present them.

Q And the engineering witness will have data to substantiate the claim that this is one field, is that correct?

A We think so, yes.

MR. NUTTER: I believe that's all. Thank you.

MR. PORTER: Mr. Morris.

BY MR. MORRIS:

Q Mr. Pickering, in the previous hearing of this case, considerable concern was expressed due to the faulting of the area, that possibly you are going to have a lot of unproductive acreage dedicated to wells if we went to 80-acre spacing. I was wondering if you would care to comment if whether the subsequent development justified that concern?



A I think the concern we had then would still be appropriate. Unfortunately, with this number of wells drilled, we have not pinpointed the bearing throw of these faults to the point of being able to set up a number of reservoirs.

Q You would be unable to say at this time that the actual dedication to the wells in existence now is proper?

A I believe the wells now are proper, simply because there are no wells that show specific faulting; for instance, to the west. Therefore, I think we're safe in assuming that we can go at least another 40 west since there's nothing to belie that assumption. We have nothing to the contrary to point up the fact that we might be contributing non-productive acreage.

MR. MORRIS: Thank you.

REDIRECT EXAMINATION

BY MR. CAMPBELL:

Q Isn't that same situation true as to the present wells on the eastern portion, the Moss 3 and 4, and the Nearburg & Ingram 1 and 2 there in Sections 26 and 35?

A Yes, sir. It's even more appropriate there because if you notice the staggered 80-acre pattern of development is there, indicating the common source of supply and productive well.

MR. CAMPBELL: That's all.

MR. PORTER: Anyone else have a question of the witness? He may be excused.

(Witness excused)

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MR. PORTER: Mr. Campbell, we will recess the hearing until 1:15.

AFTERNOON SESSION

MR. PORTER: The hearing will come to order, please. Mr. Campbell, are you ready to call your next witness?

MR. CAMPBELL: Yes, sir. Mr. Motter.

E. F. MOTTER,

called as a witness, having been first duly sworn on oath, testified as follows:

DIRECT EXAMINATION

BY MR. CAMPBELL:

Q Will you state your name, please?

A E. F. Motter.

Q Where do you live, Mr. Motter?

A Hobbs, New Mexico.

Q By whom are you employed and in what capacity?

A Cities Service Petroleum Company, Division Engineer.

Q How long have you been Division Engineer?

A About four years.

Q Have you previously testified before the New Mexico Oil Conservation Commission in your capacity as a petroleum engineer?

A Yes, sir, numerous times.

Q Referring to Exhibit 1, which has been introduced in this case, will you point out to the Commission the well in which Cities



Service Petroleum Company has an interest?

A Yes. That's the Cities Service Turner "D" No. 1. We don't have the "D" on there, but it's located in the southeast, southwest quarter of Section 27, 12 South, 37 East. The well is held jointly by Cities Service and Max Pray.

Q When was that well completed?

A February 14, 1961.

Q When was the Max Pray discovery well, or the well immediately to the north completed?

A On June 15, 1960.

Q Have you made any studies to compare the bottom hole pressures in those two wells?

A Yes, sir, I have.

Q I hand you what has been identified as Applicant's Exhibit 2, and ask you to state what that is?

A This is a curve plotting bottom hole pressure versus cumulative production for the Max Pray Zealon Craig No. 1, and the Cities Service Turner No. 1. I used cumulative production between those two wells because we feel that although there is a complexity of the structure in this area, we feel that those two are producing from the same reservoir.

Q Will you refer to that, where necessary, and point out to the Commission what the comparative bottom hole pressures were with relation to the time that the tests were taken?

A Well, the first pressure was taken on the Pray Well June

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26, 1960, shortly after completing. I think they had only produced some 2500 barrels of oil at that time. The next pressure plotted on that curve is March 9, 1961, that is shortly after the completion of the Cities Service well. The next two pressures were both taken on the Cities Service well just this past month, on July 20 -- excuse me -- June 20, '61, and June 23, '61. The last one being a pressure buildup test.

I would also like to point out that there has only been one bomb test other than drill stem bottom hole pressure data on the wells that Mr. Nutter referred to as the east. I would like to point out that that bottom hole pressure was taken on April 28, 1961, on the Moss Peck No. 4, and it was 4494 pounds. And if you would plot that on a time scale close to the March 9th, 1961 survey, of course, you would find out that the pressures were almost identical in the reservoir, or were at that time.

Q What does this data indicate to you, as a reservoir engineer, in connection with the drainage that is taking place in this reservoir?

A Well, to me, it appears that at least in the vicinity of our two wells, that there was certainly drainage occurring up until the time our well was drilled, and a bottom hole pressure run on it.

Q Would it appear by reason of the comparable bottom hole pressure data on the Moss well that at least there is a possibility that drainage is occurring throughout a single reservoir here?

A Yes, I would say that.

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Q Now, what other work have you done in connection with your well which will indicate a drainage area or movement of oil in this particular reservoir?

A Well, we have performed pressure buildup tests and resulting calculations, which are an engineer's tool to determine the effective permeability, the drainage radius, and several other factors.

Q Is this pressure buildup calculation a procedure that is commonly used in the oil and gas industry to indicate the well performance and so forth?

A Yes, it is.

Q Will you refer to what has been identified as Applicant's Exhibit No. 3, and advise the Commission whether this is the complete pressure buildup calculation based upon your well?

A Yes, it is. This is a pressure buildup calculation taken from data obtained June 23, 1961, as indicated on Exhibit No. 2. I would like to go through this and point out a few of the highlights that I think are important to this hearing.

Q Without going through the whole calculation with regards to the factors that are important in this hearing, such as permeability, drainage area, and production efficiency index, will you refer to this Exhibit and advise the Commission what it reflects to you?

A Yes. Item No. 6 is the average effective permeability of the formation, 324 millidarcies, which I consider good for this

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Devonian reservoir.

Item 26, the calculation drainage radius, 1280 feet, which, in effect, would drain probably some 160 acres.

Item 29 is the PI with no skin effects, which is 10.8 barrels per pound drop.

Going back to this skin, Item 16, that is a positive number, indicating that the permeability immediately around the well bore is probably less than the average formation. This is due probably to some drilling fluids still around the well bore. This well was completed, naturally, it was never acidized.

Q Do you consider that an average permeability of 324 millidarcies is a relatively high permeability?

A Yes, for this type reservoir.

Q What does it indicate to you with regard to the movement of fluids within the area of this well?

A Well, I think that it would indicate to me that we could easily drain 30 acres, and, of course, that is further pointed out by the drainage radius, which is affected by the average permeability calculation.

Q You used that permeability calculation in order to ultimately determine the drainage radius mathematically, did you not?

A That is correct.

Q Are you acquainted with the core analysis in the Pray well that was introduced at the last hearing?

A Yes. I have a copy of it.

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Q Will you refer to that and state what the permeability range was in the core analysis on that particular well?

A Well, on the 8 feet cored there were eight samples, and the permeability ranged from a low of 73 to a high of 1966 millidarcies. I might point out also that there was another interval where two permeabilities have different plugs, but right adjoining each other was 1233 and 1340 millidarcies, extremely high for this reservoir.

Q Using those actual core analyses and the ranges there, your figure of 324 millidarcies on your calculated permeability is a fairly conservative figure, is it not?

A That's right. It's a little bit less than the average of the core analysis.

Q Are you acquainted with the average permeabilities on the core, which will be referred to later by another witness, that was taken on one of the Nearburg-Ingram wells?

A I have been told that the permeabilities are in the same range as the one that I have available.

Q In your opinion, as a reservoir engineer, does the permeability range here, and the calculated drainage radius, as indicated on Exhibit No. 3, indicate to you that a well may reasonably be presumed to drain at least 80 acres efficiently?

A Yes.

Q Now, what other data do you have available with regard to the production history of this reservoir?

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A We have made rate time curves on all the wells producing from the Devonian reservoir.

Q Mr. Motter, I've handed you what has been identified as Applicant's Exhibit No. 4, and ask you to state what these are?

A Well, these are decline curves, barrels per month versus rate, or excuse me, time, for each well completed in the Southwest Gladiola-Devonian Pool. I might correct these. These are identified as West Gladiola. I think the production is appearing in the Oil and Gas Engineering Committee reports as West Gladiola, and my engineers put it down as such, but it is Southwest.

Q I refer you to the second page, which is the data on the Max Pray Zealon Craig No. 1, which is to the north of your well, --

A Yes.

Q -- you will note there that there has been a substantial increase in water production from that well after it initially produced only oil. As a petroleum engineer, and particularly with reference to your knowledge of the core analysis of that well, will you state what, in your opinion, has been the cause for the water production from that well?

A Well, I agree with the previous testimony, that this is water coming from the edge of the water aquifer, and it is normally termed by engineers as an unequal advance due to permeability variations in the formation. In other words, on the more permeable streaks, the oil is produced out first, and then the water follows.

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The well will probably continue to produce oil from the less permeable streaks along with considerable water.

Q What relationship, if any, do you think that this increased water production may have with the rate of production?

A I don't think it has too much effect on rate. I think that the oil has been produced in these higher permeable streaks. If we had taken a year to do it, or a month to produce it, the water would still have come along in the permeable streaks whenever so many barrels of oil had preceded it. I don't think that any under-expected normal unit allowables that we may foresee that we would see any danger from any rates that we may expect.

Q Based upon your knowledge of the bottom hole pressure comparisons in the wells in this reservoir, and upon your knowledge of the core data, and upon your knowledge of the pressure buildup calculations that you have made, what is your opinion with regard to the drainage area of a Devonian well in this Pool?

A Well, I think that we have shown here quite feasibly that it's in excess of 80 acres. I don't know if I can pin it down any greater than that. I think that following our calculations, it's somewhere around 160 acres.

Q One other question on the Exhibit No. 4, which is the series of Exhibits on the production time data. Your well, which is the first one shown there, shows a considerable decline in production in the last month or two. Will you state to the Commission what accounts for that considerable drop?

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A Well, yes. That was in the last months we had available production. There have been no pressures taken since the initial pressure taken in June of 1960. That's when we were running all our pressure buildup curves and bottom hole pressures. In other words, we sacrificed 1500 barrels of oil to get this information. I might also add, at the time we were drilling and about ready to complete our well, was about the time that the practice well started marking large water cuts, and we were a little dubious to go ahead and cut a core, run bottom hole pressure, or bottom hole fluid analyses, et cetera, that is needed for real good information, due to the fact that we were skeptical whether we could make water from the well ourselves, so we tried to complete it in the most economic manner possible.

Q Have you experienced water production from your well?

A None whatsoever.

Q Has it produced, except for the last month when you were running the test, at top allowable?

A Yes. It is capable of producing at a higher rate. If you notice, the pressure buildup rate was 303 barrels a day.

MR. CAMPBELL: That's all the questions I have from this witness.

MR. PORTER: Any questions of the witness? Mr. Nutter.

CROSS-EXAMINATION

BY MR. NUTTER:

Q Mr. Nutter, in this group of Exhibits here, I notice that several of these wells had experienced a decline, the productivity



or production, at any rate, and then a buildup. On the third sheet it would appear that Midhurst reached a low point in January, and built back up again. Can you explain those fluctuations?

A No, I can't. We have another witness that will testify on his own well. I would assume, from looking at that, it was probably an artificial lift put on at that time.

MR. CAMPBELL: The next witness will be qualified to testify on that, and answer your question.

Q (By Mr. Nutter) How many of the wells in this Pool are flowing?

A I think, if that is not an artificial lift, they are all flowing, with the exception of the Max Pray Well.

Q Is that the one that makes considerable water cut?

A Yes, that's correct.

Q Now, these pressures on your first Exhibit here, how many of them are from the Max Pray?

A The very first pressure.

Q The first pressure is the Craig. And the other three pressures are all from the Turner Well?

A From the Cities Service Petroleum Turner.

Q Were any pressures taken on the Craig Well that would show what the bottom hole pressure would be with relation to the Turner Well at the same time the Turner pressures were taken?

A There have been no pressures taken since the initial pressure taken in June of 1960.



Q Now, on the pressure buildup calculations, Mr. Motter, the important thing to determine the effective radius of drainage, one of the important things is the thickness of the pay, is it not?

A That's correct. We normally use the perforated interval or the exposed interval. In this case we used the open hole, 25 feet.

Q Is all of that effective pay?

A Yes, it is.

Q Is there any other effective pay in there that you haven't perforated?

A Yes, there is. In our interpretation, we think it's some 40 or 50 feet on down to the oil water contact.

Q But in the calculation you have used the 25 feet, is that correct?

A That's correct.

Q And if you had more effective pay than you actually used, that would tend to cause the effective radius of drainage to be larger than it actually would be, would it not, or given amount of production from 25 feet?

A I don't think so, because we don't have a homogeneous reservoir, and our vertical permeabilities vary as we run from one barrier to the other horizontal barriers.

Q There would be some vertical permeability?

A Yes, but not nearly as much as the horizontal permeability.



Q In other words, you don't anticipate recovering the additional 15 feet of --

A Yes. As the water aquifer moves in, it will push the oil up, but it will be over the entire drainage radius.

Q You will have vertical permeability?

A Yes, but it's not as great as the horizontal permeability.

Q Did you make a test, using 40 feet of pay to determine what the effective radius of drainage would be?

A No. I might point out that the 40 feet of pay would be hard to make that determination. You would have to calculate the permeability, and if you don't know what your producing rate was with 40 feet, I don't see what value it would be because it would be strictly an assumption. We know that 25 feet gives us a certain producing rate at a certain pressure.

Q You are also assuming that only the 25 feet is contributing oil to this well during this test, aren't you?

A That's correct.

MR. NUTTER: That's all. Thank you.

MR. PORTER: Anyone else have a question? The witness may be excused.

(Witness excused)

MR. CAMPBELL: Mr. Ingram.

TOM L. INGRAM,

called as a witness, having been first duly sworn on oath, testified as follows:

DIRECT EXAMINATION

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BY MR. CAMPBELL:

Q Will you state your name, please?

A Tom L. Ingram.

Q Where do you live, Mr. Ingram?

A Roswell, New Mexico.

Q With whom are you associated?

A Nearburg & Ingram.

Q You are a partner in that organization?

A Yes.

Q What is your profession?

A Geological engineer.

Q How long have you been engaged in that?

A Since 1947.

Q You have previously qualified before the New Mexico Oil Conservation Commission in that professional capacity, have you not?

A I have.

Q Are you acquainted with the application, I'm speaking now of the Devonian formation only, the application in this case?

A Yes, I am.

Q Has your company drilled any Devonian wells in this area since the time of the original hearing?

A We have drilled three wells in the immediate area since that time.

Q Will you refer to Exhibit 1, and advise the Commission

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where those wells are situated?

A The first well that we drilled is the Nearburg & Ingram No. 1 Midhurst, located in the northwest of the northwest of Section 35, which was a Devonian producer. The second well, the No. 1 Fred Keating, in the southeast of the northeast of Section 34, which was dry in the Devonian. The third well, the No. 2 Midhurst, in the southeast of the northwest of Section 35, which was also a Devonian producer.

Q Have you taken any cores -- do you have any core analysis of any of those wells, as far as Devonian producers are concerned?

A We took a core in the original well, the No. 1 Midhurst, from 12,211 feet to 12,222 feet.

Q Go ahead.

A The permeabilities in this 11-foot core ranged from one-tenth to one-thousandth and ten with an average permeability over the 11 feet of  $334$ .

Q Do you consider that to be a fairly high average permeability for the reservoir?

A Yes, we do.

Q Does that compare with the permeability based upon the pressure buildup calculations made by Mr. Motter on the Cities Service well in the western portion of the field?

A It is within five to ten, I believe, of his estimate.

Q What is your opinion, based upon the information that you have, and upon the core analysis, and upon the test that has been



given with regard to bottom hole pressures, what is your opinion with regard as to whether or not a well in the Devonian reservoir here will efficiently and economically drain at least 80 acres?

A Well, from the data presented, and the information that we have, it certainly appears that a well will drain at least 80 acres.

Q I notice that the dry hole you drilled to the Devonian, the Keating Well, is drilled upon a diagonal offset pattern, is it not?

A That is correct.

Q Do you still believe that the order of the Commission entered as a temporary order in this case, with the right to drill in either 40-acre tract, is the appropriate type of order to encourage development in this reservoir?

A I do, and I might offer as an explanation, particularly as to the reason that we drilled our third well in the location that we did, rather than moving up directly offsetting it was, the old hole that was there, and we felt fairly certain as to the geological information there. However, due to the highly faulted nature, we were, well, we felt much safer drilling in this particular location than we did maybe in offsetting.

Q Do you concur with the testimony of Mr. Pickering that this is an extremely complicated area, geologically?

A Geologically, I think it's highly complex. It appears, from our engineering data, that, at least the drainage in the area,

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that there must be some communication with it. Now, there may be minor faults. However, the separation is probably not definite, in any case.

MR. CAMPBELL: This is all the questions I have of this witness with regard to the Devonian portion of this reservoir. He will also testify in the consolidated case with reference to the Atoka-Pennsylvanian.

MR. PORTER: Does anyone have any questions of Mr. Ingram concerning his testimony on the Devonian reservoir? Mr. Mutter.

CROSS-EXAMINATION

BY MR. MUTTER:

Q As I understand it, the Michurst 1 "B" was an old well that was drilled back in 1956; is that correct?

A That is correct. It was drilled by Lawton Oil Corporation.

Q That recovered, according to the legend, 49 barrels of oil, and 408 barrels of salt water?

A That's the information we have, yes, sir.

Q When you drilled the No. 2 Well, did you use any special techniques to cause the bottom of that hole to drift away from the bottom of the old well?

A No, sir.

Q In other words, was there any directional drilling or anything like that?



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A We attempted to drill a straight hole.

Q And you recovered 480 barrels of oil in twenty-four hours?

A That is correct.

Q Do you have any indication that there was any fault or anything separating the two wells, the old one and the new one?

A No, sir.

Q To what do you attribute the difference in productivity of those two wells?

A Fifty feet less hole.

Q You completed higher?

A That is correct.

Q What is the top of the Devonian in your No. 2 Well? It's not given on the legend there.

A The top of the Devonian in the No. 2 Midhurst was 12,213 feet.

Q Do you have a subsea depth for that?

A Subsea minus 3315.

Q Is this the top of the Devonian on the 1 "B" that's minus 8317?

A That is correct, yes, sir.

Q But you completed up higher in the formation in this other well?

MR. CAMPBELL: Just a second. Was your answer yes?

A Yes.

Q (By Mr. Nutter) Mr. Ingram, could you state what is the



reason for the fluctuation of the production that's shown on the group Exhibit that Mr. Motter presented, particularly on the third page, your Michurst No. 1?

A During December and January we had the extremely heavy snows, and the pipeline gauger at that time was unable to get in and out. Subsequent to that, we installed a LACT unit, and we had excessive rains, and the electricity was off, so during December, January and February we were down because of bad weather, installation of LACT unit, and the power failure.

MR. CAMPBELL: Unchartered reefs, is that right?

A Yes.

Q (By Mr. Nutter) So these, then, would be surface conditions rather than bottom hole conditions that caused this fluctuation?

A That's right. We have had no difficulty bottom holewise.

Q Are all of your wells in the Devonian flowing?

A They are, yes, sir.

Q Do you have at the present time any plans for drilling in the west half of the northeast quarter of Section 35?

A The west half of the northeast quarter of Section 35? We are planning to do some geophysical work to help us ascertain whether or not it would be economical to drill in that particular location.

Q How about the west half of the southeast quarter of Section 26? Do you have any plans there?



A Well, the same thing. We were waiting particularly until Moss' well was dual, to see if he planned to dual prior to doing our exploratory work.

Q Has any attempt ever been made other than the initial completion to make a completion in the Devonian in the Keating No. 1 Well, in the northeast quarter of Section 34? Have you made any recent attempts on that?

A To recomplete in the Devonian?

Q Yes, sir.

A No, sir, we have not. We penetrated approximately 5 feet of Devonian on the initial test, and recovered considerable quantities of water out of it.

Q Do you think that those two wells are drilled in a fault block that has dropped down below the portions of the structure that lie to the east and to the west? Is the Devonian low in that area?

A The two wells you were referring to in the northeast quarter of Section 34?

Q Yes, sir.

A Of course, the well in the northwest of the northeast actually penetrated a fault. The well, the Keating Well, that we drilled, may or may not be in a fault. I mean, it is not an abnormally low well. Structurally, it is about three feet higher than the old Moss hole that was drilled in the northwest portion. However, we had an entire Mississippian section above, and they had none.



MR. NUTTER: Thank you.

MR. PORTER: Does anyone else have a question of the witness? He may be excused as far as this case is concerned and the Devonian is concerned.

REDIRECT EXAMINATION

BY MR. CAMPBELL:

Q Mr. Ingram, referring you, now, to the matter before the Commission to reopen the hearing by which Nearburg & Ingram were granted 80-acre spacing authority on temporary basis coextensive with the Devonian order, will you refer to Exhibit No. 1 in this consolidated case first, and point out to the Commission which of your wells are completed in the Atoka-Pennsylvanian formation?

A The Nearburg & Ingram No. 1 Midhurst and No. 2 Midhurst, located in the northwest quarter of Section 35, are both dually completed from the Pennsylvanian and the Devonian. The Nearburg & Ingram No. 1 Keating in the southeast of the northeast of Section 34 is completed only in the Pennsylvanian. The Moss No. 4 Peck in the southeast quarter of the southwest quarter of Section 26 has been perforated in the Pennsylvanian and packer leakage tests have been run, but to my knowledge it is not on production at this time.

Q Then, there are four wells in that immediate area which at least have found some production in the Atoka-Pennsylvanian formation, is that correct?

A That is true.

MR. CAMPBELL: Mark this Exhibit 5 in both cases.

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(Whereupon, Applicant's Exhibit No. 5 was marked for identification).

Q (By Mr. Campbell) Mr. Ingram, refer hereafter to this reservoir as the Southwest Gladiola-Pennsylvanian, to avoid confusion with another Pool. I refer you to what has been identified as Applicant's Exhibit No. 5 in the consolidated cases, and ask you to state what that is?

A Exhibit No. 5 is a subsurface structure map contoured on the top of the Atoka sand of Pennsylvanian age in the Southwest Gladiola area. It shows the location of the wells that have been drilled, that have -- well, that had been drilled in the area. The Wolfcamp producers are indicated with a single black dot, the Devonian producers with a black dot with a circle around it, and Atoka sand producers in which the large circle has been colored in half black.

Q Which of the wells have been completed since the original hearing in this case, which I believe was in December of 1960?

A The wells that have been completed since that time are the Nearburg & Ingram No. 1 Keating, the Nearburg & Ingram No. 2 Midhurst, and the actual perforation and completion attempt in the Moss No. 4 Peck.

Q As a result of the completion of those additional wells since the last hearing some six months ago, have you made any substantial changes in your contour as it appears on Exhibit 5 here, as compared to the contour which was offered in the other hearing?



A The contouring is essentially the same. The aerial extent of the enclosure that we have is somewhat smaller now. In other words, the reservoir appears to be somewhat smaller in the Atoka-Pennsylvanian than we had previously estimated.

Q Since the last hearing, do you have some data that you can present to the Commission with regard to bottom hole pressures in the well that was then completed, as compared to the wells which have since been completed in that area?

A Yes. The bottom hole pressure in the Nearburg & Ingram No. 1 Midhurst, at a datum of minus 7221, was 3565, and this was taken in September of 1960. Two months later, Moss, in drilling his No. 4 Peck, ran a test in which the bottom hole pressure at the same datum was reported at 3540, so that even though these are both drill stem test data, we believe that they are close enough together that they fairly well represent the original bottom hole pressure that we've had.

Then, we had the hearing requesting permission to dually complete the well, and upon approval, we began producing the No. 1 Midhurst. In February, we were drilling the No. 1 Keating, and the bottom hole pressure in it at the same datum was 3445, indicating a pressure drop of approximately 100 pounds with the production that had been taken out of the Midhurst No. 1. Then, in April of this year the No. 2 Midhurst penetrated the same sand, and we had a bottom hole pressure of 3490. While that was not quite as low as that in the Keating well, it did indicate that we had had drain-

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age also in this area. Now, the Midhurst No. 1 is some 1866 feet away from both the Keating No. 1 and the Midhurst No. 2. Well, using this as a radius of drainage, we would have an area much larger than 80 acres.

Q Do you have available logs on your Midhurst No. 2 and your Keating Well?

A I do have.

(Whereupon, Applicant's Exhibits Nos. 6 & 7 were marked for identification).

Q (By Mr. Campbell) I refer you to what has been identified as Applicant's Exhibits Nos. 6 and 7 in these cases, and ask you to refer to them, first, to Exhibit No. 6, which is the log on the Midhurst No. 2, and then to the Keating Well, and point out to the Commission your interpretation of those logs with regard to the thickness of the Pennsylvanian section there.

A Both Exhibits 6 and 7 are gamma ray neutron logs on the two wells made by the Schlumberger Corporation, and on these Exhibits we have indicated the completion data, the perforations, and the tops of the various horizons. Originally, from the Midhurst No. 1 we had estimated at the time sand pay thickness was approximately 6 feet, and based all of our reserve estimates on that particular thickness. On Exhibit No. 6, the No. 2 Midhurst in the detailed section, you will note that the entire sand section is only 4 feet thick with approximately 2 feet of that being pay, or maybe 3 feet of it being pay. The perforated interval was at 11,134 feet



to 138 feet. That, we feel, covers the entire sand thickness in this particular well. In Exhibit No. 7, it shows also 4 feet of sand pay with approximately 2 feet of net pay, the perforations being from 11,134 feet to 33 feet.

Q At the time of the last hearing, I believe that you made some calculations of reserves under a tract, I forget whether it was 40 or 80-acre tract in this reservoir. What have the drilling of the additional wells established with regard to the reserves?

A Well, originally, based on the 6 feet of pay that we were using in the Midhurst No. 1, we had calculated reserves of approximately 60,000 barrels for an 80-acre tract. Now, with the reduction in net pay to 2 or possibly 4 feet, our reserves will have to be reduced from 30 to 60 percent, thereby leaving us recoverable reserves of from 24,000 to 40,000 barrels per 80 acres.

Q What is the cost of a well drilled to this depth only?

A The cost of drilling a well solely for Atoka-Pennsylvanian would be approximately \$200,000.

Q Then, it is obviously uneconomical to drill a well just to that zone, either on 40 or 80 acres, is it not?

A That is correct.

Q Is this dual completion in order to recover the oil in this particular zone purely a salvage operation, so far as you are concerned?

A It is. It's a salvage operation. The cost, I believe,



that I reported last time was approximately \$30,000 additional expenditure.

Q In order to recover the reserves that are available in this reservoir?

A That is correct. Now, the \$30,000 is additional expenditure if the well is being completed in the Devonian.

MR. CAMPBELL: That's all the questions I have of this witness. Before I forget it, I would like to offer the Exhibits 1 through 7 in evidence, and I would also like to correct a statement that I made. The Moss properties are owned, of record, by H. S. Moss individually, rather than by the Petroleum Company. That's all the questions I have.

MR. PORTER: Any questions concerning the Exhibits? Did you have a question concerning the admission of the Exhibits?

MR. NUTTER: Oh, no.

MR. PORTER: They will be admitted.

(Whereupon, Applicant's Exhibits Nos. 1 through 7 were received in evidence).

MR. PORTER: Did you have a question of the witness now?

MR. NUTTER: Yes.

#### RE-CROSS-EXAMINATION

BY MR. NUTTER:

Q Mr. Ingram, you have logs on two of these Pennsylvanian wells. Does the sand thickness in the other two Pennsylvanian wells compare pretty favorably with these two?



A We submitted the log on the No. 1 Midhurst at the original hearing, and the sand thickness was slightly greater. We estimated the 6 feet of net pay from the logs on the No. 1 Midhurst.

Q At the original hearing, were detailed calculations as to the estimate of 60,000 barrels of oil per acre tract submitted based on the porosity and water saturation and all that?

A We gave the entire information as to the porosity estimate, the recovery factor and all that information.

Q Does everything stay the same except you have re-evaluated the net sand thickness?

A Everything is essentially the same. The porosity, now, in the last two wells is slightly less, which, of course, might reduce the reserves somewhat more.

Q Now, on your Exhibit, I notice that you have one fault line to the west side of the Pennsylvanian structure. Is there any indication that there is a fault on the east side of this structure, or does that fault, if present at all, occur only in the Devonian?

A By fault on the east side of the structure, do you have reference to the separation between Gladiola and Southwest Gladiola, or within the Southwest Gladiola Field?

Q I was talking about separation within the Southwest Gladiola.

A Within the Southwest Gladiola in the Atoka, we find no definite evidence of any faulting.

Q Has an attempt been made unsuccessfully to complete any



other wells in the Pennsylvanian in this Pool except the four wells, which are producing?

A No attempt has been made in the -- now, drill stem tests were taken in Moss' No. 5 Peck, and were, as I recall, they recovered nothing, and then Max Pray's north well, his Z Craig, a drill stem test was run in it and recovered water.

Q So, the only actual attempts at completion are these four wells, which are productive from the Pennsylvanian?

A Insofar as I know. I mean these are the only four wells that they have run pipe on, and actually perforated, yes, sir.

Q The four pressures that you gave us being Midhurst No. 1, Moss Peck No. 4, No. 1 Keating, and No. 2 Midhurst. Are all of those drill stem test pressures?

A They are all drill stem test pressures.

Q Have any bottom hole pressures been run since the drill stem test on any of these wells in the Pennsylvanian?

A We ran a drill -- bottom hole pressure test in the Midhurst No. 1 as a discovery well of a new field. However, the tubing was filled with gas for the most part, and we were unable to get what we considered as a pressure.

Q Was that run at about the time of initial completion?

A That's correct.

Q No subsequent pressures have been taken on that well?

A We attempted to run another one last week, and it was of the same caliber as the first one.

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Q No pressure at all, or what?

A Well, there was a pressure in it which was -- the man running it felt that it was very unreliable because he could not establish a good gradient on it. If you recall, in this particular well, we were forced to go to heavier casing in the bottom, and, therefore, were unable to run our tubing all the way down opposite the perforations on it, so that we are some 2400 feet or so above the pay, and we're unable to get our bottom hole pressure tool down at that point. But the bottom hole pressure that we obtained the other day, which I feel is unreliable, was 1601.

Q What depth was the bomb?

A Well, that is corrected down to this minus 7221, but it was 2400 feet above that datum.

Q That's the corrected pressure to the datum?

A Right, using the limited gradient that he had.

MR. NUTTER: I believe that's all. Thank you.

MR. PORTER: Does anyone else have a question? The witness may be excused.

(Witness excused)

MR. CAMPBELL: That's all the witnesses.

MR. PORTER: This concludes your testimony?

MR. CAMPBELL: Yes, sir.

MR. PORTER: Anyone else desire to present testimony?

Anyone have any statement to make in the case?

MR. LITTLE: John M. Little, Jr., with H. S. Moss,



Dallas, Texas. We concur with the recommendation of the operators here that the Commission order 30-acre spacing for the Devonian and Pennsylvanian reservoirs. Thank you.

MR. PORTER: Mr. Christie.

MR. CHRISTIE: R. S. Christie, Amerada Petroleum. We are now drilling in the northeast of the northwest of Section 34. We hope it will be a producer in both zones. Based on the evidence that has been presented here today, we believe that one well will efficiently drain 30 acres in either one of the reservoirs, and, therefore, recommend that a permanent order be adopted.

MR. PORTER: Mr. Campbell, did you have any statement?

MR. CAMPBELL: No, sir.

MR. PORTER: The Commission will take the cases under advisement.

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