BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
March 27, 1958

IN THE MATTER OF: Case No. 1394

TRANSCRIPT OF PROCEEDINGS

DEARNLEY - MEIER & ASSOCIATES
INCORPORATED
GENERAL LAW REPORTERS
ALBUQUERQUE, NEW MEXICO
3-6691 5-9546

BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
March 27, 1958

IN THE MATTER OF:

The hearing called by the Oil Conservation Commission of New Mexico, at the request of Ralph Lowe, et al., to consider the reduction of allowables in the Gladiola Pool in Lea County, New Mexico.) Case 1394

BEFORE:

Mr. A. L. Porter, Jr.
Mr. Murray Morgan
Governor Edwin L. Mechem

TRANSCRIPT OF PROCEEDINGS

MR. PORTER: The meeting will come to order, please. The case now being considered before the Commission is Case 1394.

MR. PAYNE: Case 1394: In the matter of the hearing called by the Oil Conservation Commission of New Mexico, at the request of Ralph Lowe, et al., to consider the reduction of allowables in the Gladiola Pool in Lea County, New Mexico.

MR. PORTER: To review this matter briefly, an emergency order was issued by the Commission, I believe effective March 1st, which reduced the maximum allowable in the Gladiola Pool to 190 barrels a day. The order called for the matter to be heard, of course, at the regular March hearing. The case was called at that time, and some testimony was presented. The matter was continued

to the 26th, and successively continued until today. In the meantime an interim order was issued maintaining the 190 barrel allowable until the matter is finally resolved.

Who has testimony to present at this time at this session?

MR. EASLEY: If the Commission please, I'm sorry if I am going to disappoint the Commission, but at this time the Applicants, Ralph Lowe, et al, move that the application be dismissed. By way of explanation, I would like to say that the application, of course, was made in good faith, based on what evidence we had at that time which was considered by the experts of Ralph Lowe to be ample evidence that there was waste being committed in the field in the reservoir, and I would like to state that the position of Ralph Lowe and his staff hasn't changed in that regard. We still maintain the view that the rate is too high to get the most out of the recovery in the pool. We feel that there are a number of danger signals there that should be heeded, but the other operators in the field, major operators who are represented here, we have conferred with them, and they of course are reasonable in their demands. They feel that they have ample evidence to show that the present rate that has been set, the statewide rate, is not too high for the field; and they think that they have evidence to support that, and were prepared to present it here. However, after discussing it with them we have, and this is merely advice to the Commission, we have made an agreement that each operator in the field will appoint a member of a committee to conduct a thorough study of the

situation there, and all the data which has been accumulated up to now plus any studies or surveys that the committee sees fit to make.

All of the operators, of course, are in substantially the same position. They all want to make the most out of the recovery, and we feel that all of us are in good faith in that regard and that we may come up with something that will substantiate our view or their view. If it substantiates theirs, why of course Ralph Lowe and the other Applicants certainly are willing to take the oil out of the ground if it won't disturb the situation as we have claimed it will; and we feel that these surveys will make it possible to make a more intelligent appraisal of the situation.

We would like to make it plain to the Commission, as I say, that we haven't abandoned the idea that this is too rapid a withdrawal, that the water is encroaching at too rapid a rate, and we want to make it plain that although we have stipulated or agreed with the other operators that this Committee will report back to the operators within a six months period, we want to be open that if any changes take place there which might jeopardize the position of Mr. Lowe, that we will be free and will certainly come back in and ask the permission of the Commission for some relief.

I believe that fairly states the situation. Of course, the April allowable has cut it back to within a reasonable range of what we were asking for initially, and we think that although it may be too high, it isn't so high that within six months it will do

any material damage to our position. Of course, if it does we will certainly be back asking for a change.

MR. BUELL: Mr. Easley, may I inquire if you intended to include within your motion that the field return to the statewide normal basic allowable?

MR. EASLEY: If the Commission please, we have no objection to that motion being granted. In order not to be inconsistent about it, we feel that that is too high, but we will not resist a motion on the part of the other operators to return it to that. In other words, if you move to return it to that, in other words, we have no objection to it. Let's put it that way. Is that sufficient answer?

MR. BUELL: I understand your answer, yes, sir.

MR. EASLEY: I mean if it helps the situation any, we are agreeable to the return, but as a matter of procedure we would just as soon you make the motion.

MR. BUELL: For Pan American, if it please the Commission, we would like to concur with the motion for dismissal of Ralph Lowe as long as concurrently with that dismissal,the field returns to the normal method of assigning allowables. Frankly, if the case is dismissed without being heard to conclusion, I can't see any other result. We are agreeable to the motion for dismissal, as long as the field returns to the normal basic method of assigning allowables.

MR. EASLEY: I didn't realize the complications of the

procedure there, we agree that be made a part of the motion.

MR. BUELL: A part of the motion?

MR. EASLEY: Part of the motion.

MR. BUELL: Thank you. I would like to state that we are prepared at this time to go forward with our presentation, as we told you we would be when we asked for the continuance. I make that statement simply because we were a company asking for a continuance. I would like to point out that the Commission shouldn't construe our concurrence to this motion for dismissal as a lack of confidence in our case. On the contrary, it is a complete confidence in our case that makes us concur with this motion. We feel that Mr. Lowe is sincere in his views as expressed by Mr. Landua, and we are just as sincere in our views, and will express here today if the case isn't dismissed, since we feel that we are all reasonable people, we think that the proper way to handle it would be through the committee method. We fervently hope that at the conclusion of the study another hearing will not even be necessary.

I would assume that if the Commission grants the motion that some type of order cancelling the interim order that is now in effect will be issued.

MR. KELLAHIN: Jason Kellahin of Kellahin and Fox for Hancock Oil Company. Hancock Oil Company concurs in the motion for dismissal on the same basis as stated by Mr. Buell. Hancock Oil Company did not desire a continuance at the previous hearing

and was prepared to go forward with the testimony;subsequent to that Hancock with the other operators has worked up additional information and is prepared to offer it today.

Hancock did not feel then or feels now that waste is occurring in the Gladiola Pool. By that I do not want to infer that we question the good faith of Ralph Lowe in filing the application, and to me of equal importance, I want to emphasize the fact that Hancock feels that the Commission did the only thing it could do in entering the emergency order. We have no criticism of that action on the part of the Commission. However, if there is any further study on this, Hancock is most anxious to participate in it and will work with the other operators in developing all the information possible to determine just what the situation is in the Gladiola Pool. They are just as anxious that this pool be produced on a proper basis as Ralph Lowe or any of the other companies involved there.

MR. WEBB: Layton Webb for Sinclair Oil and Gas Company. I would like to concur in both the statements by Mr. Buell for Pan American and Kellahin for Hancock; and also make the additional statement to the effect that since we were one of the parties requesting the continuance in this case, we have made what we consider a complete study of this field and are prepared to go forward with the case at this time.

We would like to thank the Commission for setting it down at as early a date as they did, although I want to apologize to

the Commission for a statement I made that I said that I thought the Jalmat case would not take over a day or a day and a half.

MR. WATTS: Watts, with Aztec Oil and Gas Company. Aztec does not operate any wells in the Gladiola Pool. However, we do have interest in wells operated by Ralph Lowe, and because of our small interest in the pool we have not made a thorough study of the reservoir. However, we do recognize that water encroachment can be a valuable tool in production. We also believe that the data presented at the last hearing, data presented by Ralph Lowe, that is, concerning pressure drop in production was significant data. We would like to concur with Ralph Lowe, and at the time recommend a short period with reduced withdrawals so that data might be collected. I believe the operators have agreed to do this and we will concur with the dismissal of the case with that in mind.

I might add that during 1957, I believe the allowable, if you could call it an average allowable, was approximately 265 barrels a day, whereas beginning in April it will be 223 a day, so possibly that drop will aid in the collection and evaluation of the data.

MR. WEBB: I don't want to have to be sworn, and this is certainly no reflection on any evidence that was presented by Ralph Lowe; as a matter of fact, we just made the mathematical computation from the exhibit that they presented, and during this proration period I believe we calculated that the average production per well per day from Mr. Lowe's wells in the northernmost part was in

excess of 215 barrels per day. All we did was make a mathematical calculation from their own exhibits and checked those figures. That is what it turned out to be. I don't know that we ever really had a period of cutback to 190 barrels.

MR. LANDUA: I think what Mr. Watts said was the average allowable for the whole year.

MR. WATTS: I said the average allowable of 265.

MR. BUELL: May we have the record show that I was authorized by Sunray Mid-Continent Oil Company to make a closing statement for them in support of returning the field to the normal allowable. I am not advised as to what their position would be on this motion for dismissal, but I do want the record to show that they did authorize me to enter a statement supporting a return to the normal allowable.

(Discussion off the record.)

MR. EASLEY: If the Commission please, we withdraw our motion.

MR. BUELL: Pan American, as one operator who requested a continuance, as I stated before, we are ready to proceed. Since he has withdrawn his motion, I don't guess there's any need for us to withdraw our concurrence.

I might suggest it's rather late, and while we operators who are opposing this reduction are not opposing it in a group action, we have coordinated together in order to avoid repetition and duplication of effort. I believe the Commission would be

benefited in hearing all of the testimony uninterrupted, and it's getting rather late. I doubt if we could get through. We are willing to drive ahead and get as far as we can.

MR. KELLAHIN: On behalf of the operators who are opposing the cutback, I would like to know if there are any proponents who are in support of Mr. Lowe, I think they should proceed so they could have the benefit of the proponents' testimony. I don't know if there is anybody here who is supporting the application or not.

MR. EASLEY: I don't know of any other proponents, if the Commission please.

MR. PORTER: Is there anyone here supporting the application in this case? Mr. Easley, do you have additional testimony to present at this time?

MR. EASLEY: We don't have any testimony to present at this time, Mr. Porter.

MR. PORTER: Mr. Buell, are you ready to proceed?

MR. BUELL: We have our exhibits here. May we have a minute to get them ready and in order?

MR. PORTER: Yes.

MR. BUELL: We have one witness.

(Witness sworn.)

MR. BUELL: I think the position of Pan American is fairly clear, there is no need for a lengthy opening statement, so we will just get on with it.

DANIEL R. CURRENS

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

DIRECT EXAMINATION

By MR. BUELL:

Q State your complete name, by whom you are employed, and in what capacity, and at what location?

A Daniel R. Currens, employed by Pan American Petroleum Corporation as a Reservoir Engineer, Roswell, New Mexico.

Q Does that office have supervision over Pan American's operations in the Gladiola-Devonian Pool?

A It does.

Q Have you testified at prior Commission hearings, Mr. Currens, and are your qualifications as a petroleum engineer a matter of public record?

A Yes, sir.

MR. BUELL: Any questions?

MR. PORTER: No, sir.

Q Let me ask you whether or not all the exhibits which we will present were either prepared by you or under your direct supervision?

A They were.

(Pan American's Exhibit No. 1 marked for identification.)

Q Let me direct your attention, Mr. Currens, to what has

been marked as Pan American's Exhibit No. 1. What is that exhibit?

A Exhibit No. 1 is a map of the entire Gladiola Field, reflecting the structure of the Devonian in this area. It shows the wells that have been completed in the Devonian and those wells that have penetrated the top of the Devonian. It further shows the trace of a cross-section from north to south through this field.

Q Directing your attention back to the March 13th portion of this hearing, Mr. Currens, do you recall the structural interpretation that was presented by Mr. Landua?

A I do, yes, sir.

Q In that connection, let me ask you this. Is there any material difference in your structural interpretation and that presented by Mr. Landua?

A There's only one thing that we reflect in different manners, actually.

Q Briefly describe this disagreement.

A In the northern portion of the field, the minus 8100 foot contour line on the top of the Devonian shows a slightly different picture in this exhibit than it did in Mr. Landua's. As you may recall, in Section 6, Township 12 South, Range 38 East, the Lew Wallace No. 1 was reflected as being low, and in Section 32, Township 11 South, Range 38 East, Lawton State No. 2 was reflected as being low. Now I also recognize that these wells are somewhat structurally lower than the surrounding wells. It is just that we depict it in a different manner. As you recall, he depicted

these wells being low structurally, showing them even in a circle, showing them in a sink hole,more or less. My interpretation would show them to be in valleys rather than in sink holes.

Q Other than the difference that you have just discussed, generally speaking are the interpretations pretty much in accord?

A Yes, sir, I would say they are substantially the same.

Q As I recall, he showed as the outermost contour line on his structural presentation minus 8150. Is that the outermost contour on your map?

A Yes, it is.

(Pan American's Exhibit No. 2 marked for identification.)

Q Mr. Currens, I direct your attention to what has been marked as Pan American's Exhibit No. 2. What is that exhibit?

A That is a cross section from south to north through the Gladiola Field. It reflects the top of the Devonian as we would encounter it along this trace. It starts in the southwest on Ohio State E-476-A No. 2 and proceeds north through the field to Ralph Lowe State "A" No. 2. It is located in Section 32, Township 11 South, Range 38 East. This is the trace of the cross section we saw on Exhibit 1.

Q This is just another manner of showing structure?

A Yes, this is just to show you the structure and the horizontal plane across the trace of the cross section.

Q I notice on some of the wells on this exhibit, Mr. Currens, that the log does not penetrate the entire Devonian productive section. Why is that?

A Well, there are a number of scratch-type completions in this field.

Q What do you mean by "scratch-type completions"?

A Well, scratch-type completion, which is not an unusual sort of thing in a water drive field of this sort, it means that you penetrate the top of the producing interval only. You don't drill all the way through your oil column.

Q Do you have any other comments to make on this exhibit?

A No, sir.

(Pan American's Exhibit No. 3 marked for identification.)

Q All right, Mr. Currens, I direct your attention now to what has been marked as Pan American's Exhibit No. 3. What is that exhibit?

A Exhibit No. 3 is a series of performance curves versus time for the entire Gladiola Field. We show in here the number of wells in the field, the daily production rate for the field, the cumulative production for the field, and the reservoir pressure.

Q I will ask you to discuss each of those curves starting first with the uppermost curve which I believe is the pressure curve. Briefly describe the pressure curve.

A The pressure curve which is the topmost curve here on Exhibit

No. 3 shows a discovery pressure of the field which was approximately 4820, and proceeds in a very flat manner, very little pressure decline throughout the life of the field to a point here on January 1st, 1958, of approximately 4357 pounds.

Q Mr. Currens, I notice some various symbols on that pressure curve. What do they reflect or signify?

A Well, you note that some of the points are represented by dots enclosed in circles, these are points that are taken from the fieldwide pressure surveys as run by the N.M.O.G.C. There are other points here that are dots enclosed in triangles. These are the pressures that were reported by Mr. Landua in the March 13th hearing as the pressures run on the Ralph Lowe wells at various times. There's one last point here on the end, which is enclosed in a square, which represents the pressure on some wells that we ran ourselves the first of March, certain Pan American wells.

Q Let me see if I understand the dot within a circle, fieldwide survey?

A Yes.

Q Dot in the triangle, Ralph Lowe wells?

A Yes.

Q Dot in the square, Pan American wells?

A Yes.

Q Does that pressure curve also reflect the pressure of the initial well in the northern area of this reservoir?

A Yes, sir, the first triangular dot we see here is the

discovery well in the north end of the field, which was, oh, the latter part of March, 1956, Ralph Lowe's, 4708 pounds on the discovery well.

Q How did the initial pressure come in in the north end, with respect to the curve reflecting the average pressure in the southern portion of the field?

A Came in right on the line with the fieldwide surveys.

Q Would you go now to the next curve on that exhibit, the cumulative curve?

A The cumulative curve is simply a reflection of the cumulative production in this pool, showing out here as of 1/1/58 we have a cumulative production of slightly more than nine million barrels of oil from the field. It is easy to see from this with only a 459 drawdown and the production that we have a water drive field. I don't think anyone doubts that.

Q Will you go now to the next curve?

A This is the daily producing rate for the entire Gladiola Field, ending out here on the last day of 1957 slightly more than 20,000 barrels per day. The January rate's also reflected on there, which is something over 21,000 barrels per day.

Q The bottom curve?

A It shows the number of wells that were completed in the field with respect to time, the end of the year was approximately 84 wells, as I recall.

Q All right, Mr. Currens, before we leave Exhibit 3, let me

direct your attention back momentarily to the plot you have of the I.P. in the northern area of this reservoir.

A Yes, sir.

Q Approximately how far was that well located from the older producing wells to the south?

A It would be about two miles, maybe a little more.

Q Would the fact that that well came in at the approximate range of pressure of the older producing wells indicate to you that in this reservoir production from wells in one area of the reservoir will affect wells or other portions or areas of the reservoir?

A Yes, sir, I certainly believe it does show that.

Q Based on your study and analysis of this Devonian reservoir, are you of the opinion that to arrive at accurate engineering conclusions it is necessary to study the entire reservoir?

A Yes, sir, I believe that in this reservoir, with the small pressure differentials we might have between various areas, that the only valid way to make a reservoir study is to study it in the whole, not by parts.

Q Mr. Currens, I want to call on your memory again and ask you if you recall at the March 13th portion of this hearing where Mr. Landua testified as to, I believe it was production per pound drop for certain increments of time?

A Yes, sir. I remember that. He presented an exhibit which in part showed the barrels of oil produced per pound pressure drop

for periods of time.

Q In your opinion as an engineer, Mr. Currens, is that a valid method of calculation upon which you can base a sound engineering conclusion as to efficiency of performance or ultimate recovery?

A I don't see how you could base any conclusion of that sort on that type of information. It simply says that for a period of time we produced so much oil and had so much pressure drop while we were doing it.

Q Has it been your general experience in working on reservoirs, Mr. Currens, that when you use data accumulated over a short increment of time, when you consider the long life of an oil field, that sometimes the results of a calculation over such a period could be very misleading?

A It's often misleading, yes, sir, very often.

Q Can you recall, Mr. Currens, any other limitation on the type of calculation that Mr. Landua made at that hearing?

A Well, as I recall that was based on pressures which were run from the Ralph Lowe wells only, and further on the production from the North Gladiola Field as it was then called, only.

(Pan American's Exhibit No. 4 marked for identification.)

MR. PORTER: Let me ask you, Mr. Currens, while Exhibit No. 4 is being passed out, have you made a similar calculation for the same increments of time used by Mr. Landua, only your calculations were on a fieldwide basis?

A Yes, sir, using fieldwide production data.

Q Directing your attention now to Pan American Exhibit No. 4, briefly explain what that exhibit reflects.

A Exhibit No. 4 as to what it reflects, is that what you said?

Q Yes, its composition, headings.

A Looking at Exhibit No. 4 we see we have a column which shows date, fieldwide pressure at that date, fieldwide production which would be an increment from the previous date to that date, the barrels of oil produced per pound of pressure drop for the entire Gladiola Field for that same increment of time, and the numbers that were reported by Mr. Landua at the March 13th hearing for that same period of time.

Q Mr. Currens, looking at the last two columns on this exhibit, do you see that these calculations form any kind of a pattern or trend or indicate anything in a uniform nature of any kind?

A Between the two columns?

Q Yes.

A No, there's no particular correlation between the two columns.

Q This is more or less self-explanatory and we won't go into each calculation for each period of time, but let me direct your attention to the first calculation you made for the period ending December 21st, 1956, compare the fieldwide with the North Gladiola area.

A Fieldwide would be 43,900 barrels of oil produced per pound

pressure drop. The North Gladiola area shows 1850 barrels of oil produced per pound pressure drop.

Q Just looking at those two figures alone, Mr. Currens, and nothing else, that would indicate to you that one area of the field was operating much less efficiently than any other area?

A Just looking at those figures?

Q Yes, just the figures alone.

A Yes, sir, it might indicate that.

Q But you as an engineer who studied this field know that circumstances and facts in the field completely explain that difference?

A Yes, sir, I think there is a very good explanation for that.

Q For the benefit of the Commission, you might briefly tell them what causes the difference between those two calculations.

A Well, it would depend on the number of wells that were completed during that period of time, the wells that were in the field at that period of time. Certainly the development in the North Gladiola area was small in comparison to the fieldwide development as a whole.

Q And we are dealing with a common reservoir?

A Yes, sir, it is certainly common reservoir.

Q Now if I interpreted Mr. Landua's testimony correctly, the figures that caused him the greatest apprehension were for the last two periods of time, the period ending August 1, 1957 when he compared it with December 1, 1957. Would you briefly discuss

the result of the calculation for the North area as presented by Mr. Landua, and compare those with the fieldwide calculation?

A Well, for those two periods of time you named, the increments ending August 1st and December 1st, the North area as the information presented by Mr. Landua shows had a production of 19,200 barrels of oil per pound of pressure drop during the first period and a production of 6,580 barrels of oil produced per pound pressure drop for the period, indicating that it was going down there. Looking over at the entire fieldwide results, we can see that for the first period it was 20,000 barrels per pound drop and for the second period there, the latter period I'm discussing, 20,200 barrels of oil produced per pound pressure drop.

Q In other words, on fieldwide, if this is a measure of efficiency, you show that the reservoir is improving in its efficiency, do you not?

A I would think that if this were a measure of efficiency of the reservoir it would show that it was producing at a more efficient rate.

Q If you believe that a calculation such as we have been describing was a valid thing from which to draw an engineering conclusion, could you conclude in any way that the rate should be reduced, based on that calculation?

A If I were of the conviction that this showed us that information, I could only say that the reservoir was being improved as time went on, based on these numbers that we show, these data.

Q You can see nothing there to necessitate a reduction in allowables?

A No, sir, I couldn't see anything from that that would necessitate a reduction in allowables.

Q Let's put Exhibit 5 up on the board.

(Pan American's Exhibit No. 5 marked for identification.)

Q Mr. Currens, I now direct your attention to what has been marked as Pan American's Exhibit 5, and I'll ask you to explain what that exhibit is, please.

A Exhibit No. 5 is a plot of reservoir pressure versus producing rate for the entire Gladiola Field. We can see that we start up here early in the life of the field with the first information we have, with a low producing rate and a high pressure. We extend along a very straight and flat curve to a point out here something in excess of 21,000 barrels per day and a pressure, oh, on the order of 4300 pounds.

Q Now on our Exhibit 3 we plotted pressure versus time. Is this simply another method of plotting pressure?

A Yes, sir, it is another method of plotting pressure, changing the variable and making it rate this time.

Q Do you see anything in the attitude of the pressure curve which you have plotted against producing rate that would give you any alarm from the standpoint of efficiency or ultimate recovery?

A It is certainly a very flat sort of curve. We have rate

varying from 300 barrels to 21,000 barrels and very little pressure drawdown.

Q Let me ask you this, Mr. Currens, are you of the engineering opinion that in this Devonian reservoir the greatest ultimate recovery of oil will result from pressure maintenance or through drawing down the pressure?

A It's my firm opinion that we will recover the most oil from this reservoir if we can drop the pressure as far as is possible. If we maintain pressure in this reservoir, we are going to leave oil behind,thereby causing waste.

Q Will you then assume for the purpose of this question that pressure maintenance would result in the greatest ultimate recovery. With that assumption let me ask you this. If you were of that opinion, is there anything in the attitude of that pressure curve that would alarm you?

A If I were of the opinion that we could recover more oil by pressure maintenance, I certainly wouldn't be alarmed by this curve. We have a very flat curve, it's very little drawdown for this period of time for the wide increase in rates that we show here. It couldn't alarm me, no, sir.

Q All right, Mr. Currens. Let's put Exhibit 6 on the board, please.

(Pan American's Exhibit No. 6 marked for identification.)

Q What is Exhibit No. 6?

A Exhibit No. 6 is another map of the Gladiola Field. It is essentially the same as we presented in Exhibit 1; however, the trace of the cross section is not on this, and certain wells are encircled in blue.

Q Does this exhibit have plotted by each well certain basic data relating to that well?

A Yes, sir, it does. As an example, here, let's look in Section 18, the Slack Hancock No. 2 in the southeast quarter of the northwest quarter of Section 18.

Q All right.

A You will note here that we show the elevation and the well number by the well. You'll see a single number which is a negative number below it,in this particular case, minus 8090, that reflects the top of the Devonian for that well. Beneath that you see two other numbers, in this case minus 8092 to minus 8107, which would reflect the completion interval in that well, and above it a number, plus 43, this shows the bottom of the completion interval with respect to minus 8150.

Q Now, with reference to minus 8150, in your opinion is that a reasonable pick of the water-oil contact?

A Yes, sir, I would say it was a reasonable estimate of the water-oil contact within say, oh, ten or fifteen feet.

Q I believe you said the wells colored in blue are wells that are now making water, is that correct?

A Yes, sir, this is through February, information as reported

to the Commission.

Q In that connection, let me ask you this, Mr. Currens. Generally speaking are those wells around the edge of the structure or completed low in the producing formation?

A You only need to follow them around and see that they are all edge wells on the structure, practically without exception. There is one exception here in Section 18, Sinclair's Rosa Schultz No. 1. Otherwise they are all very low wells structurally.

Q With respect to Sinclair's Schultz well, did the operator have some trouble in effecting a completion in that well?

A He had a great deal of trouble getting a completion in there, they were pretty deep in there.

Q In a water drive field such as we have here, and the cumulative production which we have enjoyed, do you find anything unusual or unexpected about low wells or edge wells making water?

A No, sir, I don't see anything unusual about that. On the contrary, I would be surprised if these edge wells in these low structural completions weren't making water in a field of this type with this type drive mechanism; anything else would be a surprise to me.

Q Directing your attention back again to the March 13th portion of this hearing, and in view of your statement that you just made, I take it then that you are in general agreement with Mr. Landua that as of that time that the edge wells making water was normal?

A Yes, sir.

Q And that the only unusual factor that existed at that time was the performance of Lowe's Lawton State No. 2; are you in general agreement with that?

A Yes, sir, I am in general agreement with that.

Q What was the status of the Lawton State No. 2?

A That well had gone to 100 percent water as of that time.

Q Was testimony introduced to the effect that a workover rig was over the hole at that time?

A Yes, they did say that workover was being attempted on this well.

Q In the interim period between March 13th and today, what has happened to that well, based on information furnished to us by Mr. Landua?

A Mr. Landua furnished information to Pan American that Lawton State 2 had been worked over and it was now producing pipe line oil without a trace of water.

Q I realize that Mr. Lowe's representatives will probably put in full detailed information about the workover and the completion, if they see fit, but let me ask you this. Did he also furnish us the present completion interval?

A Yes, sir, he furnished us the present completion interval in that well.

Q Would you compare it with the old completion interval?

A Now he has some eighteen feet of section open, all but two of those being section that was opened previously before this

workover.

Q All right. In view of the apparent successful completion of Lawton State No. 2, in that it is now producing without any water at all, would you say that there is no unusual or unnormal or abnormal condition in the field at this time?

A Now that that well has been brought back to an oil producing status and is now an oil producing well, I fail to see anything unusual happening in this field at this time.

Q I will ask you to put up Pan American's Exhibit No. 7.

(Pan American's Exhibit No. 7 marked for identification.)

Q What is Exhibit No. 7, Mr. Currens?

A Exhibit No. 7 is a plot of reservoir pressure versus cumulative oil production for the entire Gladiola Field. It simply shows the pressure versus the production at any time.

Q Let me direct your attention to the extreme left portion of that exhibit and ask you the significance of the dashed line that goes in a downward manner, or what that dashed line reflects? Yes, sir, the one to the left.

A The dashed line here on the left simply would be what the predicted performance of this field would be with a depletion type drive field, comparing the recovery that we could expect with the drawdown to the bubble point pressure, which is 537 pounds; we can see that it's, oh, something slightly over six million barrels of oil. It will serve to point out again that we have a water drive

field here.

Q Let me direct your attention again, still on the left portion of the exhibit, to the solid line that starts at the left and goes right in a more or less horizontal manner, what is that solid line?

A The solid line we show up here with the points is simply a plot of the reservoir pressure versus the cumulative production for the entire reservoir.

Q All right. I notice where the solid line stops, a dashed line picks up and continues on to the extreme right portion of your exhibit. What does that line reflect?

A Well, that line is simply an extrapolation of the trend of pressure cumulative that we have had previously here. It's certainly not a prediction, it'just says if this trend were to continue what would happen. You will note that it stops at a point down here which is thirty-four and a half million barrels of cumulative recovery. That's the recoverable oil from the reservoir, by my calculations.

Q All right. In other words, to draw that horizontal dashed line you just assumed that the present trend that we have noticed to date would continue?

A Yes, sir, that's all.

Q You recall Mr. Landua's testimony to the effect that in his opinion the pressure in this Devonian reservoir would never decline to anything near the bubble point, do you not?

A Yes, sir, I recall that.

Q Are you in agreement with that testimony of Mr. Landua?

A I certainly am. We have a bubble point pressure point here of 537 pounds, we'll never reach that bubble point pressure. I certainly wish we could. We would recover more oil if we could.

Q From the standpoint of increased recovery, then, it is your opinion that the nearer or the more approximate the pressure is drawn down to bubble point, the greater the increased recovery of oil?

A If we were to draw this pressure down to the bubble point and slightly below, if we were able to do that, that's the place that we would realize the maximum recovery from this reservoir.

Q Since we know, or both of our witnesses that we have had are in agreement that we will never approach the bubble point, let me ask you this. What factors will come into play between the current pressure that we now have and a point above the bubble point pressure that will tend to increase ultimate recovery? What are those factors?

A Well, there are certain physical factors that we would have to consider. Naturally you have got your reservoir volume factor; as you decrease pressure on the crude oil, it's above its bubble point. You decrease pressure, you cause that oil to expand. As it expands it helps drive more oil out of the reservoir. You would have an improved viscosity relationship with a decrease in pressure. As you release the pressure from the crude, you make the oil less

viscous, and cutting its viscosity allows it to flow more easily. You have got the expansibility of the reservoir rock, as you decrease pressure on the rock in a reservoir. We have a reservoir here of 12,000 feet, you decrease the pressure on that rock, the rock expands, squeezing more oil out of the pores. You would have connate water expansion, the connate water from the reservoir would expand. All these things would be factors that would help increase ultimate recovery with a decline in pressure. If we can draw the pressure down we will get more oil out.

Q Mr. Currens, I will ask you to put up Pan American's Exhibit 8.

(Pan American's Exhibit No. 8 marked for identification.)

Q What is Exhibit No. 8, Mr. Currens?

A Exhibit No. 8 is designed to show the increased oil recovery that we can get from this reservoir as a result of oil expansion, simply by increasing the reservoir volume factor as we lower the pressure.

Q All right. Let me direct your attention to the extreme right portion of that reservoir and ask you what that set of curves thereon represent?

A Well, on the extreme right we show three curves on this figure. The top one is the reservoir volume factor, which shows that as the pressure decreases the oil expands, the reservoir volume factor increases, oil viscosity,which shows as the pressure is

decreased the oil becomes less viscous and can flow more easily; and a rock expansibility curve which will show that as the pressure is taken off the reservoir rock, it too will have a certain expansion.

Q All right, now I direct your attention to the portion of the exhibit shown in red and marked Figures I, II, and III in Roman numerals. What do they reflect?

A Figures I, II, and III here are designed to show the increased recovery that we can gain from this reservoir as a result of raising the reservoir volume factor, expanding the oil, and driving it out as we reduce the pressure.

Q Go right ahead with your explanation.

A Well, looking here at Figures I and II, they're identical with the exception of the pressures shown on top of them. We can say that they represent the reservoir. Looking at Figure III, this is what we might call a combination figure, since it will reflect the recovery under these two conditions as shown in Figures I and II. Now with a fifty percent recovery factor, we will produce fifty percent of the oil, we will leave a residual oil saturation of fifty percent.

Q Excuse me, Mr. Currens, what do you mean by residual oil?

A Residual oil,saturation of residual oil is that oil that is left behind in the reservoir. Now we depict residual oil on the exhibit as the portion cross-hatched; the recovery is the portion shown in red not cross-hatched. If we were to get this reservoir with a pressure maintenance where the pressure stayed essentially

what it was on the 1st of January, 1958, or approximately 4375 pounds, we would produce this amount of oil shown in Figure III as colored in red, not this part that is cross-hatched, just the part colored in red. That would represent some thirty-four and a half million barrels of oil. Now taking another condition, at abandonment pressure of 2820 pounds, I have used that figure on a previous exhibit, taking the abandonment pressure at 2820 pounds we can look over at Figure III and we can see that in addition to this solid red amount of oil, the thirty-four and a half million barrels of oil, we will get some of this oil that is cross-hatched. This is what would be residual oil that we have squeezed out of that reservoir as a result of lowering the pressure, increasing the reservoir volume factor, and expanding the oil.

Q All right, what is the magnitude of the increased oil recovery under your two pressure situations that you have set up that would result from the increased reservoir volume factor?

A This additional oil that would be residual that we would recover?

Q Yes, sir.

A That is in excess of 260,000 barrels. That is over three-quarters of a million dollars' worth of oil that we can recover that we would normally leave behind if we maintain pressure, but we can recover if we drop the pressure to 2820 pounds.

Q That takes care of one of the factors you mentioned. Would you not only expect an increase due to the other factors you described?

A Yes, sir, you would have to expect certain other bonuses over here. I have only used reservoir volume factor because it lends itself to the most precise calculation. Certainly we have the viscosity improvement, the oil is less viscous and can flow more easily, has a better chance of being recovered. The rock expands, which will help squeeze more oil out of the pore spaces. I mentioned one previously in addition to these, the connate water, that will help some, too. These are bonuses in addition to what I show here, three-quarters of a million dollars' worth of oil.

Q As I see the problem that is before this Commission here today, it's concerned with the problem from their standpoint of waste from an individual well standpoint and from a reservoir standpoint. Now let me ask you this. Based on all the data that you have analyzed and evaluated on this entire Devonian reservoir, have you seen anything that indicated to you that the reduction of the allowable in this field would serve conservation?

A No, sir, I don't. I see nothing that would cause that to serve conservation.

Q On the contrary, would a reduction in allowable in this Devonian water drive reservoir actually be a dis-service to conservation?

A I think that by reducing the allowable, of course we are going to have to force the pressure up and cause a certain amount of maintenance of pressure in the reservoir, and that if we maintain pressure in the reservoir, we are going to leave behind oil

that could otherwise be recovered. If we can bring the pressure down, we are going to get the most out of the field.

MR. BUELL: That's all we have at this time.

MR. PORTER: Anyone have a question of the witness? Mr. Easley.

CROSS EXAMINATION

By MR. EASLEY:

Q Mr. Currens, you've testified that this unquestionably is a water drive field?

A Yes, sir, I believe it is a water drive field.

Q Water drive reservoir. As far as a water drive reservoir is concerned, I will ask you if it's a fact that the oil naturally goes before the water or above the water?

A Yes, sir, that is generally true.

Q Is it true also that as you remove the oil from the well bore that by virtue of that you reduce the pressure, thus bringing the other oil in with the water forcing it on in, the oil naturally coming before the water?

A As I understand your question, you are saying that as we produce oil from the field, water comes along behind it?

Q Yes, sir.

A Yes, sir.

Q That is a natural consequence in a water drive reservoir?

A Yes, sir.

Q And now, in this particular reservoir here, do you have

considerable amount of water?

A Being produced?

Q Yes. No, I'm sorry, in the aquifer.

A I think there is a pretty large aquifer there, yes, sir.

Q In the dry holes that have been drilled around the area, have you had any experience with those?

A I've looked through the reports and records on them.

Q Do you find water in those dry holes at approximately the level, the water-oil contact that you find in the reservoir?

A Yes, sir. That generally would be true, particularly on the east side of the field.

Q Let me ask you directly, do you know from your experience in the field and from the knowledge that you have of the wells that have been drilled whether or not you have an unlimited supply of water in this reservoir?

A No, sir, I don't know that we have an unlimited supply of water in the reservoir, in the area.

Q Would you say that you have a sufficient supply of water in this reservoir to produce the oil in place?

A I think we have a substantial amount of water there, yes, sir.

Q Would you say that you have a strong water drive in this reservoir?

A Yes, sir, I would say that there's certainly the effect of a water drive being seen here.

Q Would you say that is your principal drive?

A Well, depending on what you mean by "principal drive". Now the principal drive, of course, is going to be that we will have water coming along behind the oil and pushing it ahead of it. Now the thing that we would like to do, of course, is keep a big pressure or certain pressure differential between it.

Q Ordinarily in a water drive field don't you have a sustained pressure? You don't have a real drastic drop in pressure as you would in a depletion drive field?

A No, sir, you don't expect to get as big a pressure drop in a water drive field.

Q You have indicated in your exhibit, is that No. 8?

A This is No. 8.

Q You have elaborated on the expansion of the oil as you remove the oil from the well bore,and expansion of the fluids,as being a drive for the production of the field?

A Yes, sir, it will help drive, it sure will.

Q Now you have approached this right here from the standpoint of how much will be produced by an expansion drive, expansion of the fluids in place?

A Yes, sir.

Q Now this hasn't been on consideration of the additional water drive behind this oil pushing it before it, pushing the oil before the water?

A Are you talking about the increase that we would get as a

pressure drop?

Q Yes.

A No, sir, that is only the increase we would get due to the pressure drop by expansion of oil.

Q In other words, you have ignored the question there, or have eliminated the question from your consideration as to whether or not the water would produce that oil anyway, if you have a strong water drive?

A I don't believe it could produce that additional oil there.

Q Well now, suppose you explain why the oil would not be forced ahead of the water, if you have a strong water drive.

A Well, it ties to your residual oil saturation. We have to leave so much residual in the reservoir. If we leave fifty percent oil saturation, it is simply a case whether we want to leave behind compressed oil or expanded oil. If we can leave expanded oil, oil under less pressure, certainly we leave less behind and produce more. If we maintain the pressure, we keep the oil compressed, that it can't expand, it can't help.

Q Suppose we consider this point in this reservoir, now you are talking about an ideal situation, aren't you?

A This could easily happen. I am not saying it will. I'm saying we should give it the opportunity, I think it can.

Q In other words, the substance of your statement here to the Commission is that you could produce this at an unlimited allowable, say a thousand barrels a day, and by virtue of reducing the pressure

that you are going to produce more oil?

A I'm not recommending a rate, but I think we can go to substantially higher rates than we now have and it won't hurt us.

Q Let's say how far can you go? You are saying that the pressure can be reduced, and because you reduce the pressure that you are going to have more in the way of an ultimate recovery. Let me ask you this question. If you produced it at the rate of 2,000 barrels a day, do you think that because of the reduction in the pressure you would have more in the way of an ultimate recovery?

A Well, I don't think we could ever see 2,000 barrels a day from this field, the situation being what it is. That would be an awfully high basic normal unit allowable. I don't care to set a number on the upper limit that we could produce this field. I think we can do it at substantially greater rates than we are now.

Q The theory that you have advanced here, that the problem of getting ultimate recovery depends on reducing the pressure; the maximum ultimate recovery depends on reducing the pressure, if possible, down to the bubble point?

A If we could possibly reduce the pressure in this field to the bubble point and even below, we would realize the maximum oil recovery from this field, in my belief.

Q Now, Mr. Currens, there are other factors which enter into each individual case which might limit the application of your theory, aren't there?

A You talking about for an individual well?

Q I'm talking about the reservoir.

A Would you state that again, please?

Q Your theory of reducing the pressure being the point which makes for more ultimate recovery varies with the situation, doesn't it?

A You mean --

MR. BUELL: I can't understand, may it please the Commission, what the situation is.

MR. PORTER: Just a minute.

MR. EASLEY: Excuse me, I didn't know I was being so obscure in my questioning.

Q What I'm driving at, Mr. Currens, is that the idea of dropping the pressure may not work in every instance if there are other factors like the premature encroachment of water to prevent the oil recovery?

A I think if you had a field where there was premature encroachment of water, that what you say might be true, but I don't see any premature encroachment of water in this field. We are talking about this Gladiola Devonian reservoir, I think that it is reacting just as it should, and if we could draw the pressure down we would increase the recovery.

Q Now in what manner do you propose to reduce the pressure?

A Well, sir, I wasn't advocating that we go in for some method to bring about a greater pressure reduction. All I'm saying is that there is no point in keeping the pressure up. If we're experiencing

a pressure drop by producing at the normal rate that this reservoir would be assigned, that this field would be assigned, if then we are getting a pressure drop it is helping us.

Q With regard to a water drive field, would you state whether or not it is rate sensitive?

A This field?

Q Any water drive field. Generally would a water drive field be rate sensitive?

A I couldn't testify on any water drive field, but I don't believe that this field is rate sensitive.

Q What did you find the gas-oil ratio to be here?

A Solution gas-oil ratio?

Q Yes.

A It is in the neighborhood of 175 cubic feet per barrel.

Q Is that a high or low ratio?

A That is very low gas-oil ratio.

Q In cases where you have a low ratio of gas, do you have a considerable amount of expansion or a lower rate of expansion of the oil in place?

A Possibly I could clear this up by saying that these data were taken from a bottom-hole sample that we obtained in this field, and run by our laboratory, so these are actual data pertinent to the crude in this reservoir.

Q Are you talking about --

A (Interrupting) The reservoir volume factor, the viscosity,

actually we didn't have a piece of reservoir rock in original conditions, this is a curve that you'll find in A.I.M.E. transactions as a typical carbonate curve for rock expansibility.

Q Those were actual tests that were run on the oil and rock?

A Yes, on the oil.

Q On the oil?

A Yes.

Q Excuse me, what did you say about the rock on the bottom?

A I said it is a typical curve as taken from A.I.M.E. transactions. I didn't make a calculation on that because it wasn't exact reservoir data.

Q With regard to a water drive reservoir such as this, is it possible that the fast rate of production will bring the water through the permeable rock and bypass some of the oil?

MR. BUELL: May it please the Commission, what advanced rate of production?

MR. EASLEY: I'm trying to get at this as theory.

MR. BUELL: I don't want to interrupt you any more than I have to, but I would like to be able to understand the question, and some of these I'm having a little trouble with. I apologize for interrupting.

MR. EASLEY: I'm sorry. I'm struggling with this engineering, I'll have to admit.

MR. BUELL: I know what he's going through.

Q (By Mr. Easley) Let's ask this question, if I can rephrase

it. In say the edge wells in this particular field, do you recognize that any rate of production might possibly cause premature water encroachment and leave oil in the formation?

A Well, by premature water encroachment, do you mean something like coning?

Q That, and then bypassing the oil in the formation.

A I don't believe we could bypass the oil in the formation even on these edge wells that we're speaking of, and I really don't think we could have any coning in this reservoir.

Q In other words, what you are saying is that you could produce it at any rate and you wouldn't have --

A (Interrupting) What I am speaking of there is any rate that we are liable to be granted as an allowable as a result of the normal unit allowable in this study.

Q But in other words, you recognize the principle that in a water drive field that you can produce it so fast that you commit waste in the reservoir?

A It depends on the reservoir conditions, the type of completions and things like that. Yes, that could be a case, but I don't think so in this field.

Q With reference to this field, what studies have you made with regard to the permeability of the formations?

A Well, sir, of course, we had the core analysis that Mr. Landua presented, we have core analysis on a well that we operate.

Q Have you arrived at any sort of idea about the average

permeability in the entire reservoir?

A I don't have the figure on the tip of my tongue, I could give you a pretty good idea if you want me to look at it.

Q Never mind that, I am asking if you did.

A Yes, I had an idea.

Q On the basis of the analysis of those two cores?

A Yes, sir.

Q You haven't made an analysis of any other wells in the field?

A I have information that people have told me. I don't have access to any actual, other core data myself, as such.

Q On how many wells do you have the data?

A I have the data, of course, on the well that Mr. Landua presented and Texas Crude A-19 No. 1, I believe it is, Pan American operated well.

Q How many cores have you the data on?

A Those two.

Q And on the basis of that you have arrived at what you think is the average permeability in the reservoir?

A No, sir, I said that what the average of those two might be, I looked at it and got an idea, yes, sir.

Q And that's part of the basis on which you have estimated the reserves and the amount of recoverable oil?

A The reserves are not normally estimated on the basis of permeability, Mr. Easley.

Q I'm sorry, but isn't that figured in as far as determining

the amount of recoverable oil?

A You want to know where I have my recovery factor?

Q Yes.

A I took an average recovery factor for a Devonian reservoir, a normal expected recovery factor for a water drive field.

Q It isn't keyed to this particular reservoir?

A No, sir, but it is certainly reasonable.

Q That is the basis on which you estimated that there would be 35.5 million barrels?

A Thirty-four and a half million barrels, yes, sir.

Q Is there homogeneity in the reservoir?

A This reservoir, of course, I have -- no reservoir is completely homogeneous, there are certain localized conditions that can be found spot-to-spot in any reservoir that you would find. I wouldn't say that this is an untypical reservoir.

Q Untypical Devonian reservoir?

A I said I would not say it was. I would say it was probably typical.

Q Did you have any analysis, did you analize the porosity as far as these cores are concerned?

A Yes, sir.

Q I'm wondering, I might ask you this, if we could have those as a part of the record.

MR. EASLEY: Do you have those here?

MR. BUELL: By "those", Mr. Easley, what do you mean by "those"?

MR. EASLEY: The analysis of the cores.

MR. BUELL: One of them is already in the record, and the core that we have on our well, we don't have it here but we will be glad to furnish it. You put one in the record?

A Yes.

MR. EASLEY: That would be fine.

Q (By Mr. Easley) You also have analyzed the fluids, in other words, the oil?

A Our laboratory did, yes, sir.

Q And do you have those with you?

A The curves that are pertinent here were drawn from those data.

MR. EASLEY: I'm wondering if we could also request that the data be put in the record.

MR. BUELL: We will be glad to furnish any data that we obtained from the bottom-hole samplings, a part of which is reflected on the two uppermost curves of Pan American's Exhibit No. 8.

MR. EASLEY: Thank you.

Q (By Mr. Easley) On your pressure chart there, reservoir pressure, it is No. 7?

A Yes.

Q Exhibit No. 7. Mr. Currens, on that you have shown the reservoir pressure versus cumulative oil production, and you have extended the curve there, up to the point that is shown to be nine million barrels produced; now that represents the oil produced?

A Yes, sir, that's oil recovered.

Q Now you have extended your curve on the basis of the amount of oil produced there?

A Sir, all I have got on that curve is to draw the line on out from the last trend that we have, following the trend out to my predicted recovery.

Q Would the increased production of water have any influence on that curve?

A Well, I didn't consider anything there. I just drew the line on out from the trend it now has. I'm not trying to predict anything there.

Q In other words, you are not representing that will be the --

A (Interrupting) No, sir, I am not saying that will be the reaction of the reservoir.

MR. LANDUA: That just so happens to be my total reserve prediction.

MR. EASLEY: May I ask permission for Mr. Landua to repeat the question? What was your question?

MR. LANDUA: My question was that in Mr. Currens' analysis he estimated that he would recover thirty-four and a half million barrels by some other means, and projected from his last pressure point on to the reservoir figure?

A That simply is a projection of the last trend;that covers some four or five points to that reserve, it's not a prediction.

Q You have stated here that the chart which is represented by your No. 4 Exhibit, I believe you said that these figures were

taken from Mr. Landua's report of the bottom-hole pressures?

MR. BUELL: By "these figures", Mr. Easley, what do you mean? There are several columns.

MR. EASLEY: Yes, I am sorry.

Q These figures with regard to Mr. Landua's report of the per pound pressure drop for the production of the oil in the last column. Now those were taken from his report?

A Those numbers are the ones that he showed on his exhibit.

Q I notice that you duplicate the dates over here --

A Yes, sir.

Q -- on which he took the bottom-hole pressure surveys, is that correct?

A Yes, sir.

Q And then will you explain to me how you related those to the other bottom-hole pressure surveys that were made in the field?

A Well, if I have your meaning correctly, here, you say what pressure did I use for the cumulative production?

Q Yes.

A I have shown the pressures that I would find at that period of time on the figure which was Exhibit 3, was it not?

MR. BUELL: Yes, 3.

A Or the performance time curve. On these dates I have come up to fieldwide pressure curve and taken the pressure that would be reflected by that pressure on those dates.

Q Your testimony is that you don't think that is representative,

that that is significant at all in the determination of the production of the oil?

A That those pressures?

Q Yes.

A Sir, all I have said about this exhibit is that it only reflects how much oil was produced for some period of time with a certain amount of pressure drop. I don't really see where it has any further significance than that, just a factual report of what happened at some period of time.

Q You are not attempting to show that this would be the per pound drop, then, of pressure over that period of time?

A You mean that this would be the oil produced over that period of time?

Q Yes.

A Well, sir, this is the incremental oil production for that period related to the pressure as shown on the curve in Figure III for the field-wide pressure for this field.

Q But it's your testimony that you don't think that either one of the figures is significant?

A No, sir, I don't think either one of them is significant.

MR. LANDUA: May I interject a question here? I want to be sure, Mr. Currens, that these pressures are at what datum?

A Which pressures?

MR. LANDUA: The pressures on your chart.

A The pressures that are the field-wide survey are at minus

8,000 feet, which is the datum for the Commission. The pressures shown for Mr. Lowe's wells are just exactly as you have reported them to the Commission, 8150. The pressures as shown here by the six wells of Pan American are at 8,000 feet.

MR. LANDUA: There may be some discrepancy in your data because you made the statement when our well was brought in that it had pressure that was tied in with the field-wide pressure. The pressure we measured was 4808 at minus 8150.

A Yes.

MR. LANDUA: You corrected the pressure back to 8,000 feet in your statement?

MR. BUELL: I requested that they be shown that way on this exhibit because I thought it would eliminate confusion that might be created if we converted them to a common datum. For that reason we plotted them exactly as he reported them. It seems that we may have caused confusion rather than saving confusion.

MR. LANDUA: He took the pressure that we measured in the discovery well when he made the statement that the pressure in our well, even though two miles from the other production, was the same as the pressure that existed in the south quarter at the time.

MR. BUELL: The question was, did it come in at approximately the same range. His answer was yes. Surely you agree with that, Mr. Landua, that it did come in at the approximate pressures of the older wells.

MR. LANDUA: If he made that at the same datum; if he didn't,

there would be about 100 pounds difference.

A Pardon?

MR. LANDUA: If you corrected our pressures back to your 8,000 datum.

A Yes, there would be how much?

MR. LANDUA: If you made your correction, if you took our 4708 and corrected it back to the 8,000 foot datum.

A Yes, sir.

MR. LANDUA: Then I would say that the range would be right. Do I make myself clear?

A I'm afraid I didn't follow you, really.

Q (By Mr. Easley) Would you get the exhibit there and point it out, in which you indicated the wells that were producing water?

A Yes, sir, this is Exhibit No. 6.

Q I'm wondering if you would point out the wells on that map that your company operates that are producing water, and indicate the percentage of water, if you know.

A The Pan American State No. 1 in Section 19 and the State "AN" No. 1 in Section 19 are water producing wells. I don't recall the exact figures on them, it seems like one is about fifty percent and I don't know that the other is significantly different, right off-hand. I could check and see.

Q In other words, both of them are producing about fifty percent water?

A Well, one of them is, I believe. I can't think of the figure

on the other.

Q Can you say off-hand when those wells were drilled?

A I can look it up for you.

Q Does that show on the map?

A No, sir, it doesn't show on the map.

Q Well, suppose we wait on that and then you can supply it later.

A All right.

Q Do you know about the water production in the other wells along there? Are those the only two that you have that are producing water?

A The water production that we reflect on this map is the water production as reported by the operators to the Commission for January and what other operators have told me that their wells were producing water in February. They are taken from engineering committee records.

Q Do those records show it in percentage?

A No, they show it by barrels.

Q By barrels?

A Barrels of oil and barrels of water.

Q Have you made any study of the balance of materials or the amount of water that is coming in as compared with the amount of oil that is being taken out in the reservoir?

A Well, sir, we have only had cumulative water production, and you have something on the order, as I recall, about the first

of the year, of around 100,000 barrels. We produced nine million barrels the first of the year.

Q Does the decrease in pressure indicate that the water drive is keeping up with the withdrawal of the oil?

A Well, if you had it absolutely keeping up with the withdrawal of the oil, you would have absolute pressure maintenance.

Q Does that indicate that there is any absence of permeability that prevents the water from coming in to push the oil forward? Is there anything significant about that?

A Well, let's look at this. If we have a large connected aquifer to that field, that thing has a lot of inertia in it, it takes some time in a water drive field before water shows up. You expect to see it show up, certainly, because it is a water drive field. You shouldn't produce water with the first drop of oil you produce from a water drive field.

Q Now your statement that it's good for the pressure to drop depends upon whether or not you flood the wells out, isn't that correct? If you are going to decrease your pressure to the point where you flood some wells out, then that would not be economic recovery, would it?

A You mean that by decreasing the pressure, suck a whole lot of water into the reservoir?

Q Yes, or suck a whole lot of oil out.

A Out of the ground?

Q Yes.

A That is recovery.

Q I'm talking about the ultimate recovery.

A I think the only way we can effect the maximum ultimate recovery from this field is to get the pressure down as far as it will go. Anything we do to keep the pressure up is going to deplete the ultimate recovery and leave more oil behind.

Q At the expense of producing a lot of water in some of the other wells?

MR. BUELL: I wonder if you could be a little more definite. I think Mr. Currens is trying to answer your questions.

MR. EASLEY: Let me try again.

Q In the event that the allowable is held up to the point that it is now, say 223 barrels, but that as a result of that that the water is prematurely drawn into wells in the reservoir, do you think in your judgment that the reduction of the pressure or the allowable is justified?

MR. BUELL: May it please the Commission, this witness has already testified that in his opinion coning does not exist in this field and would not be created producing at any foreseeable normal unit allowable for the State. He has already answered that question once.

MR. EASLEY: It is a hypothetical question.

MR. BUELL: You want him to assume that you have coning?

MR. EASLEY: Yes.

A You want me to assume you have coning?

Q Or premature edge water being pulled in because of the rapid withdrawal.

A If I were to assume that water production was premature, which I don't think it is, but if I were to assume that water production was premature, then I would have to assume that that condition was unfavorable.

Q Then your theory of reducing the pressure is predicated on the fact that you have to avoid the premature production of water?

A I don't think we have any premature production of water in this field.

MR. EASLEY: If the Commission please, may Mr. Landua ask a question or two here?

MR. PORTER: Surely.

By MR. LANDUA:

Q I would like to start with the Exhibit 3, that is the one I would like to ask you a few questions about.

A Performance time.

Q Yes.

A Yes.

Q Mr. Currens, isn't it the usual practice whenever you plot your performance curve on a reservoir to go ahead and include the water production as well as other production?

A Well, sir, we have -- are you talking about, say here on cumulative?

Q I'm just wondering why the percent water or the amount of

water taken out of the reservoir hasn't been depicted on your curve?

A Water production is very small. If I were to put it, say the cumulative water production on the cumulative curve, you couldn't see it.

Q You could have a large scale on the side to depict the increase in water that has occurred?

A Yes, it wouldn't be on the same scale, it wouldn't be a fair comparison.

Q I understand that, but your pressure is on a different scale, too. It is possible to put it on?

A Yes. I have the figures, if you would like them.

Q I have them, too. I just wondered why they weren't shown on the curve.

A They were rather small amounts and I didn't show them because they would hardly show.

Q Good. You made the statement, I believe, that this barrel per pound drop was not any measure of the efficiency at which a reservoir was being produced?

A I think that only says that this reservoir did that at that time.

Q Then on down in your testimony, you use these figures on Exhibit 3 to say that you thought the reservoir efficiency was being increased?

A No, sir.

MR. BUELL: Hold it. May it please the Commission, Mr.

Landua must have missed this, and I am sorry; but I specifically asked him to assume for the purpose of this question that that is a valid engineering tool to use, and it was on that assumption only that he said, with that assumption, from 2,000 to 2,200, that assumption, that would be good efficiency, but he assumed that, Mr. Landua, that is not his opinion.

MR. LANDUA: He believes that the barrels per pound drop is no measure.

MR. BUELL: He testified to that, over a short increment of time. When you look at the long life of a reservoir, he testified it isn't a valid basis to drawing an engineering conclusion to reservoir efficiency and what you might expect in ultimate recovery.

Q (By Mr. Landua) Now he said that the efficiency was being improved, if you assumed that was a measure; now your first increment of 43,900 barrel per pound drop, and the last one, you only have 20,200?

A We were only --

Q Would you assume from those figures that the reservoir was being produced half as efficiently as it was in your first increment?

A Well, sir, we were only discussing the last two points in here.

MR. BUELL: I don't believe either Mr. Currens or myself understood that question, if it was a question.

Q Exhibit 3 --

A Exhibit 4.

Q Exhibit 4, the question is, in the first pressure increment that you report by your figures you say that 43,900 barrels of reservoir oil was obtained for each pound drop in bottom-hole pressure?

A Yes, sir.

Q Then on 12/1/57 for that increment you say that the barrels recovered for each pound drop was only 20,200?

A Yes, sir.

Q Is it your assumption or conclusion here based on these figures that this reservoir was being produced half as efficiently?

MR. BUELL: Pardon. May it please the Commission, I believe that I can clear that up. My hypothetical question, Mr. Landua, and the question on which I asked him to assume the validity of such a calculation from an engineering basis, was on the last two figures, the last two increments of time.

MR. LANDUA: Was there any reason for forgetting the first one?

MR. BUELL: No, I would be glad to ask him that, it is meaningless.

MR. LANDUA: We shouldn't be taking up time with meaningless things.

MR. BUELL: Very simple calculation, it didn't take five minutes.

Q I think that what Mr. Easley was trying to establish in Mr. Currens' testimony on reservoir pressure drop, we believe that

as the reservoir pressure is drawn down significantly in this reservoir, that it's conducive to water encroachment of one nature or another, and that much oil would be bypassed, much more than would be gained by his theoretical expansion of 276,000 barrels for that reservoir.

MR. BUELL: May it please the Commission, it appears Mr. Landua is doing more testifying than asking questions.

MR. MORGAN: I agree. I think it ought to be placed in the form of a question. Ask him if he agrees with that.

MR. LANDUA: Thank you.

Q Mr. Currens, would you say that if you produced this reservoir at a thousand barrels a day per well that you would cause waste?

A I don't think we'll ever have to look at producing this reservoir at a thousand barrels of oil per day per well, so I don't know.

Q Okay. You are of the opinion that it's impossible to bypass oil and have coning in this reservoir?

A In this reservoir, yes, sir.

Q No matter what producing rates you would have?

A I don't think you'll leave behind any oil that should be recovered, no, sir. Beg your pardon, sir, you said with what producing rates you had?

Q Yes.

A Any reasonable producing rate that we would have, anything

that we might expect as a normal allowable for the field.

Q Would you take Exhibit 6, the one that has the structural map of the water wells?

A Yes, sir.

Q Would you count for me the number of wells that you would consider edge wells in that reservoir, from your structure map?

A I would say sixteen.

Q Edge wells?

A Oh, edge wells, total.

Q Not water edge wells.

A Total edge wells, I may have missed one, but I got about thirty-eight there.

Q Thirty-eight out of a total of how many you consider in the field?

A There is something in exces of ninety, I would say right now.

Q In other words, about four-ninths of the total wells in the field are some type of an edge well?

A Yes, sir, the field is rather long, so we have a big periphery.

Q So whenever we have happenings to an edge well, we are talking about four-ninths of the reservoir?

A Yes, sir, if you want to say that. We are not talking about four-ninths of the reservoir, we are talking about four-ninths of the wells.

Q Four-ninths of the wells in the reservoir. In your opinion

can we completely ignore edge well happenings whenever we analyze this reservoir?

A No, sir, we can't, and that is why I think the reservoir is acting as it should, the edge wells make water. I don't know what else you would expect. Edge wells and low structural wells make water in water drive fields.

Q In examining your plat, I think you will see that some of the edge wells are making water at a higher interval than some wells located in other productive limits of the field. Is that unusual?

A No, sir, because if you get on the edge of the structure, let's say that you have a triangular sort of thing on the edge of a structure, if that's clear, you don't have as much oil on those edge locations as you have farther up-structure. You produce so much oil out of a well. You have voided that much reservoir space.

Q Even though that structure, even though the location of a pay is higher than it is at some well within the limits of the field?

A Depends on what you have as the entire volume underneath the well. You have got a smaller volume, so as you produce, your water has to come up somewhat higher.

Q Let's assume for the minute that the wells in this terrace-like part of this large structure of ours would go to 100 percent water and be washed out. Would the recovery of the 600-acre part of the field that is so thick be increased appreciably?

MR. BUELL: Do you understand that question, Mr. Currens?

A I wanted to ask him which was the terraced and which was the 600 acres.

Q I'm talking about in the northern part of the field, that is relatively flat.

A This part here, on north and this part on down south, from say here to here?

Q Not quantitatively in any way,but do you think that you would get more oil if the low thin wells would be washed out?

A In both ends of the field, up here in what you are calling the thinner end of the field, you have some good structural relief, you are coming up-structure. If the oil moves, it has to move that way, so I don't see where you would leave any oil behind that you would recover, as these wells are depleted, their methods of getting more oil or less out of them. I think you will get more if you drop the pressure.

Q If we drop the pressure and would cause premature coning, which we think happens?

A I don't agree with you. I don't believe there is premature coning in this field.

Q But the oil that would be left in the relatively thin area would be recovered in some other part of the field, in your opinion?

A Well, if the oil is left, it can't be recovered. If you are talking about recoverable oil, I believe that the -- you have got to expect in a water drive field wells to go to water and to

be abandoned because they have produced their proportionate share of the recoverable oil in place. Any oil that is ahead of that would move on forward and be produced. I don't think you are going to bypass any.

Q In your opinion, then, there's nothing that could be done that would cause you to bypass oil in any one of these well bores in this reservoir?

A No, sir, I wouldn't say nothing.

Q Something happened in Lawton State 2?

A Yes, sir.

Q We left some oil, we were lucky enough to do a workover and try to get it. You testified, Mr. Currens, that the reservoir pressure in our discovery well was in line with field average?

A Yes, sir.

Q How could that pressure have been drawn down, since there was no wells in that area?

A Well, as I recall the well came in at 1955, and the field was discovered in 1951. There's a long period of time.

Q Are you saying there would be drainage of oil from that area to the south?

A I would say there was an equalization of pressure between the two.

Q The only way you could equalize would be to have some travel fluid?

A If you had equalization of fluid, you would have expansion

of fluids, too.

Q It would have to travel?

MR. BUELL: What was that?

Q If the oil had to travel from the north end to the south end to cause the pressure drop, for our pressure to be in line with the field average pressure at the time?

A There would have to be a pressure average across the field. The pressures in the field reflect the drainage from the reservoir, of course.

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

MR. PORTER: Anyone else have a question of the witness? Mr. Nutter.

By MR. NUTTER:

Q Mr. Currens, to what do you attribute the change in the barrels of oil obtained from the entire pool as of the bottom-hole pressure survey taken in December of 1956, the figure being 44,000 barrels of oil per pound drop, as compared with 8,800 barrels per pound drop in April of 1957?

A We produced more oil. We had less pressure drawdown. There were very few completions, or not nearly so many completions in the field at the first interval of time as at the second interval of time, which of course is going to have to be a reflection of this, too, as the actual numbers are.

Q Do you think that the completion of additional wells caused the recovery of less amount of oil per pound drop from December of

'56 to April of '57?

A Well, I can't really give much credence to these numbers, it is just a mathematical computation, where we have taken the amount of oil and the pressures for the period. I don't really see where it says anything more than that. I don't think it is a reflection of anything, particularly.

Q You attach no significance whatsoever to the number of barrels of oil that are produced per pound of reservoir pressure?

A Not over these increments of time, no, sir, these small increments.

Q You think the increments of time are too short in these comparisons here?

A Well, you have very short periods. Well, not very short, but you have short periods of time in this, one of them is about eight months. It's just a factual statement there, that during this period of time so much oil was produced. When we started we had this pressure and when we ended we had this pressure. I don't really know much more to say about that than that.

Q What causes the change in pressure in the reservoir?

A Well, certainly withdrawals would be a function, have something to do with it.

Q Do you attach any significance whatsoever to the last three figures on the right-hand side column on your Exhibit 4, being the amount of oil that was recovered per pound drop from June to August to December of 1957?

A I don't attach any significance to these numbers.

Q Mr. Currens, on your Exhibit No. 6, you depicted the water producing wells with blue circles, is that correct?

A Yes, sir.

Q What did you say was your estimate of the oil-water contact in this pool?

A I think it's approximately 8150 plus or minus, say 10, 15, feet.

Q Are all of these water producing wells completed in an interval that falls below that oil-water contact?

A Below it?

Q Yes.

A Of 8150?

Q Yes.

A No, sir.

Q What is the reason that they are producing water?

A Well, we have edge wells. As I have said before, you are on the edge of the structure, the structure is coming up, you have less productive area to void the smaller average oil column over your entire 40-acre lease. It is what I would expect, you withdraw oil and water comes in.

Q Now, the Lawton State No. 2 well up in Section 32 in the north end of the pool --

A Yes, sir.

Q What was the interval of completion on that well?

A Original?

Q Yes, sir.

A Minus 8117 to minus 8157 are the numbers I have.

Q Did that fall within or did the interval of completion on that well fall below your pick of the oil-water contact?

A Minus 8157 would be below minus 8150, yes, sir.

Q I don't know if you made any statements of your opinion as to why that well went to water or not. Do you have any opinion as to why water was produced in that well?

MR. BUELL: I have no particular objection if Mr. Currens wants to answer that. Actually, insofar as I know we have been offered nothing in the way of evidence that would even show that it was producing Devonian water, so until you know the source of your water it is pretty hard to analyze its performance. We see nothing that would preclude it from being water from up the hole.

Q Are you acquainted with the manner in which the well was worked over?

A Generally, sir, I believe by the information that Mr. Landua presented to Pan American.

Q Would the manner in which the well was worked over cause you to think that the water was from any source other than the Devonian?

A No, sir, I don't necessarily believe it would make it look like it came from anywhere else.

Q Do you think it was Devonian water?

A It very likely could have been, yes, sir.

Q Do you have an explanation for what Devonian water was encountered in that well overnight?

A I don't really know, it was an unusual factor in this field. However, it has now been cured because instead of 100 percent water that well now produces 100 percent oil, according to our information.

Q Mr. Currens, on your exhibits -- you don't have to turn to them, I can refer to them.

A All right, sir.

Q Exhibits 3, 5, and 7, in which you show various reservoir pressure statistics --

A Yes, sir.

Q -- for the pool as a whole?

A Yes, sir.

Q You show pressure declines and so forth, versus producing weight, cumulative oil production, and such other things?

A Yes, sir.

Q Do you think that you would have had the same curve if you had been dealing with the two pools separately, as you have with one curve representing the entire pool?

A I really couldn't say. I don't know, Mr. Nutter. I hadn't looked at it in that way.

Q Is there substantial variation in the thickness of the pay in the two parts of the pool?

A Well, yes, sure. There's a portion of the south that is

thicker than the north, certainly.

Q Would you expect pressure decline at a given rate of production to be greater or lesser in an area where the pay is thicker or thinner?

A It would depend on the type reservoir, of course. I think that very possibly where the pay is a little thinner, you could draw the pressure down a little bit faster.

Q So you think you might have a pressure decline in the north end of the pool?

A Yes, I think very likely that the pressure might be, well, in looking at the pressure surveys, field-wide pressure surveys in the field seem to indicate that slightly lower pressure in the north end than in the south.

Q Now, Mr. Currens, you made the statement that with the consideration of reservoir volume factors, viscosity of the oil, expansion of connate water and such --

A Yes.

Q -- that you feel the pressures in the water drive pool such as this should be dropped as low as possible?

A In this field I think it should be, yes.

Q Is this a theoretical observation or a fact that has been proved?

A Well, sir, of course, we can't go past the basic allowable rate here, but I firmly believe from the physical facts involved that by drawing the pressure down we will get more oil recovery.

Q Has this ever been substantiated in field tests?

A I couldn't cite one right off-hand, no, sir.

Q Do you feel that a pressure maintenance program such as is conducted in the East Texas Field is in error, then?

A I'm not familiar with the East Texas Field. I think that the most desirable method and means of producing a reservoir, particularly a water drive reservoir, let me say, is to drop the pressure to slightly below the bubble point pressure, establish a small residual gas saturation, and produce it at a pressure maintained below the bubble point pressure.

Q But you also stated that it was impossible to drop this field below the bubble point?

A Yes, we will never get this far here, unfortunately.

MR. NUTTER: I believe that is all. Thank you, Mr. Currens.

MR. PORTER: Mr. Kellahin.

By MR. KELLAHIN:

Q You have referred to the water-oil contact as being 8150 feet. Is that the original water-oil contact in the pool?

A I would have to say it would be somewhere in that neighborhood.

Q Wouldn't the withdrawal, something in excess of nine million barrels of oil, have any effect on the water-oil contact?

A You should have a rise, it might be evidenced in different places in different ways.

MR. PORTER: Does anyone else have a question of Mr. Currens?

MR. LANDUA: If it please the Commission, I would like to

ask one more.

MR. PORTER: Mr. Landua.

By MR. LANDUA:

Q In your opinion in this type of reservoir, would it be possible to predict that waste is going to occur before it actually occurred?

A Well, sometimes I think it is rather hard to say that waste occurred until after it occurred. I think that looking at the physical factors involved, we can say that we will realize more oil recovery if we can drop the pressure. Leaving behind oil that is possible to recover, in my opinion, is reservoir waste.

Q If your management asked you to determine whether waste was going to occur in this reservoir at a certain producing rate, you could not do it, is that correct?

A Absolutely?

Q Yes.

A No, sir, but I could sure give them my opinion.

Q That is what I wanted, your opinion.

A I could sure give them my opinion.

Q In your testimony you cannot predict that waste is going to occur?

A I think in my opinion I could tell them that if we were going to follow a certain set of conditions and so on we would probably recover more oil.

Q You don't have any practical yardsticks or practical

happenings in your mind that would indicate to you that waste is occurring and will possibly continue to occur?

A That waste is occurring in this field now?

Q Yes.

A You are talking about while producing under the normal rate?

Q Yes, that is correct.

A I don't believe that waste is occurring in this field while we are producing under the normal rate.

Q If it were occurring, could you detect it?

A Only after it had happened.

Q Then you could detect it?

A Yes, sir, possibly.

MR. LANDUA: Thank you.

MR. PORTER: Anyone else have a question of the witness? Mr. Buell.

REDIRECT EXAMINATION

By MR. BUELL:

Q Mr. Currens, the East Texas Field was brought up, and you said you knew nothing about it, is that right?

A I don't have any certain particular knowledge.

Q Then you couldn't disagree with me when I say that the East Texas reservoir is below the bubble point at the present time?

A No, sir, I surely couldn't.

Q One more question. I'm afraid that we have talked so much about reducing pressure that we might have actually lost sight of

the physical factors that existed in this reservoir. Do you anticipate very much of a pressure reduction while we are producing at only the normal allowable rate?

A That we would get a large pressure reduction?

Q Yes.

A I don't think it would be as large as we would like to have. It will not be too large.

MR. BUELL: Thank you. That's all. May I offer Exhibits 1 through 8 inclusive, please?

MR. PORTER: Without objection they will be admitted. The witness may be excused.

(Witness excused.)

MR. WEBB: May I be permitted to ask what we're about to do now?

MR. EASLEY: It is stipulated that the figures that are contained on this paper, which we will mark as Exhibit "A" to this hearing; we move that it be introduced in evidence.

If the Commission please, we would like to submit for the record letters from Jake L. Hamon and Colorado Oil and Gas Corporation supporting the position of Applicants, and I believe the Commission received a telegram from the McAllister Fuel Company, if there is no objection.

MR. PORTER: Is there objection to the admission of these letters?

MR. BUELL: Not from us.

MR. KELLAHIN: I have no objection to the letters being submitted to the Commission, but we would object to their being treated as evidence.

MR. EASLEY: We offer them under those conditions.

MR. BUELL: I assume they are statements of position?

MR. PORTER: That is correct.

MR. KELLAHIN: If they are mere statement of position, we have no objection.

MR. BUELL: They do contain evidence, which I am sure the Commission will not consider, since they are unsupported by sworn testimony or exhibits in any form. There is evidence in the letters. As far as statement of position is concerned, we have no objection.

MR. EASLEY: We offer those as statement of position only and do not offer them as evidence in the case.

MR. PAYNE: Do you gentlemen have any objection to stipulating for a dismissal at this time?

MR. EASLEY: We are not prepared to stipulate.

MR. BUELL: I might move that the Commission dismiss because in my opinion, certainly, all the probative evidence is to the effect that waste will not result.

MR. WEBB: I would like to concur in that motion and state to the Commission that we have approximately thirty exhibits which we believe will support the testimony offered by Pan American and will show the same thing that they have offered.

MR. KELLAHIN: We would like to concur in the motion to

dismiss, and we have about thirty minutes' testimony and two exhibits.

MR. PORTER: Do you have any objection to the motion for dismissal?

MR. EASLEY: Surely, we'll have to object to the motion for dismissal.

MR. PORTER: The motion is sustained and the case will be dismissed.

The hearing is adjourned.

* * * * *

C E R T I F I C A T E

STATE OF NEW MEXICO)
) ss
COUNTY OF BERNALILLO)

I, ADA DEARNLEY, Notary Public in and for the County of Bernalillo, State of New Mexico, do hereby certify that the foregoing and attached Transcript of Proceedings before the New Mexico Oil Conservation Commission was reported by me in stenotype and reduced to typewritten transcript under my personal supervision, and that the same is a true and correct record to the best of my knowledge, skill and ability.

WITNESS my Hand and Seal this 11th day of April, 1958, in the City of Albuquerque, County of Bernalillo, State of New Mexico.

Ada Dearnley
NOTARY PUBLIC

My commission expires:

June 19, 1959.