BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
September 14, 1960

IN THE MATTER OF:

Application of Benson-Montin-Greer Drilling Corporation for the creation of a new oil pool for Gallup production and for the promulgation of temporary special rules and regulations for said pool. Applicant, in the above-styled cause, seeks an order creating a new pool for Gallup production consisting of the E/2 of Section 7, all of Sections 8 and 17, the W/2 of Section 9, the W/2 of Section 16 and the E/2 of Section 18, all in Township 28 North, Range 13 West, San Juan County, New Mexico. Applicant further seeks the promulgation of special rules and regulations governing said pool including a provision for temporary 80-acre oil proration units. Applicant also requests that allowables for wells in said pool may be transferred to other wells in the pool so that interference tests may be conducted. Case No. 2069.

BEFORE:

Mr. A. L. Porter
Mr. Murray Morgan

TRANSCRIPT OF PROCEEDINGS

MR. PAYNE: Application of Benson-Montin-Greer Drilling Corporation for the creation of a new oil pool for Gallup production and for the promulgation of temporary special rules and regulations therefor.

MR. VERITY: George L. Verity for Benson-Montin and Greer.

MR. PORTER: Mr. Verity has entered an appearance for the applicant. Do we have any other appearances in this case?

(Witness sworn.)

MR. PORTER: You just have the one witness, Mr. Verity?

MR. VERITY: Yes, that is all I have.

By way of an opening statement, we would like to point out to the Commission that we believe this is a new Gallup pool. We have considerable evidence to this effect. It is right close to the other Gallup pools in the vicinity, and we will show similarity of logs, and we think that we can demonstrate at this early stage in this pool that there is definitely drainage of areas in excess of 80 acres by one well.

We realize that where there is no longer history on production of the pool than we have with regard to this one that caution should be exercised with regard to making permanent designation concerning the proration and spacing units, and for this reason we are only asking at this time for a one-year temporary order with setting at the end of that time for further evidence to the Commission, and permission during the interim to take interference tests and transfer allowables with regard thereto.

We are confident that when the history of another year has transpired regarding this pool we can show interference tests that will definitely show drainage. We also want to demonstrate to the Commission that it is uneconomical to drill on any greater density pattern than one well to 80 acres, because it is just not economical to drill with a greater pattern than that.

I have several copies of the exhibit. I would like for you to mark this exhibit. We would like to get these extra copies back,

if I could.

MR. PORTER: We would like to keep two copies.

MR. VERITY: If we could have the others I would appreciate it.

ALBERT R. GREER

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

DIRECT EXAMINATION

BY MR. VERITY:

Q Will you state your name, please?

A Albert R. Greer.

Q Mr. Greer, what is your educational background and training?

A I am a graduate petroleum engineer.

Q Have you been familiar with the Gallup production in the San Juan Basin, and are you familiar with it?

A Yes, sir.

Q Have you studied its reservoir producing characteristics?

A I have.

Q And have you made a particular study with regard to the Benson-Montin-Greer Jones wells in Section 17 of Township 28 North, 13 West?

A Yes, sir. I am personally familiar with each of these wells.

Q You have heretofore, I believe, testified before this Commission as an expert petroleum engineer?

A Yes, sir; I have.

Q You have in your hand there what the clerk has marked as Exhibit 1?

A Yes, sir.

Q Will you please tell us what this is, in general?

A This Exhibit 1 contains a number of individual maps and plats and graphs and data sheets covering the engineering and geological aspects of this application. It is broken down into four parts. Part One is general information; Part Two, data relative to recoverable oil reserves; Part Three, data relative to ability of Jones No. 2 to drain in excess of 80 acres; and Part Four is economics. Each of the individual items is designated by the letter, A, B, C, D, E, F, and so on, which we will refer to as sections of Exhibit No. 1.

Q These sections letter from A through R, do they?

A Yes, sir, A through R.

Q Drawing your attention at this time to Section A, will you please tell us what that is?

A Section A is the area map, the purpose of which is to show the location of the area involved in this Case No. 2069, with respect to other Gallup pools in the area. This map covers the north and east parts of San Juan County, and we have shown on there only

Gallup oil pools in their outline. The total Gallup pool, which is the nearest to the area in which we have drilled these wells, is colored in yellow, and the area covered by this case is colored in red.

Q Is a copy of this Section A on the board over there, on the left-hand side?

A Yes, sir.

Q Directing your attention now to Section B; will you please tell us what it is?

A Section B is a correlation made from two electrical logs, one in the Totah-Gallup Pool and the other Benson-Montin-Greer No. 1 Jones. This correlation sets out the tops of various formations from the Gallu p through the Dakota, and also indicates the particular part of the Gallup formation in which Tennessee found production in their No. 12 Callow, and I believe from which all of the wells in the Totah-Gallup Pool produce, and it can be seen it is about the same section that we are producing in our Jones area.

I'd like to point out that, although the Section is about the same position in the Gallup formation in the two areas, at this time it is impossible to correlate the individual producing sands between the two areas and, in fact, I believe they are producing from different sands.

Q Turning next to Section C, will you explain it to us?

A Section C is a simple listing of the wells drilled in the

Jones area, their location and dates of completion. Primarily, we wish to show by this exhibit that only one well has produced in excess of about a month. That is our Jones No. 2, completed in October of '59. All the rest of the wells have recent completions, with practically no production history.

MR. VERITY: At this juncture we would like to call the Commission's attention to the fact, also, that the Jones No. 4 and the Jones No. 6 have been completed since the date of the application.

Q Turning now to Section D, will you explain it?

A Section D.is a vicinity map which shows in detail the location of the wells in the Jones lease, the wells in the Totah-Gallup Pool and a development of wells to the Gallup formation to the northwest of the Jones lease.

Q You have just placed on the wall a copy of Section D, have you?

A Yes, sir.

Q Next, Section E.

A Before we go to E, I should describe that we have colored in yellow the Totah-Gallup Pool, although it is not set out on the map, and in the red is the Jones area.

Q Now, turning to Section E, will you explain these logs to us?

A Section E is a cross-section prepared from electrical logs for the wells drilled on our Jones lease, the No. 1, 2, 3 and 4.

We wish to show by this cross-section that we have continuity of pay sands across the area covered by these wells. You will note that on each log I have colored a little resistivity kick in gray, and another in brown. The purpose of that is to help correlate from one log to the next. I believe it is quite apparent that the logs are almost identical in nature. If we look at the gray zone and the brown zone, it is almost impossible to distinguish one well from the other. It is a simple matter, then, to move down to the area opposite the zones colored in yellow to positively identify the producing zones. These producing zones are opposite the lines colored in yellow.

Q I notice on the bottom of the section, to the left of the center, you have a square there with designations. Does that show the placement of the wells and the locus of the ones in the logs?

A That shows the location of the cross-section on the little plat. The plat covers Section 17.

Q Referring next to Section F; will you explain these logs?

A Section F is a cross-section of the same wells as in Section E, prepared from sonic logs. The sonic log gives us an indication of porosity and in this instance, as to this part of the Gallup formation which is productive, appears to give reasonable correlation with core analyses which have been taken in two of the wells. We, therefore, believe that the sonic log, in this instance, provides a very good tool for estimating total pay sand thickness. We can see from this cross-section that the lower sand is our thicker,

and our, we believe, most productive sand. It occurs in all four of these wells. The upper sand is thinner, appears to be developing to the north and to the east, but is still a very thin sand, and, of course, can contribute only a small amount toward the total oil reserves of the wells.

Q What relation do you think there is between these two sands?

A The two sands are very definitely separate and distinct sands. I believe, however, that they are pretty well joined by fracturing system, and that they are undoubtedly one common source of supply. I believe it would be impossible to separate production of one sand from the other, Nevertheless, from a standpoint of reserves and recoverable oil we can consider only the individual sand.

Q Turning now to Section G, will you explain these logs?

A Section G is a cross-section from southwest to northeast; locus of the cross-section is indicated on the little plat on the exhibit, and although I have not colored in on this exhibit the identifying markers above the pay sands, they are present in these wells and also can be correlated readily. Among other things, this exhibit shows that in the northeast direction the lower sand is moving down in the section, separating from the upper sand at a fairly rapid rate. This is what led me to believe that this lower sand is not correlative with any of the sands in the Totah-Gallup Pool. It is quite likely this sand will disappear from a section before it moves as far north as one or two locations.

Q Then, turning to Section H, will you explain this?

A Section H is merely a complete copy of the core analyses taken in our No. 2 Jones well. We will summarize these characteristics later. This is just for the record a complete copy of the core analyses.

Q And have you used the information from this log in your calculations?

A I have used this information from core analyses in computing recoverable oil.

Q Then, turning to Section I, is it the same thing from another well?

A Section I is another core analysis from our Jones No. 4.

Q And it is utilized in making your calculations?

A Yes, sir.

Q Then, turning to Section J, which I notice is in three separate pages; will you explain Page 1 of Section J?

A Page 1 of Section J is a schedule of the pay thicknesses in the six wells which we have completed at this time as commercial wells. I have listed on the left-hand side pay thicknesses determined from core analyses and, on the right-hand side, pay thickness determined from sonic logs. I'd like to point out the comparison there. For instance, in No. 2 Jones, in the upper sand the core analysis shows three feet; the sonic log shows four feet. In the lower sand the core analysis shows 16 feet and the sonic log shows 20 feet. In the No. 4 well we have six feet in the core analysis

as compared with five from the sonic log, and both the core analysis and the sonic log shows ten feet in the lower sands. I feel that these are fairly comparable sets of information. The fact that they correspond that closely, I believe that we can therefore interpret the sonic logs in terms of productive pay section even though we do not have core analyses on all the wells. The average of the pay thickness from the sonic logs is four and a half feet in the upper sand and 15.6 feet in the lower sand.

Q Turning now to Page 2 of Section J, continue.

A Page 2 shows a summary of the core analyses of both the Jones 2 and the Jones 4. What we would like to point out here is the similarity of porosity and permeability in both of the two wells that were cored in each of the sands. For example, in the upper sand, in the Jones 2 we found porosity of 7.4% and in the Jones 4, 9.3%. In the lower sand we had 11% compared to 10.8%. These are close comparisons and indicate to me that the sand is fairly uniform, both the upper and the lower.

Q This bears out, does it not, the continuity that is demonstrated in the logs?

A Yes, sir, and it tends to add accuracy, of course, to our analyses in that we are dealing with numbers that are relatively the same. When we make an average between 10.8 and 11, for instance, in the lower sand, we have an average that we feel is reliable. I would like, also, to point out that the average permeability of the core analyses of these wells is extremely low. It averaged

.26 millidarcies for both sands, both lower and upper sands in Jones 2 and Jones 4, and averaged only seven hundredths of a millidarcy in the lower sand. This is a range or an order of permeability so low that ordinarily we would feel that it could not produce at all. We feel certain from this analysis, and also from examination of the cores, that our medium for transmitting the oil from the outer reaches of its drainage area to the well bore is through a natural fracture system. The cores were fractured all the way through from both vertical fractures and horizontal fractures.

Q Did you, yourself, examine the cores taken from the 2 and 4 well?

A Yes, sir. I examined the cores personally, and I was quite impressed by the fracture system found in the cores.

Q This fracture system, I believe, connects the upper and lower sand as well?

A There were fractures in the section cored between the two sands, and I believe that they are connected by virtue of that.

Q Turning to Page 3 of Section J --

A Page 3 summarizes my calculations as to recoverable oil, based on the core analyses and our knowledge in general of behavior of the Gallup formations as of this time. I have determined an acre foot recovery for the upper sand of about 65 barrels per acre foot. Now, normally with the porosity that is in this upper sand, if it had good permeability we would anticipate about 85 barrels per acre

foot, but we believe that there will probably be a poor relative permeability relationship because of the particular nature of the sand which will result in a higher proportion of gas being produced with each barrel of oil than would occur with a sand of good permeability. As a result, I have reduced the estimated recovery from 85 barrels per acre foot to 65 barrels per acre foot, and for the same reason, in the lower sand, although we might have anticipated 110 barrels per acre foot had it had good permeability, I estimated 80 barrels per acre foot for it. I would like to make clear at this point that I believe this reduction in recovery is due to the nature of the sand itself, and the flow of the gas and the oil in the sand. It is not a result of a large pressure gradient across the tract. There is a big distinction in this type of reduction of recoverable reserves. It appears that the fracture system is providing a very good set of communication channels throughout the sand, and I believe that it will move over a considerable distance. Nevertheless, the recovery will be less than if we had good permeability for the reason of this flow characteristic of the gas bypassing the oil.

Now, the net result of this is 1500 barrels per acre ultimate recovery for the average of the two sands, which, on 40-acre spacing is 60,000 barrels per well, and on 80-acre spacing, 120,000 barrels per well.

Q I believe these exhibits include the data that is being presented in Part 2, which is data relative to recoverable oil re-

serves; is that correct?

A Yes, sir.

Q And starting now with Section K, we turn to the question of drainage area, do we not?

A In Section K we have a simple schedule of the oil production from our No. 2 Jones, and we have based our calculations now for drainage in this area from production history of the No. 2 Jones, and the reason for that is, of course, it is the only well in the area that has produced long enough to give us any reliable information at all. It has produced about ten or eleven months, and, as of the end of August, at which time we shut the well in for a bottomhole pressure build-up test, it had produced 21,700 barrels of oil.

Q Turning to Section L.

A L is a summary of the bottomhole pressure measurements which we took on the Jones No. 3 well. Purpose of this test was to make a determination of the original bottomhole pressure. We did not take an initial bottomhole pressure on the Jones No. 2 when it was completed. This being a new well, we feel that it will give us fairly good information as to initial pressure. This well produced only about 3,000 barrels of oil when it was shut-in and the test started in August.

Q And Section M?

A Section M is a summary of the bottomhole pressure taken

on our No. 2 Jones. This is the well that has produced for about ten months.

Q These pressures are used in graphs later to be demonstrated?

A That's right. The analysis of both of these bottomhole pressure tests is set out later.

Q Turning to Section N, explain this graph, please.

A Section N is a plot of the bottomhole pressure covered under Section L, for the Jones No. 3. This indicates to me that we have just about reached a stabilization at a pressure of 1517 pounds, at a datum of 350 feet.

Q And Section O is also a graph?

A Section O is a graph showing the pressure buildup on the No. 2 Jones, which can be seen that it has not yet reached stabilization at the end of 13 days. I believe that 13 days was the day before yesterday; two days ago. The well is still shut-in and we may be able to continue that curve if we can transfer allowables.

Q So as to give greater demonstration of the facts that are now concluded and apparent?

A Yes, sir.

Q Turning, then, to Section P; will you explain this?

A Section P gives my analysis of the preceding bottomhole pressure data set out on the four previous sections. I have estimated the initial reservoir pressure as being the 1517 pounds found in Jones No. 3 after 23 days shut-in, plus an estimated 15 pounds pressure drop that could have been caused by depletion resulting

from the 3,000 barrels of oil which we produced from the well before it was shut in, plus a possible eight pounds additional pressure build-up that might result. We are measuring the bottomhole pressures in this well with an instrument which, of course, has an accuracy of only four or five pounds. Because of this one might extrapolate the curve to another eight pounds above the 1517 we measured. This gives a total of 1540 pounds that I believe was probably very close to the original bottomhole pressure in the area.

The current reservoir pressure in the Jones No. 2 for the area that is in communication with the well bore is estimated at 1460 pounds. I have arrived at this by the extrapolation of the curve to 1300 pounds at 30 days. At the end of 30 days I believe that the Jones 2 will have a minimum of 1300 pounds in the well bore. Now, since there were no other wells producing in the area, we know that at the edge of the boundary of the radius of drainage of this well that the pressure is 1540 pounds. Now, the average pressure that that well is draining from has to be somewhere between 1300 pounds and 1540 pounds. Now, if we have a straight line relation of pressure from the well bore to the edge of the radius of drainage, by simple mathematics we arrive at 1460 pounds as being the average pressure in the area being drained by the Jones No. 2. We have set this out on the next exhibit.

Q Exhibit Q, on the graph?

A Yes, sir, on the graph in Exhibit Q. This graph shows a plot of bottomhole pressures taken in the Jones No. 2 at the end of

the time it had produced nearly 22,000 barrels of oil, and the pressure build-up taken at that time. I have colored in yellow, a little yellow dot on this graph, the two-day shut-in pressure of approximately 900 pounds. The 13-day shut-in pressure is colored in green, which is approximately 1250 pounds. Then, in red, I have shown the estimated true average reservoir pressure as of this time to be 1460 pounds, and then comparison of this 1460 pound pressure with an initial pressure of 1540 pounds, and the oil produced of approximately 22,000 barrels, we can arrive at only one conclusion, and that is that the well is in communication with a recoverable oil reserve on the order of 300,000 barrels of oil.

Q How large an area does it take to encompass that many barrels of oil in this reservoir?

A The Jones No. 2 had one of the thickest pay sections in this area, and I have assumed that for good permeability, in normal recoveries, we might anticipate 2,000 barrels per acre. I have used that for the purpose of this calculation, and we arrive then at something in excess of 140 acres that the well is now draining.

Q Actually, your 2,000 barrels there, per acre, was greater than your calculation for the pool, was it not?

A That's correct.

Q You have made this graph on a very conservative basis?

A That is true. That, I believe, is the minimum area the well is now draining; 140 acres, and, of course, this is true after thewell has produced only about ten months. Actually, we know the

radius of drainage is receding all the time, and probably in two or three years it would have an influence over maybe 200 or 250 acres.

Q Then you think the amount of drainage will increase as the life of the pool continues?

A For one well; if there had been no other wells drilled in the pool, then its area of drainage would, of course, extend, until it finally reached the limits of permeability. I would like to point out, I have drawn small dashed lines on this graph to show what might be anticipated if we had used, for instance, a two-day shut-in bottomhole pressire. If we draw a line from our initial pressure through the yellow dot we would estimate an ultimate recovery for this well of only some 52,000 barrels of oil, and that is draining only 26 acres. Then, by leaving the well shut in 13 days instead of two days, we draw a line from our initial pressure through the green dot, and we can see our first estimate was in error considerably. We could anticipate over 100,000 barrels of oil and that the well is draining something like 56 acres, and, of course, the curve drawn through the green dot is probably just as much in error as the one drawn through the yellow dot, because neither of those pressures are the true reservoir pressure. That is the reason why we calculated the pressure we have set out as the estimated true average reservoir pressure as of September 11, 1960, and although, of course, we have called that an estimated pressure, it is a pretty good calculation, we believe, and has considerable reliability behind it.

Q Now, if you are given a year to observe the production of this pool and to run interference tests during that period of time, do you anticipate you can get additional information that will confirm the information demonstrated by this graph?

A That is true. We have the wells drilled on an 80-acre pattern at this time, and if we can transfer allowables and run an interference test I feel that we can demonstrate positively and conclusively that we have communication from one 80-acre location to another 80-acre location and, of course, if we do have communication on wells drilled on 80 acres that is, in itself, an indication of drainage of 160 acres.

Q If, however, the pool were allowed to be developed on general rules, which would permit one well to 40 acres, then after you had positively demonstrated that information, it would be too late to protect the correlative rights and prevent the waste that would be involved?

A That is correct. We have determined that the wells are uneconomical to drill on 40 acres, and we feel it is necessary to prevent drilling on 40 acres until we have definitely proven that 80 acres is the proper pattern.

Q Turning to Exhibit R, with regard to your economics, does that set out the economics regarding production from these wells in this pool?

A Yes, sir. Exhibit R shows the amount of money we can

anticipate from wells drilled on 80 acres and wells drilled on 40 acres. We have set out simply there the cost that we have, royalties, taxes, trucking charges, operating expense, and we arrive at a net income to the working interest of $81,000 for a 40-acre well or $162,000 for an 80-acre well, and the approximate cost of drilling and completing these wells is about $75,000.

Q Mr. Greer, you are familiar, over a period of many years of production in this area, with the production, drilling and completion costs, are you not?

A Yes, sir. We have operated in the area for a number of years.

Q These figures are based both on this general information as well as on the particular information concerning the drilling of these wells?

A Yes, sir. We have our costs on five of the wells in now, and it is pretty accurate.

Q If it costs $75,000 to drill a well, and on 40 acres you would only recover $81,000, is this a feasible economic project?

A No, sir. We cannot afford to drill wells with that small a profit.

Q This would allow nothing for interest on your money?

A That is true.

Q And it would allow nothing for risk concerning non-productive wells?

the Commission might want to make at a later date, subsequent to the termination of the temporary period?

A Yes, sir; that could be changed.

Q Do you have any conclusion to make with regard to what should be a proper allowable for 80-acre drilling and spacing allowable units?

A I feel that we should be governed by the Commission's normal practice of allowing two normal 40-acre allowables, plus the one depth factor.

Q Do you have anything further that you want to say to the Commission regarding Exhibit 1 or any of the sections therein?

A I believe we omitted one thing in talking about the recoveries. I would like for us to get in the record, I believe it is a normal solution gas drive reservoir, with the exception, of course, that our main means for transmitting oil to the well bore is a fracture system rather than inherent permeability in the sand.

Q These factors were, of course, considered in making your conclusions which have been demonstrated in the various sections of Exhibit 1, were they not?

A Yes, sir.

MR. VERITY: We have nothing further from this witness.

MR. PORTER: Do you want to offer the exhibit at this time?

MR. VERITY: We offer Exhibit 1 in evidence.

MR. PORTER: Without objection the Applicant's Exhibit No. 1 will be admitted to the record. Does anyone have a question?

A That is true, and it also does not provide for costs of acquisition of the lease.

Q And I believe that in this Section 17, itself, you have already drilled one non-productive well, have you not?

A That is true. We already have one well -- we can't say it is non-productive; it is currently making about 10, 15 barrels a day.

Q This is the well that has been designated as your A-1 well?

A As our Jones A-1.

Q Now, is it economically feasible to drill one well to each 80-acre tract?

A It is economically feasible to drill one well to every 80 acres.

Q If the Commission grants the application for spacing of one well to 80 acres in drilling allowable units, what would you recommend to it in regard to the way the 80-acre unit would be made up in each quarter section, and with regard to spacing pattern?

A We would recommend the operator be allowed to space or choose the location of his wells on the 80-acre tract, dividing the quarter section either north or south, and letting him choose either 40 to drill on, but we believe the well should be drilled near the center of the 40-acre tract with a tolerance of 150 feet for terrain, which I believe is adequate for this area.

Q Such a pattern would also lend itself to any changes that

CROSS EXAMINATION

BY MR. NUTTER:

Q Mr. Greer, I notice on Section D of Exhibit 1 that there is an area northwest of the red area on this exhibit; is this area producing from the Gallup formation also?

A Yes, sir, and from approximately the same interval as our area in the Totah-Gallup Pool. However, in this instance, as compared to the Totah-Gallup, I believe that our main pay, which is our lower sand, does not continue to this area to the northwest. It is possible that the upper sand may be the same. However, at the present time there is a considerable difference in the characteristics of them, and it is possible that they are producing from a separate sand entirely.

Q Is there more similarity between that area to the northwest of yours, and your area, or more similarity between that area and the Totah-Gallup?

A I would say there is more similarity with the area to the northwest in the one upper sand, whereas I can find no similarity between our wells and the Totah-Gallup Pool.

Q You miss the point of my question, Mr. Greer. Is there more similarity between this area to the northwest and your area, or more similarity between the area to the northwest and the Totah-Gallup?

A Oh, I see, I would believe the upper sand has the possibility of correlating between our area and the area to the northwest,

and no correlation between the area to the northwest and the Totah-Gallup.

Q Totah, then, would be separate from both of them?

A That would be my estimate at this time.

Q Do you anticipate that the developments in the upper sand may some day be continuous between your area and the area to the northwest?

A There is a possibility. The main difference we see right now is they have considerably better porosity, better permeability, and our No. 4 well, which is our furthest northwest well, happens to be structurally higher than any of our others. It also appears to have some free gas in it. If there is a gas cap in this area, then there could be a separate between our area and the area to the northwest because they are structurally higher. However, I understand they have no free gas.

Q You estimate the average pressure in your pool was 1540 pounds; is that correct?

A That's correct.

Q Has any analysis been made of the fluid to determine the bubble point of the oil?

A No, sir. We have not done that. Our No. 2 well, I think it would be pretty difficult to determine because it would have a productive capacity of something over 200 barrels a day, and gives a pretty good drawdown by the time it gets in the well bore, and I am afraid gas would be gone.

Q You do expect there may be some free gas in the reservoir, however?

A In the No. 4 well it appears there could be some free gas; yes, sir. If I might continue, we wish to live under the Commission's normal regulations of 2,000 cubic feet per barrel for the reason that a well such as that be restricted if more free gas is encountered.

Q What is the gas-oil ratio on your No. 4?

A We don't have it exactly; just now getting it tied into the tank battery. All we can do is estimate. We know it is considerably higher than the other wells. I would judge we have probably 2,000 to 25 cubic feet per barrel right now, whereas the other wells, some come in from 6 to 100,000.

Q It appears from the cross-section, Section E, that the upper sand is developing as you go to the northwest, and the lower sand may be pinching out slightly; correct?

A Yes, sir. We believe the lower sand to the northwest will probably, in one more location, be gone.

Q Now, in the cross-section running from the A-1 to the 5, it appears that the lower sand is dipping more sharply to the northeast than the upper sand?

A That is true.

Q You stated that you felt that the lower sand would probaby pinch out before it got to the Totah area?

A Well, it will either pinch out or reach the base of the

Gallup formation before it gets to the Totah area.

Q Now, is there any possibility that the upper sand which is developing to the northeast could be the producing sand from the Totah?

A It is possible. The correlations as we now can make them leaves some doubt. We can trace them pretty well to the northwest, and the correlation is pretty good, but we are just too far apart to tell definitely with the Totah.

Q There haven't been any dry holes drilled between your area and the Totah, or your area and the productive area to the northwest, however, have there?

A No, sir.

Q Referring to Section H, Mr. Greer, which is the core lab analysis of the cores. Is there any indication on that analysis to show the fractures in the cores?

A I don't know whether they set it out here or not; sometimes they do. It appears they did not. However, the cores which they analyzed were sections; it is very seldom that they get a piece of the core that has a fracture in it and, of course, the reason being that we break the core up on the location. It breaks at the fractures, and they analyze only the samples that we give them which, ordinarily, do not contain the fractures.

Q There appears on this core analysis, or the core graph, that there was considerable porosity and oil saturation from the vicinity from 5360 to about 5380. You didn't perforate in that

section, did you?

A No, sir. That zone is very consistent. As a matter of fact, it can be correlated over the entire area with no question. That is the area to the northwest of Totah-Gallup, our area and several miles southeast, and for that reason we cored it in this well and, of course, our analysis of this particular sand is that since the porosity is so low that it probably would be non-commercial in itself. Also, we feel that it would probably result in high gas-oil ratios immediately, and for that reason we did not attempt to commingle it with the lower zones at this time.

Q Is that one of the areas you have indicated to be brown or gray?

A No, sir. I will point it out on this map. It is this zone at 5350, approximately, on our Jones 1, and 5320 on Tennessee Gas No. 12 Callow.

Q Those last two logs you referred to are Section B of the exhibit?

A Yes, sir. We feel that perhaps close to the time the pool has been depleted it might be feasible to perforate that section at a time when gas-oil ratios are high, and perhaps recover a little additional gas and oil at that time.

Q At the present time you wouldn't want to commingle it with the production from the main pay, sir?

A No, sir, because it might give us too much free gas.

Q Mr. Greer, do I understand correctly that you don't

expect a well to be able to drain 80 acres through the permeability in the sand itself, but that you do expect it to be able to drain it through the system of fractures?

A That is correct. I feel the permeability is too low, and that if we did not have a natural fracture system that the wells would produce at uneconomical rates.

Q Why, if this fracture system is so effective, has the No. 2 well failed to reach its maximum shut-in pressure after 13 or 14 days?

A We have, of course, a wide range of permeabilities in which I believe we can have commercial production, the same as we found, for instance, in the gas production in the Pictured Cliffs and Mesa Verde production, in that although wells take a long time to stabilize, it is still possible for them to produce at commercial rates, and I believe that is just the range of permeability on an average that we happened to hit.

Q Wouldn't you expect for an effective system of fractures which were in communication with each other to have almost infinite permeability?

A The fractures, yes, sir, but, of course, one fracture, for instance, may have to drain this tight sand over a distance of ten or fifteen feet or maybe twenty feet, or maybe thirty feet, and whereas these fractures continue over the whole area, and they will drain close to the fracture fairly rapidly, as I say, we get several feet from the fracture; then it takes longer for it to produce into

the fracture, I feel.

Q I was under the impression possibly that these fractures were very close to each other. They are rather widely scattered, then?

A Yes, sir. On an average they would be two or three feet apart, and once in awhile a longer vertical fracture, maybe three or four feet long, and then we might have an area that would have some small fractures, perhaps two or three feet would have fractures maybe an inch or two long, or five or six inches long, but it is not a completely crushed formation.

Q I see. Now, in Section J, Mr. Greer, you stated that the upper sand, because of its poor relative permeability, might recover 65 barrels per acre foot, and the lower sand might recover 80 barrels per acre foot?

A Yes, sir.

Q What percentage of recovery of total oil in place is that based on?

A I haven't computed that. I made my calculations based on porosity. We can arrive at it here in a little bit.

Q I would be interested in knowing what the actual estimate of barrels per acre foot in place is, if you have that.

A The average would be 433 barrels per acre foot in place in the upper sand; that is 15% in the upper sand, and in the lower sand there is an average of 475 barrels per acre foot, and I have estimated 85. That is 17.8% of oil in place, and of course, the

reason I have estimated a different percentage for the different sands is based on the connate water content. Actually, I feel we will recover a higher volume of oil for the same porosity where we have a high connate water content as compared to a low connate water content for the reason of shrinkage, and the fact you reach your free gas saturation at a quicker rate, and the gas begins to by-pass the oil faster.

Q The lower sand has considerable more connate water saturation?

A Right.

Q Did you ever have an initial bottomhole pressure that would be indicative of the pressure?

A Of course, the No. 3 well, although that is pretty much initial bottomhole pressure; we completed on August 2 and shut it in on August 15, maybe shut in quicker than that.

Q And it measured 1517, correct?

A Yes, sir; 1517.

Q Now, in arriving at your original reservoir pressure of 1540 you had to assume, first, that that well was in communication with 300,000 barrels of oil, didn't you?

A Yes, sir, and of course, I arrived at that from the graph under Section Q that shows that No. 2 Jones is in communication with about 300,000 barrels of oil, and that is the reason I used that figure.

Q How could you use Q to arrive at the estimate in Section P

when Q utilizes the figure of 1540; in other words, you had to use the original bottomhole pressure to arrive at the 300,000 and then you had to use the 300,000 to arrive at original bottomhole pressure?

A It is pretty simple. You can choose any figure between 1400 and 1600 and work them back and forth, and pretty soon you will arrive at a balance.

Q So it was a trial and error; the figure finally fitted?

A If you are off 50,000 barrels, you are only talking about 2 or 3 pounds.

Q In your economics, in the last page in your exhibit, Mr. Greer, you haven't taken into consideration any gas sales that you may have here, have you?

A No, sir. The situation with respect to gas sales -- and, incidentally, we plan on selling the gas -- is that there is no low pressure gathering system in the area, and we have, in fact, entered into a contract with El Paso Natural Gas to sell them our gas, but we have to gather it and treat it and compress it, and our initial estimates of this cost runs approximately $80,000, and there is just a question in our mind as to our thinking as to whether it is going to be a profitable enterprise or not. Nevertheless, we feel that we should gather the gas and conserve it.

Q At any rate, you don't feel that your economics picture would be materially enhanced by gas sales due to the cost of compressing and gathering?

A That's true.

Q Well, I note you also have a trucking charge of 36 cents per barrel for your production. Do you anticipate you will have to truck this oil until the depletion of the pool?

A That I don't know. We have had three different companies, in fact, we have asked them to come in and check into the area and give us estimates of pipeline costs and such, and at the current time they are considerably disturbed about the total reserves in the area. There appears to be a question whether it is economically feasible for them to come in and gather the oil, and if they do, at least one company has indicated an initial charge of probably 20 cents a barrel. They feel it is a risky area.

Q They are not convinced it is a pool?

A They are not convinced. I just hope I am not wrong.

Q I note on your income in the last page that you have exactly twice the amount of oil on 80 acres that you would have on 40; is the recovery going to be identical?

A I think so. This fracture system has to be pretty effective for us to have produced like we have already in the Jones No. 2, and if it is as effective as I think it is we will recover, I believe, substantially all the oil, in fact, all of it on 80 acres as we would do on 40 acres.

Q Any possibility that this productive area might be on the same trend as the Angel's Peak Oil Pool?

A That's a long way to extrapolate. I think it is possible it is the same trend.

Q Do the logs on these wells look similar to the logs on Angel's Peak area?

A Well, we are so far away, I don't know. The way the sands can move up and down in the section, it is impossible for me to correlate that far across.

BY MR. PORTER:

Q It seems you are depending more on these fractures for your drainage than you are on the permeability. Do you think a well would be an economic well on any spacing if you didn't have the fractures?

A No, sir, I don't believe you could afford to drill it at all.

Q You don't think the formation would give up enough oil to pay for the well?

A I believe at the end of one or two months it would be down to practically nothing.

BY MR. NUTTER:

Q One more question, Mr. Greer. Mr. Greer, you recommend to the Commission that the spacing pattern for the wells in this area, if the 80-acre order should be adopted, that the spacing should be flexible. However, I note that all of your wells have been drilled on a rather well-defined pattern of alternate 40-acre tracts. Why have you done that if you recommend the flexible pattern?

A To kind of continue with one of your earlier questions, I

believe it is possible our pool may connect with the area to the northwest, and they have got both patterns up there, so I just would avoid some confusion later on. As far as our drilling is concerned, we propose to stay on a definite pattern.

Q You expect the recovery per well would be more uniform by having a fixed pattern?

A Actually, I kind of doubt it. I believe where there will be off-pattern wells will be probably where a man is afraid if he gets on the regular pattern he is liable to miss the sand, so he will probably come in and drill on the other 40, and we have no objection. We feel that close to the edge of the pool that his productivity will be low enough that he will probably only be producing the equivalent to a 40-acre allowable anyway. On account of the pinch-off of the permeability he wouldn't have as much sand, so we aren't really concerned about the pattern.

Q But you prefer the pattern for the better section of the pool; you prefer the uniform pattern, at least for the better section of the pool?

A Yes, sir, and as to our spacing, we propose to stay on pattern.

BY MR. PORTER

Q Which pattern, Mr. Greer, do you think would allow the greatest ultimate recovery in this pool?

A I believe there would be no difference.

Q By the way, have you recommended a name for this pool?

A No, sir, we haven't.

Q Do you have any suggestions?

A No.

BY MR. ARNOLD

Q To get back to this fracture again, I believe you said Totah-Gallup and Jones area are producing from about the same relative position in the Gallup formation?

A Yes, sir.

Q Do you have any reason for assuming that the fracture system maybe extends from the Jones area to the Totah?

A I think it is possible that the fracture system could extend; yes, sir.

Q In other words, they could be the same reservoir even though the sand isn't continuous?

A Yes, sir, by virtue of the fracture system it is possible that they could be the same common source of supply even though they are producing from separate sands.

MR. ARNOLD: That is all.

BY MR. PAYNE:

Q Mr. Greer, does your acreage include Section 17 only?

A No, we have additional acreage in the area.

Q But all your wells are presently completed on the same basic lease?

A The Jones A-1 is on one lease; the eight other Jones wells are on another lease.

Q On this transfer of allowables, what well or wells do you propose to shut in and to what wells do you propose to transfer those allowables?

A Since we already have reached stabilization, I believe, in the Jones No. 3, I believe that that would be a good well to shut in. In fact, we would like to just leave it shut in, and then we would just transfer allowables to the other wells on the lease. Actually, I think one well would satisfy us as to communication if it would satisfy the Commission.

Q Would you propose to transfer the entire allowable from the No. 3 well to one other well, or would you divide it up?

A I imagine we would divide it up.

Q Would you propose to transfer it to a well which offsets acreage owned by another operator?

A Well, let's see; we'd almost have to. Our offset operators are Pan American and Southern Union; however, they think, currently, that recoveries are so low that they are about willing to farm that tract out to us, so it is possible that we will own the offset tracts.

Q If you transferred it to the No. 2 well, it wouldn't be offsetting acreage owned by parties other than yourself, would it?

A That is true. I doubt, however, that No. 2 could make

the entire amount.

Q Did you propose this red area as the pool boundary?

A We just chose approximately half a mile around our producing wells.

Q You would have no objection to limiting the pool to Section 17 and setting out a nomenclature order as additional oil was drilled?

A Can I ask you a question in answer to that? I believe the regulation is if a well is drilled a half mile --

Q A mile.

A If we have just Section 17 designated, then, for instance, an operator wanted to drill three quarters of a mile away on the northeast of the northeast of Section 16, would he be bound by our 80-acre spacing?

Q He would if he was in one mile of the designated pool boundaries.

A If that is the case we would have no objection to it being Section 17.

Q There is a possibility that this acreage to the west of your No. 1-A well might be dry?

A Yes, sir; south and west probably dry is our thought.

Q Now, what is the depth of your discovery well?

A Approximately 5706 feet.

Q Now, Mr. Greer, have you made any general comparison, both from the standpoint of reservoir characteristics and economics,

between this pool and the Bisti Pool?

A The Bisti Pool has considerably better sand in that the per well and per acre recoveries on an average will be considerably better than in this area.

Q You feel that this pool probably doesn't connect to that; is that right?

A Well, I feel that the individual sands probably do not connect. Definitely the lower sand doesn't connect; possibly the upper one, but it is doubtful.

Q If it does, it would be by way of vertical fracture?

A It is possible that the upper zone might move around in the section and tie in with one of the other sands in the Totah Pool, but that, I think, is kind of remote; probably through fractures and, of course, we don't know if the fractures actually exist between the two pools unless it is drilled.

Q Do you have any figures on the comparative gravities of gas-oil ratios; information of that kind between one pool and the other?

A No, sir. We just confined our study to our little old pool.

Q Did you testify you thought you would get the same amount of oil on a flexible pattern as you would on a rigid pattern?

A Yes, sir.

BY MR. PORTER

Q I would like to ask a question in connection with that.

Do you think you might get more wells drilled if you had a flexible pattern in any given pool?

A Yes, sir; I believe that is possible.

Q Don't you think you get more oil if you get more holes in the ground?

A No, sir. You might get it out quicker.

Q Doesn't permeability have anything to do with that?

A I believe the permeability in this area, the inherent permeability in the sand, is so low as to have no bearing at all on our drainage. I believe we are just looking at a fracture system.

Q You think any of those wells that might be drilled on a flexible pattern would be unnecessary wells?

A As far as getting the oil is concerned? In order for the man to protect his correlative rights, even though he has only 40 acres of oil, we are willing for him to go drill his 40 acres and are not worried about him getting too much oil.

BY MR. PAYNE

Q Mr. Greer, do you feel that this is definitely an oil pool?

A At present the history of our No. 2 well would indicate that, and we felt fairly confident about it until we drilled our No. 4 well. Now, we are not so sure.

Q It could be a gas cap?

A It could be one of those problems that the Gallup has created before. We hope it won't be, but it could be.

Q Now, the way your application in this case was phrased,

it appeared that you would prohibit the drilling of a second well on an 80; is that right, or would you allow an operator, of his own choosing, to drill more than one well on an 80 if he so desired?

A Our thought was for the time of the temporary order that he should be prohibited from drilling a second well on 80 acres, and after the time we have more information and can talk just a little more conclusively about the nature of the formation, then I believe would be the time to talk about such a drilling program as that.

Q Of course, if he did drill more than one well on the 80, if he drilled two, the worst that could happen is that he drilled an unnecessary well; isn't that right?

A You reach a problem in the event all wells are producing at capacity. That is the problem we are faced with, and our thought is that if the area is developed on 80 acres, and enough information accumulated, we feel that there will be no one to even suggest such a thing as drilling wells on 40's.

Q If someone desires to, why would you prohibit him from doing it?

A After we have enough information and see what the situation definitely is under permanent order, we probably would favor such a regulation. Temporarily we would prefer to prohibit it.

Q You would propose that the operator be allowed to dedicate the 80 acres either to a north-south or east-west?

A Yes, sir.

Q And that he be allowed in either 40 of the 80 as long as he drills within 150 feet of the center of the 40 he drills on?

A Yes, sir.

BY MR. PORTER

Q Mr. Greer, do you think it might be appropriate to call this pool the South Totah?

A I think that probably would be a proper designation.

MR. PORTER: Any further questions? Witness may be excused.

MR. VERITY: We have nothing further. I believe you have possibly received some communications from other operators in the area.

MR. PAYNE: One, Mr. Verity, is all I have on hand.

MR. VERITY: You are going to put that in the record, I presume?

MR. PORTER: Will you read that telegram, Mr. Payne, please?

MR. PAYNE: The telegram is kind of garbled, but it says in effect that Pan American Petroleum Corporation agrees with the application that 80-acre temporary oil prorationing should be adopted in this pool.

MR. PORTER: Does anyone have anything further to offer in Case 2069?

MR. SPANN: I would like to make a statement. Charles Spann, 904 Simms Building, Albuquerque, New Mexico, representing El Paso Natural Gas Products Company.

El Paso Natural Gas Products owns a number of oil and gas leases, and six producing wells, near the area covered by the application in this case. These leases and wells may be part of the same common source of supply as the pool for which spacing is now sought. The entire area is still in the early stages of development; however, our present information indicates that one well will drain an area of at least 80 acres, and the economics of drilling even on this basis are still doubtful, for these reasons we believe the Commission should issue a temporary 80-acre order with provision for review when more information is available.

MR. PORTER: Anyone else have anything to offer in this case? Commission will take the case under advisement and take up next Case No. 2017.

STATE OF NEW MEXICO)
) ss
COUNTY OF BERNALILLO)

I, JUNE PAIGE, Court Reporter, do hereby certify that the foregoing and attached transcript of proceedings before the New Mexico Oil Conservation Commission at Santa Fe, New Mexico, is a true and correct record to the best of my knowledge, skill and ability.

IN WITNESS WHEREOF I have affixed my hand and notarial seal this 23rd day of September, 1960.

June Paige
Notary Public - Court Reporter

My Commission expires:

May 11, 1964.

BEFORE THE
OIL CONSERVATION COMMISSION
Roswell, New Mexico
October 18, 1961

REGULAR HEARING

IN THE MATTER OF:
Application of Benson-Montin-Greer Drilling Corporation for the establishment of 80-acre oil proration units in the Cha Cha-Gallup Oil Pool, San Juan County, New Mexico. Case 2069 will be reopened pursuant to Order No. R-1800 to permit the applicant and other interested parties to appear and show cause why the Cha Cha-Gallup Oil Pool should not be developed on 40-acre proration units.

CASE NO. 2069

TRANSCRIPT OF HEARING

EXAMINER PORTER: The hearing will come to order, please.

We will get under way with Case 2069, next on the Docket. Before we do, I want to read a telegram which we just received, addressed to the Chairman of the Commission.

"To let you know that I cannot be with you in person this year. However, I should like to convey to you and my friends, my best wishes for a most successful and oil productive meeting.

"Best regards, John M. Kelly, Acting Secretary".

As many of you recall, John has been very instrumental in helping us set up this Roswell hearing in the past.

Take up Case Number 2069; in the matter of the application of Benson-Montin-Greer Drilling Corporation for the establishment

of 80-acre spacing oil proration units in the Cha Cha-Gallup Oil Pool.

I would like to call for appearances, please.

MR. VERITY: George Verity for Benson-Montin-Greer.

MR. BRATTON: Howard Bratton for Humble Refining.

MR. BUELL: For Pan American Petroleum, Guy Buell. We will have one witness.

MR. WALSH: Ewell Walsh for El Paso Products Company.

MR. PORTER: As I understand it, we will have Benson-Montin-Greer, Humble, Pan American and El Paso. Does anyone else desire to present testimony?

We noticed that, during our break, we had microphones set up for the witnesses. We placed one over there (indicating) for the attorneys. If you feel like you will need one to make yourself heard, we will request the lawyers to use it so that the reporter and audience can hear you.

MR. VERITY: We will call Mr. Greer to the stand.

MR. MORRIS: Mr. Verity, do you plan to have more than one witness?

MR. VERITY: No. Just one.

MR. BUELL: Would you like to swear all the witnesses at one time?

MR. MORRIS: If it is possible.

(Witnesses sworn.)

ALBERT R. GREER,

called as a witness herein, having been first duly sworn on oath, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. VERITY:

Q State your name for the record, please.

A Albert R. Greer.

Q When this case was called about a year ago, initially, did you appear and testify at that time?

A Yes, sir, I did.

Q What is your educational background, Mr. Greer?

A I am a Petroleum Engineer, graduate of the New Mexico School of Mines.

Q You testified in this hearing as an expert witness?

MR. PORTER: Unless there is some question concerning him, we will accept his qualifications.

Q (By Mr. Verity) Mr. Greer, I hand you what was introduced at a previous hearing as Plaintiff's Exhibit Number One. Do you recall this exhibit?

A Yes, sir.

Q Was this prepared under your supervision?

A Yes, sir. It was.

Q Would you briefly, for the Commission, in order to bring them -- to refresh their memory concerning what has preceded in this case, briefly outline the information presented in this

Exhibit, the conclusions that were derived from it?

A Yes, sir. This Exhibit Number One from a previous hearing has a number of sections in which we outline the entire case. To begin with, as of a year ago, the pool was in its infancy. There had been only one well produced for about a year and six weeks, produced for a couple of months, and at that time we determined that the pool cound not be financially or economically produced on a spacing of less than 80 acres per well. So, we asked for a hearing early in the life of the pool, for 80-acre spacing.

We set out in the first exhibit the locations of the producing wells, their relation to the other wells in the area, and the correlative producing zones, with nearest production, which was in the Totah Field to the north. At that time, we determined that the producing intervals were in the same part as the Gallup formation as in the Totah Pool, but there was some question that the individual sands were exactly the same or that they could connect further on.

In Exhibit Number One we pointed out that it appeared quite important in that there were two producing zones and these zones, in themselves, were correlative across the area covered by producing wells. In other words, we felt that we were not dealing with a number of stray sands, with two sands which could be correlated and conclusively prove to be continuous across the area of production. We had performed an interference test or commenced

an interference test, by shutting in one of our wells, our Jones Number 3. And in a part of this exhibit we show the rate at which this built -- was building up pressure after having been shut in. At that time the well had been shut in a comparatively small time and had not yet reached its maximum pressure. Nevertheless, since the sands were continuous, we felt that this well, after reaching its maximum pressure, would begin to decline, even though it were not producing.

Because of production from offset wells, that particular test has been continued, and we would like to show the continuation and results of that particular test.

For that, we have some new exhibits.

Q Mr. Greer, first, what was the relation and what is the relation of the Jones Number 3 Well, with regard to wells around it?

A The Jones Number 3 was shut in shortly after it was flowed; I believe we produced it about ten days, established that it had a producing capacity of approximately 400 barrels per day, and shut the well in with an accumulated production of something around 3,000 barrels of oil.

Q Now, in your study a year ago and the information set out in Exhibit 1, did you make a conclusion with regard to what the proper spacing would be in the pools?

A We concluded that proper spacing would be at least 80 acres per well. On a closer spacing of 40 acres per well, it

would be economically unsound to produce the field; even at 80 acres per well, it didn't look like real good economics.

Q Mr. Greer, you started to say there was other conclusions that you previously drew?

A Yes, sir. In Section "Q" Of Exhibit Number 1, we had a more or less interpretive conclusion that one well would drain at least 140 acres. We estimated this from the initial reservoir pressure, the pressure measured in the Jones Number 2 and being shut in 13 days and extrapolated on out to a maximum pressure. This particular type of exhibit cannot be considered conclusive, but is a very good indicator to us that this first well was drawing at least 140 acres.

Q Mr. Greer, have the developments in the pools and reservoir characteristics observed since these exhibits were made caused any confirmation of the exhibits made at that time?

A Yes, sir. We feel we have definitely proven that communication and drainage exist over a rather large area.

(Whereupon, Applicant's Exhibit A marked for Identification.)

Q I hand you what the reporter has marked Exhibit A. Will you please tell us what this is?

A A complete schedule of continued bottom hole pressure taken on the Jones Number 3 while it was shut in and surrounding wells were producing. This covers a period of time from September 1 of 1960 to March 31 of 1961.

(Whereupon, Applicant's Exhibit B marked for identification.)

Q Mr. Greer, I hand you what the reporter has marked as Exhibit B. Will you please tell us what this is?

A Exhibit B is a summary of the oil produced, green oil, in the Cha Cha Pool up to and including March 31, 1961, which covers the same interval of time that the pressure test was taken on the shut-in well.

(Whereupon, Applicant's Exhibit C marked for identification.)

Q I hand you what has been marked Exhibit C. Will you please tell us what this is?

A Exhibit C is the complete pressure measured in the Jones Number 3 while it was shut in. Again, the cumulative oil production from the entire Jones Lease.

Also set out on the graph are the dates at which the pressures were taken.

As of the time of the hearing a year ago, the latest pressure information we had was that shown by the second point, dated September 10th, which shows on the graph to be a little over 1,500 pounds. Subsequent pressures taken shows that, although the well was shut in and never produced, the production from the adjoining wells caused the pressure in this particular well to decline, which, of course, is evidence of the drainage of the oil and gas away from this well to the other wells. There is a total

pressure drop of something over 200 pounds, from approximately 1,525 pounds to about 1,300 pounds in this interval from September until March.

We would like to point out in connection with this particular test that, although it doesn't show here, when we opened this well up in April, it had a productivity of 100 to 150 barrels per day, as compared to 400 barrels per day it had in August the year before when it was shut in.

Q Mr. Greer, does this interference test and the observations of fallen production and fallen pressure demonstrate the interpretation and conclusions that you made October, a year ago?

A Yes, sir. It does.

Q From this information, can you testify as to whether or not the oil under the Jones Number 3 well was being produced, even though it was shut in?

A That is correct. Even though this well was shut in, oil from under its tract was being produced by adjoining wells, and the radius of drainage on 80-acre spacing to which these wells were allocated, indicated a drainage capacity of these wells of at least 250 acres.

Q The location of these wells is on 80-acre spacing?

A That is correct.

Q So, when you shut in the 80-acre well, it actually leaves 160 -acre drainage, insofar as this immediate vicinity of where that well is?

A I believe, sir the drainage calculation is 250 acres, approximately.

MR. VERITY: We offer Exhibits A, B, and C in evidence.

MR. PORTER: Any questions concerning the exhibits? They will be admitted.

(Whereupon, Applicant's Exhibits A, B, and C admitted in evidence.)

MR. VERITY: That is all we have from this witness.

MR. PORTER: Any questions of Mr. Greer?

CROSS EXAMINATION

BY MR. MORRIS:

Q Mr. Greer, on your Jones Lease, now, how many wells do you have on that lease?

A Six wells.

Q Six wells producing 188,000 to March 30?

A To March 30.

Q Do you have a breakdown of how much production could be attributed to each well?

A No, sir. I don't have that.

Q Would that be impossible, since some of them have been shut in?

A It wouldn't be impossible. We could go back to our records, where we checked the well occasionally to see how much each one was producing, and I believe the oil allocated to the one shut-in well was distributed to two or three of the other

wells, but I don't have that information handy.

Q I believe at the last hearing of this matter you stated that, as to the Jones Number 2 Well, it had had something over 21,000 barrels attributed to it at that time. I was wondering, with respect to that well, if you could say how much would be allocated to it as of the date of your calculation?

A I don't have that. The reason we had the exact figures before was Number 2 was the only well on the lease. The Number 2 was a gas well originally. So, the figures were exact for that particular well.

Q I believe at the previous hearing of your case, as a result of your tabulations, you estimated 60,000 barrels recovery from a 40-acre tract. Is that figure still valid, or do you believe that has changed considerably?

A I believe, sir, with this additional information that we have, that I was too optimistic about our recoveries. A year ago I estimated about 1,500 barrels per acre, and I feel certain that the recoveries will be less than 1,000 barrels per acre.

Q Less than 1,000?

A Yes, sir. Possibly considerably less than 1,000.

Q Where in your calculations do you feel that you were in error, Mr. Greer?

A I believe I was in error with respect to efficiencies of recovery from the formation. We had very good information, I believe, on the sand thickness and porosity, and the only place

for error is that the Gallup formation is just evidencing a very poor formation in primary recovery.

Q Now, your original estimate was about the same recovery, somewhere between 15 and 18 per cent of the oil in place; is that the figure that you believe that was too high?

A Yes, sir. That is the figure that was too high.

MR. MORRIS: Thank you, sir.

MR. PORTER: Mr. Nutter?

CROSS EXAMINATION

BY MR. NUTTER:

A Mr. Greer, in the matter of economics, at the original hearing you stated that you would have recovery of 15 to 18 per cent, is that correct?

A That is correct.

Q What is the estimated recovery factor at the present time?

A It is going to be closer to 10 per cent.

Q Isn't a secondary production recovery contemplated in this?

A Yes, sir.

Q It will raise that figure above 10 per cent?

A Yes, sir. This is primary recovery percentage.

Q Primary recovery would be 10 per cent?

A Yes, sir.

Q What is the maximum amount of oil that any well that you

operate has produced to date?

A Well, it would be about -- I don't have accumulated dates. As of March 31 it would have been 30,000 barrels.

Q Are these wells on the Jones Lease capable of producing top allowable?

A No. Since April, I believe -- As a matter of fact, one of the reasons we discontinued our test was other wells to which allowable for the shut-in well had been allocated failed to make their allowable and an allowable for the shut-in well. At that time we opened it up and commenced -- I believe the next month all the wells failed to make their allowable, and we have been producing at capacity since that time.

Q Capacity is less than allowable?

A Yes, sir, considerably less. Our gas volume seems to be about the same. Oil dropped off and gas-oil ratios have increased four to five cubic feet per barrel?

Q As average GOR?

A I would judge that is, for now. Yes, sir.

Q Now, economics that you presented a year ago also did not go into the consideration of value of casinghead gas that would be produced?

A I believe that is true. We did not put anything about it in the exhibit. I believe we discussed it a little bit at the hearing. Our thinking then, and still is, the cost of gathering and compressing the casinghead gas is about the same as the

value of it. Therefore, we can't really say that it has any definite value other than enough to pay for the gathering and compressing.

Q Mr. Greer, the gas on the Jones lease has been gathered and sold for a considerable period of time?

A That is true. I believe we started compressing gas in February.

Q But the economical benefits of this gas that is sold won't change the economics of the lease as a whole?

A No, sir.

Q Now, your economics, at that time, also went into a trucking charge of approximately 36 cents per barrel. Are you now paying that trucking charge?

A No, sir. We do have pipeline connections to the point now. Though it does help considerably, it does not keep up with reduction in recovery. Total economics are worse than I estimated a year ago.

Q What is your estimate now, of recovery per acre; 1,000 barrels?

A A very maximum of 1,000. This point I don't understand. The recovery is so low, and it is just pretty evident that it is going to be low unless it takes some kind of drastic turn in the price range of two to three hundred, which at this time appears unlikely.

Q If you have a recovery of 10 per cent, you are going

to recover 1,000 barrels per acre. That would indicate there was, approximately ten times that, or 10,000 barrels per acre?

A There could have been.

Q Or 400,000 barrels per 40 acres?

A Yes, sir.

Q Do you have any estimate at all what the pressure the project will recover?

A We have had a couple of estimates which run on the order of recovering the same amount of oil by water flood as by primary methods; perhaps a little bit more if the recovery could be started early enough.

Q I see. So your maximum recovery in utilizing that pressure would be 20 per cent?

A Yes, sir.

MR. NUTTER: Thank you.

MR. PORTER: Any further questions?

You may be excused.

(Witness excused.)

MR. VERITY: That concludes our testimony.

RALPH C. WALKER,

called as a witness herein, having been first duly sworn on oath, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. BRATTON:

Q Will you state your name, please, by whom you are employed,

and in what capacity?

A Full name, Ralph C. Walker; Area Geologist for Humble Oil and Refining in Denver, Colorado.

Q Are you familiar with the Cha Cha-Gallup Pool? Is that within your area?

A Yes, sir. It is.

Q State very briefly your educational and experience background.

A I have a Bachelor of Science Degree from Harvard University, and I have been employed by various oil companies.

(Whereupon Humble's Exhibit No. 1 marked for identification.)

Q Mr. Walker, if you will go to the board, please sir, (witness complies) and refer to the exhibit that has been marked Humble's Exhibit Number 1. Explain briefly what that is, what it reflects.

A The first exhibit is a basic map showing the general area of the Cha Cha field which lies in Township 29 North, 14 West, and part of Township 28 North, Range 13 West.

It shows on it the wells. Below the wells are indicated the initial potential producing intervals, also completion dates. It shows two lines of cross sections, one running along the Northwest-Southeast strike of the field, and one Southwest-Northeast across the field; and in addition, it shows the limits of the pool

as established through the Commission's Order RR2048 of 1961.

Q Very briefly, what is the nature of the pool?

A The Cha Cha Pool produces a good grade of sand. It is a stratigraphic trap, bar-type of sand in the upper formation. There is no local structure associated with the accumulation. There is regional depth in the base of the northwest, and the sand does plunge 200 feet. The sub-surface then changes toward the southwest northeast parts and south a little.

Q There were two cross sections reflected there on Exhibit 1?

A Yes, sir, A prime down the strike of the field and B Prime across the sand developments.

(Whereupon, Humble's Exhibit No. 2 marked for identification.)

Q Referring to Exhibit No. 2, then, explain what that reflects, please.

A AA Prime stretches Northeast over part of the field to the Southeast. It is a stratigraphic cross section of productivity with interval, trap-like correlation showing the two producing sands, A and B sands. It very clearly demonstrates it and corroborates Mr. Greer's statement that the sands are continuous and correlative.

Q What, briefly, is the reef~~s~~ formation there, Mr. Walker?

A Immediately overlying the upper producing sand is a section of interspersed sands, of interspersed shale and of fine

grain sand shale, frequently fractured and bleeding oil. The upper sand is a finer grain sand, normally well cemented and relatively low in porosity and permeability, and frequently fractured.

(Whereupon, Humble's Exhibit No. 3 marked for identification.)

Q Referring you to BB Prime on Exhibit 3 --

A BB Prime extends from the Southwestern part of the field northeast across the productive area and with a great many intervals, and it also shows the two producing sands, again shows them to be correlative and thickening to the southwest and to the northeast.

Q Mr. Walker, based upon your examination, as reflected in these exhibits, is it your opinion that these sands are continuous throughout the pool?

A Yes, sir.

Q Is there anything further you would care to testify to with regard to Humble's Exhibits 1 through 3?

A I don't believe so.

Q Were these exhibits prepared by you or under your supervision?

A Yes, sir.

MR. BRATTON: We will offer Humble's Exhibits 1 through 3 in evidence.

MR. PORTER: Any questions concerning these exhibits?

Exhibits 1 through 3 will be admitted to the record.

(Whereupon, Humble's Exhibits 1 through 3 admitted in evidence.)

MR. BRATTON: We have no further questions at this time.

MR. PORTER: Anyone have any questions of Mr. Walker?

CROSS EXAMINATION

BY MR. NUTTER:

Q What is your initials?

A R. C.

MR. NUTTER: Thank you.

MR. PORTER: Does that conclude your questioning?

MR. NUTTER: Yes, sir.

FURTHER CROSS EXAMINATION

BY MR. MORRIS:

Q I notice on your Exhibit Number 3 that your Humble Well Number 13 is perforated in the 30 zone. That is above the two main zones. Is that well producing from that?

A At the present it is. That is a completely new fracture which we noticed in the course of supplementing of the wells. I do not believe that information was conclusive as to whether or not that section would produce any wells.

MR. MORRIS: Thank you.

MR. PORTER: Any further questions?

The witness may be excused.

(Witness excused.)

JAMES A. KELLY,

called as a witness herein, having been first duly sworn on oath, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. BRATTON:

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

A James A. Kelly. I am employed by Humble Oil and Refining Company as Area Engineer, located in Denver, Colorado.

Q Does the Cha Cha Pool in San Juan County, New Mexico, come under your jurisdiction?

A Yes, it does.

Q And you have testified before to this Commission?

A No, I have not.

Q Briefly state your educational background.

A I have a B.S. Degree in Engineering from Texas Technical College. I have been employed by various companies for 21 years.

Q Are the witness's qualifications accepted?

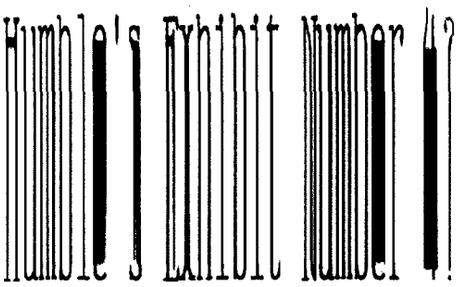
MR. PORTER: Yes, sir. They are.

Q Did Humble obtain from the Commission permission to run an interference test in the Cha Cha Pool?

A Yes. They did.

(Whereupon Humble's Exhibit No. 4 marked for identification.

Q Is the results of the interference test reflected in



A Yes. They are.

Q Would you go to Exhibit 4 and explain what it reflects, sir?

A On Humble's Exhibit 4 we have depicted the results of the interference test that was performed during the period of June 16 to August 14, 1961. The location of the interference test is shown on the small plate in the upper right-hand corner of the Exhibit.

Well Number 4 on the Navajo Lease was shut in. The wells surrounding, Numbers 2, 3, 6 and 7, were produced. The upper chart reflects bottom hole pressure measures taken from the shut-in well. The center bar represents the flowing bottom hole pressure in the four producing wells around it. The bottom section of the chart shows the producing rate of the four wells that were producing around the Well Number 4. That is the total or combined producing rate of the four wells.

As can be noted from this chart, when the test was started on June 16, the Well Number 4, shut in, bottom hole pressure was something in excess of 1,300, approximately 1,304. It did increase up to something in excess of 1,350 when the production of the off-setting wells began to show some effect on it in that the pressure itself in Well Number 4 did not rise to the point that it normally would had the wells or off-setting wells been shut in.

Twelve days after the well was shut in, a measure of pressure reduction occurred. It was rather slight at that time; however, such pressure indicated that it was -- really was valid.

The total pressure drop that occurred in Well Number 4 was 23 pounds per square inch in this period of June 16 to August 14, 1961, at which time the test was terminated.

I would like to point out that these wells are on 160-acre spacing.

Q So that even on a spacing pattern of 160 acres, in six weeks of shut-in test you experienced a 23-pound drop or decrease from the well?

A That is correct.

Q If the wells had been on 80-acre spacing, your decline would have been much more severe?

A Correct.

Q Does the pressure evidence you gave apply to the southeast portion of the pool?

A Yes. It does.

Q What conclusions did you draw from the pressure interference test?

A The sands are homogenous and continuous in that one well will certainly drain in excess of 80 acres.

Q Is there anything further you care to point out with relation to Number 4, Mr. Kelly?

A Not that I am aware of.

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

Q Referring to Humble's Exhibit Number 5, explain what it is and what it reflects.

Can the Commission hear all right?

MR. PORTER: Yes.

A On Humble's Exhibit Number 5 we have plotted the originally measured bottom hole pressure in various wells as a function of time when they were plotted. Also, we have plotted the cumulative production of the area in question. You will note on it that wells completed early, in the northwest section of the Cha Cha-Gallup Pool, that is, up on the Navajo Tribal land, somewhat removed from the southeast section where Mr. Greer's Jones lease is located; that the first wells had a pressure of or very near the shaded bottom hole pressure. But as time went on and production increased, it is very clearly reflected that production from wells completed ahead of any given well had affected the bottom hole pressure of the well. The result was that wells completed back in June or July or completed for some time has 150 to 170 square inches less bottom hole pressure.

Q Now, this evidence is primarily in the northwest portion of the pool?

A That is correct, confined largely to this area (indicating) shown here as Township 29 North, Range 14 West.

Q As Mr. Greer testified as to the southeast portion of the

A Correct.

Q Now, Mr. Kelly, there are some pressures on here that do not fall exactly in pattern. Would you care to comment briefly as to those, sir?

A Yes, I would be glad to. I do have supporting data which is available to the Commission or anyone else who desires to see it.

The fact that Well Number 8 on the Humble Lease would appear to be somewhat lower than it should be at the time concerned. However, some of the measures, as dated -- If you will examine the stage of development which I have handed to you, at this time, you will find that it would be hardly conceivable that Number 8 would have been fixed because of the location with respect to the other producing wells in the northwestern part of the Gallup Pool at that time.

Q Mr. Kelly, the four exhibits that are being handed to the Commission, which will be marked Humble's Exhibits 5A, B, C, and D, reflect the stage of development of the pool and accumulated production as of the dates of certain points on your graph?

(Whereupon, Humble's Exhibits 5A, B, and C marked for identification.)

A That is correct.

Q And those show that wells that are apparently exhausted can be explained by the fact that off-setting producers as of the date of completion of the work over was very small.

A That is correct. They show it very clearly.

Q In your opinion, Mr. Kelly, does Humble's Exhibit 5 with the supporting four graphs or four plats support the information which you have obtained from the pressure interference test; that is, one well will drain, efficiently drain, considerably in excess of 80 acres in this pool?

A That is correct.

Q All right. Now, is there anything further you would care to explain with relation to this exhibit?

A No.

(Whereupon, Humble's Exhibit 6 marked for identification.)

Q Turn to Exhibit Number 6 and explain it, sir.

A Well, now that the interference test and completion pressure has indicated that there is continuity of the sands for the reservoir length, we used these calculations to determine or to compute the average reservoir time, the time at 40-acre, 80-acre and 160-acre spaced wells. The points that are plotted on the graphs are various rates of velocity. You will notice that for 40-acre spacing the average reservoir pressure, at the time this was taken, was some 208 pounds per square inch.

For 80-acre spacing it is 212 pounds per square inch, for 160-acre spacing, 216 pounds per square inch, for a total difference of only 8 pounds. This does not take into consideration this time (indicating). It should be pointed out that this

(indicating) requires more time to achieve than this (indicating). However, we have **taken** it down to the same economic limit per well. In each case that economic limit was 4 barrels of oil per day.

Q What factor did you use in that computation, Mr. Kelly; what is your permeability?

A Permeability used -- Well, let me put it in terms more easily understood; average permeability in deriving at these facts was approximately 57 millidarcies, which is the permeability of the main or A sand.

Q In the Cha Cha Pool, what other factors did you use, Mr. Kelly?

A Well, we used the estimated flow rate of two down to four barrels per well per day. We used the well's **abandoned** pressure of 100 pounds per square inch, a formation volume factor of 1.13, and oil velocity of 7.68 and last, an average net pay thickness of seven and one-half feet. Those system --

Q What is your oil, calculated oil, left in place in the reservoir per additional pound of pressure?

A Well, I computed it for the recovering, here (indicating) to 28 to 216. The difference -- It comes out slightly less than 1,000 barrels total per well.

Q So that, going as we are, in this case, from 40- to 80-acre spacing, your amount left in the reservoir would be less than 500 barrels per 40-acre locations?

A Well --

Q Per 80-acre locations?

A For 80.

Q Which is an insignificant amount compared to cost of a 5,000-foot well?

A Correct.

Q Is there anything further you care to point out with regard to this Exhibit?

A No, there is not.

(Whereupon, Humble's Exhibit No. 7 marked for identification.)

Q Turn to Exhibit Number 7, which I do not believe is on the board.

A It is not. It is in the book that was handed out.

Q Would you explain it briefly?

A That was just an investigation of economics of the 40-acre spacing pattern in the Cha Cha Gallup Pool.

To prevent any confusion, we have within our own company some terms that are not used by other, such as lower-sand in the Cha Cha sand. Exhibit 7 shows A and B sands specifically with respect to the reservoir data for it. A sand shows 14.7. For the B sand, 7.7 per cent. Water, 35 per cent in the A sand, 40 per cent in the B sand; Formation Volume Factor, 1.334 in both sands. Average net pay thickness, 5.8 in the A sand and 2.9 in the B. Primary Sand Volume in acre-feet for A

sand, 272; for the B sand, 116. The primary recovery factors which we have compiled are 82 barrels per acre-foot for the A sand, 40 barrels for the acre-foot in B. The estimated Ultimate Production, gross barrels, 22,304 for the A sand and 4,640 for the B. The combined total is 26,944. Converting that to net production by deducting the one-eighth royalty reduces it to 23,576 barrels.

In the next tabulation following that we have estimated earnings, based upon current price information for this oil. The oil earnings at $2.70 per net barrel amounts to some $63,660.00. Gas earnings, relating it to barrels of oil we have committed at seventeen cents per net barrels.

Throughout the life, primary life, on 40-acre wells, total earnings would be 67,670; add operating expenses for the life, 19,010; overhead, 3,770; taxes, 4,060; for a total operating expense of 26,840. Deduct from that, then the investments for a 40-acre well the drilling and completions, 53,300; pump equipment, 11,000; lease equipment, 6,100, which would result in a net loss of some $29,570.

I might point out that the earnings do not even correspond with the direct cost of drilling, completed.

Q Now, this is calculated on the basis of an average well in the pool?

A That is correct.

Q The first well in the field, in the pool, would recover

more oil than you have reflected here?

A That is correct.

Q The latest well in the pool would recover less?

A That is correct.

Q Now, does this tally, roughly, with what Mr. Greer testified to?

A I would certainly say it does not disagree with him.

Q Your figures are somewhat more pessimistic than Mr. Greer's, then, as to your recovery?

A Apparently that is the case.

Q Even on 80-acre spacing, and assuming that a pressure water flood project was ventured, it would still not be enormously practical, would it?

A That is correct. I do not have those figures here, but I have made those computations.

Q Would your estimate of increased recovery by pressure maintenance or secondary recovery be approximately what Mr. Greer testified, that primary recovery would be better?

A Yes, I would - -

Q Is there anything else you care to testify to, with respect to your exhibits or the economics in the pool?

A No, sir. There is not.

Q Is there anything you would care to offer in your exhibits?

A No.

Q Were Humble's Exhibits 4 through 7 prepared by you or under your supervision?

A Yes. They were.

Q From those exhibits, Mr. Kelly, would it be your conclusion that one well in the Cha Cha-Gallup Pool could excessively drain in excess of 80 acres?

A Yes. That would be my conclusions.

Q Is it your conclusion that a drilling pattern of 40 acres would result in economic waste?

A Yes. That would be my conclusion.

MR. BRATTON: We would offer into evidence Humble's Exhibits 4 through 7, and we have nothing further from Mr. Kelly.

MR. PORTER: Humble's Exhibits 4 through 7 will be admitted.

(Whereupon, Humble's Exhibits 4 through 7 admitted in evidence.)

Are there any questions concerning the exhibits?

We will recess the hearing until 1:30, at which time the witness will be made available for cross-examination.

AFTERNOON SESSION

MR. PORTER: The hearing will come to order, please. We will ask Mr. Kelly to take the witness stand again.

JAMES A. KELLY,

recalled as a witness herein, having been previously sworn on oath, was examined and testified further as follows:

MR. PORTER: Mr. Bratton, I believe you had concluded your direct examination. Does anyone have any questions of Mr. Kelly?

CROSS EXAMINATION

BY MR. VERITY:

Q Mr. Kelly, referring to your Exhibit 4, if I understand you, you have a well shut in that is on a 160-acre spacing and 4 off-setting wells on 160-acre spacing?

A That is correct.

Q Does your observations in production in these other wells, your observations of the characteristics in that well, show that the other four wells are actually producing the oil from under that well?

A That is the conclusion I draw; certainly.

Q Does this testimony verify the fact?

A The testimony verifies it beyond all doubt.

Q If I also understand you, then, this production, in your opinion, continues to where the production under the shut-in well will be as great as in a 40-acre, except it will be only

1,000 barrels?

A Less than 1,000 barrels.

Q Less than 1,000 barrels?

A Yes.

Q If you went on 80-acre you would also have some production under the shut-in well, and you would only have 500 barrels?

A Correct.

Q Where you actually shut this in, your testimony stated that production is being had over that area?

A That is correct.

Q One other question: There was some testimony with regard to the fact that there might be water flood of this area. If this pool is water flooded, that is a brand new project, is it not?

A That is what I would consider it.

Q Sometimes water flood works, and sometimes it does not?

A There is a large degree of risk.

Q That is a little bit like going out and trying a new oil pool?

A To some extent.

Q It will cost money to produce any oil that is produced under water flood?

A That is correct.

MR. VERITY: That is all.

MR. PORTER: Anyone else have a question of Mr. Kelly?

CROSS EXAMINATION

BY MR. HUGHES:

Q Mr. Kelly, have you formulated any plan for water flooding, or how far along is the project?

A Mr. Hughes, we have formulated some plans. They are not finalized. In order to take best advantage of all the factors, we are attempting to embrace lands larger than our own lease by uniting with other companies, and I would say that we are well along on this negotiation, although they are not finalized, they are not complete. It is my hope that within the relatively near future we will have those completed, possibly within the next six months to a year. I would certainly hope within that time.

MR. HUGHES: Thank you.

MR. PORTER: Any further questions?

The witness may be excused.

(Witness excused.)

MR. PORTER: Mr. Buell?

MR. BUELL: We have one witness, Mr. Eaton, who has already been sworn.

MR. PORTER: Will you take the stand, please?

(Witness complies.)

GEORGE EATON,

called as a witness herein, having been first duly sworn on oath, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. BUELL:

Q Will you state your complete name, by whom you are employed, and in what capacity.

A George Eaton, General Petroleum Engineer for Pan American in Meramec, New Mexico.

Q Mr. Eaton, have you testified at prior Commission hearings, and your qualifications as a petroleum engineer been made part of the public record?

A Yes, sir. They are.

MR. PORTER: His qualifications are accepted.

(Whereupon, Pan American's Exhibit 1 marked for identification.)

Q Mr. Eaton, would you take a look, now, at what has been marked Exhibit Number 1?

A Yes, sir. Exhibit 1 is simply a tabulation of pertinent reservoir statistics and data for the Cha Cha-Gallup Pool.

Q Do you feel that any comments are necessary on that exhibit, or is it completely self-explanatory?

A I believe Exhibit 1 is self-explanatory.

(Whereupon, Pan Amercian's Exhibit 2 marked for identification.)

Q Go now, then, to Pan American's Exhibit Number 2.

A All right, sir. Exhibit 2 is a plot of various field information, main characteristics as functions of time.

Specifically plotted on Exhibit Number 2 are bottom hole pressure, cumulative production, number of wells producing, and monthly producing rates. All of these are things plotted as a function of time.

Q For the benefit of the record, if you would briefly comment on each curve reflected on Exhibit 2?

A All right. I will commence with the uppermost curve on Exhibit 2. That is a plot of the bottom hole pressure, performed in the Cha Cha-Gallup Pool. You will note that the initial reservoir pressure is approximately 1,560 PSI. It remained at approximately that same level until about the middle of 1960, at which time the bottom hole pressure commenced to decline and it continued to do so until, at the present time, the average reservoir pressure is about 1,160 PSI. That is the curve colored with a green line.

Proceeding downward, the red curve is the cumulative production curve. This curve shows that, until about the middle of 1960, there was a relatively small amount of cumulative production from the Cha Cha-Gallup Pool. Since that time, cumulative production increased regularly up until, at the present time, it amounts to approximately two and a half million barrels.

Moving downward again, the brown lines is the number of wells producing from the Cha Cha-Gallup Pool. That curve shows a rapid increase in number of wells producing, commencing about the first of July of 1960. It increased from that point

to the present day, at which there is nearly 80 wells producing.

The last curve which is shown, colored with an orange line, is the monthly producing rate. It has an attitude similar to the cumulative production curve and number of wells curve in that, beginning about the middle of 1960, it showed a sharp increase to the extent that, at the present time, monthly production amounts to 2,250 barrels per month.

Q Mr. Eaton, let me direct your attention back now to the uppermost curve, the green curve. Can you compare the cumulative production and the bottom hole pressure? Would the decline in the reservoir be abnormal?

A No, sir. You see, the cumulative production and bottom hole pressure curves meet each other going in the opposite direction, which is a perfectly normal reaction for those curves to take.

Q What type recovery mechanisms are experienced at this time?

A The recovery is solution-gas drive.

Q At that time, when you produce a barrel of oil you are going to record the pressure of the reservoir?

A That is our plan.

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

Q Going now to what has been marked Exhibit Number 3, what is that?

A Exhibit 3 is a base map of the Cha Cha-Gallup Pool area. It shows on it the NMOCC's defined pool limits of the Cha Cha-Gallup pool, which is shown by the heavy dash line. It shows there, on it (indicating) the completed wells in the Cha Cha-Gallup Pool; it is shown by the blue dots.

Q Do you intend to use that exhibit in connection with future exhibits to show drainage in this reservoir?

A Yes, sir. This exhibit will be used with all the remaining exhibits.

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

Q All right, sir. Go now to Exhibit Number 4. What does that exhibit reflect?

A Exhibit 4 actually consists of three separate parts, which I will describe each part briefly.

To begin with, across the top of the Exhibit 4 is a heavy red line which represents the initial reservoir pressure of the Cha Cha-Gallup Pool. That line shows that the initial reservoir pressure was 1,560 PSI.

The blue line represents the field average bottom hole pressure at various times during its life. That is shown with the blue line on Exhibit 4.

On the extreme right of the Exhibit 4 are shown three small squares. These small squares, with a well name beside them, is the initial pressure on new wells which were completed

in the life of this pool.

Q Mr. Eaton, let me ask you this question: Generally, before we get to discussing this data on the reservoir; generally, what is the significance of the appearance of the initial pressure subsequent to the completed well and the field average, as well as the original pressure? What is the significance?

A There is no pressure or communication between these lately drilled wells and the pool as a whole. These new wells should have a reservoir pressure of 1,560 PSI, which is the initial reservoir pressure. Likewise, because they are not in the area of the older developments, they should not be expected, necessarily, to extend bottom hole pressure exactly to the field average where new drilling results have been made. In other words, if there is a pressure communication between these new wells in an area of development, these initial pressures on the new wells should fall somewhere between the initial reservoir pressure and field average pressure at that time.

Q All right, sir. Let's discuss in detail the three initial pressures you have reflected on this exhibit. What is the first one?

A The first such pressure is on the **Gallinas Canyon** Number 103. The initial pressure on that well was 1,340 PSIG, at the time when the field average pressure was 1,559 PSIG.

Q That pressure is also substantially below the original reservoir pressure?

A Yes, sir. It was some 200 pounds below the initial reservoir pressure; lower, slightly.

Q Higher than the field average. This would show you that the reservoir pressure in that well was in effective communication with other producing wells in the pool?

A That is true.

Q Go to Exhibit 3 and locate, for the record, the well.

A Gallinas Canyon Number 103 is in the southeast quarter of Section 23, Township 29 North, Range 13 West. The area of that well is shown with this brown circle (indicating). The red arrow points to the well itself.

Q All right, sir. Now, within that, older producing wells have affected the reservoir pressure in the area of the well. How near is the nearest producing well to that well, when it was completed?

A At the time Number 103 was completed, the nearest producing well was Gallinas Canyon Unit Number 97, which is located up 1,500 feet from it.

Q Do you reduce that area, acre-wise?

A Yes, sir. The area of circle whose radius is 1,500 feet is 162 acres.

Q 162?

A Yes, sir.

Q That would show that in the area records the well is draining at a minimum of 162 acres?

A That is exactly what the data shows. As a minimum, Well Number 79 was contacting at least 162 acres of the reservoir.

Q All right, sir. Would you go now to the second initial pressure you have plotted on Exhibit 4?

A Yes, sir. The second pressure on Exhibit 4 is on the Tenneco Oil Company's Unit B-1. That pressure was 1,288 PSIG as compared to the initial reservoir pressure of 1,560 SPIG.

Q Again lower than the original pressure. All right, sir. Let's locate that well for the record, from Exhibit Number 3.

A The Tenneco Oil Unit B-1 is located in the northwest quarter -- southwest quarter, Section 31, Township 29 North, Range 13 West.

Q You have that area shaded a particular way on your Exhibit 3?

A That area is shaded green on Exhibit 3; the pressure point is shaded green on Exhibit 4.

Q Is the red arrow pointing to the particular well?

A The red arrow points to Tenneco Oil's Unit B-1.

Q All right. Signs were that this well was interfered, or rather the reservoir in that area was interfered with. How far away is the nearest producing well at the time that well was completed?

A The nearest producing well was some 2,000 feet away from the new well.

Q Would you convert that drainage for that well into acres,

for the record, please?

A That represents an area drainage of 288 acres.

Q Now, go to the third initial pressure you have marked on Exhibit 4; what is that, please?

A The third new well whose pressure is plotted on Exhibit 4 is the Wood Oil Unit. That well had an initial pressure of 1,267 as compared to the initial reservoir pressure of 1,560.

Q Again indicating effecting pressure communication?

A Yes, sir.

Q Would you locate that well on the Exhibit 3?

A The Wood Oil Unit Number 11 is located in the Southeast Quarter, Section 17, Township 2) North, Range 15 West. It is colored in yellow on Exhibit 3. The red arrow again points to the well.

Q All right, sir. At the time that well was completed, how far away was the nearest then producing well?

A The nearest well to the Wood Oil Unit is about 1,400 feet away from that well.

Q All right, sir. For the record, would you convert that drainage area to acres, please, sir?

A The area circled whose radius is 1,400 feet is 141 acres. At the time that well was placed, it was off-set, it was affected by pressure communication in an area of 141 acres.

Q Mr. Eaton, while are still there at Exhibit 3, would you comment on whether or not the location of the well, the three

wells upon which you have discussed their initial well completion pressure. How are they located throughout the pool?

A The three wells are so located that one of them is in the extreme northwest portion of the pool, one is located about the center portion of the pool, one is located at the extreme southeast end of the pool.

Q Certainly covering those three areas like they do, would that indicate to you that that performance is representative of the entire pool?

A Yes, sir. In my opinion this geographical distribution of this data indicates that the entire pool is capable of draining an area much greater than 80 acres.

Q All right, sir. Mr. Eaton, do you want to come back to your chair?

Did you satisfy yourself, Mr. Eaton, that these initial pressures you have been discussing is completely built-up pressure?

A Yes, sir, I did.

Q Have you prepared an Exhibit to show build-up characteristics on one of the wells?

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

A Yes, sir. If we can refer to Exhibit Number 5, which is a tabulation of the pressure data which was shown on Exhibit 4 for the three new wells. Two of the wells, namely Unit Number 103 and Tenneco Oil Unit, were simply one point, as

far as -- In other words, the well was shut in; after a certain amount of shut-in time, the pressure board was lowered into the well and the pressure obtained. On the Wood Oil Number 1 the build-up curve was obtained -- The top portion of Exhibit Number 5 shows the pressures which were obtained during that build-up period.

Q Would you briefly discuss those build-up characterists?

A All right, sir. After a shut-in period of one day, 12 hours, that is 5 minutes to bottom hole pressure, the board recorded a pressure at the bottom of 467 PSI. It immediately built up until after ten hours shut-in time a bottom hole pressure of 1,265 PSI was recorded.

This next point is rather significant; after 30 hours shut-in time the bottom hole pressure only built up two more PSIs. After 76 hours shut-in time there was no more build-up over what was obtained after 30 hours shut-in. In other words, after 30 hours shut-in period the well was completely built up.

Q And both of the other wells whose pressure you used were shut in in excess of 30 hours prior to running the test?

A That is true. The indications from the Number 103, the pressure was taken after 32 hours shut-in time, and the Tenneco Oil Company's Unit bottom hole pressure was obtained after 34 hours and a half shut-in time.

Q Are you satisfied, Mr. Eaton, then, that all three pressures represent, good, the build-up pressure?

A Yes, sir. I would say that they do.

Q Mr. Eaton, would it be proper to describe the data that you testified to as interference data?

A That would be proper for that data.

Q It is a form of interference study?

A It is a type of interference study.

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

Q All right. Would you look now to what has been marked Exhibit Number 6. What does that exhibit reflect?

A Exhibit 6 is a graphical illustration of the data obtained by special interference test. This particular test was conducted on Pan American's Navajo "E" Number 3.

Q In connection with that, would you state generally what you mean by "special interference study"?

A In a special interference test, a key well or control well is chosen and completely shut in. Other wells in the vicinity are continued to be produced. The bottom hole pressure is immediately obtained from the control well, that is, the shut-in well. Observations are made. If there is any change in that bottom hole pressure in the control well -- our records are from the control well.

Q What well did you use for this special test?

A The control well or shut-in well was Navajo Tribal "E" Number 3.

Q All right, sir. Would you now discuss for the record the data presented on Exhibit 6, which was gathered during this special interference test?

A Yes, sir. Actually a tabulation of data, which is plotted on Exhibit 6, are shown in tabulation form on Exhibit 6. The well was shut in on March 9, 1961. Immediately thereafter, an increase in bottom hole-pressure was observed. The maximum bottom hole pressure which was observed occurred two days later on March 11, 1961. During that two-day shut-in period, the bottom-hole pressure had increased to 1,440 PSI. Subsequent bottom-hole pressures was obtained periodically on the shut-in well more frequently after the trend was established -- less frequently, but never again was the bottom-hole pressure on the Navajo Tribal "E" Number 3 ever as great as 1,440 PSI, which measured two days after shut in. The bottom-hole pressure declined as shown by Exhibit 6, continued until the test was discontinued on September 29, 1961.

Q What would you, as an engineer, say a pressure decline such as this, shut in and not producing; what can it mean to you?

A The only thing that it can mean is that the area in the vicinity of the Navajo Tribal "E" Number 3 bore is being affected by withdrawal rates of the other wells in the Cha Cha-Gallup reservoir. In other words, this well's bore's ineffective pressure shows effective interference with the other portions of the Gallup reservoir which are producing.

Q Let's go now over to Exhibit 3 and locate this control well for the record.

A The Navajo Tribal "E" 3 is located in the southwest quarter, Section 21, Township 29 North, Range 14 West. The area of that well is colored with an orange circle; the red arrow points to the control well or shut-in well.

Q All right, sir. At the time this data was gathered, what was the nearest producing well, to your control well?

A The nearest producing well to this control well was located 2,180 feet away.

Q Would you convert that drainage area into acres, please?

A Again, the area of the circle whose radius is 2,180 feet, is 342 acres. In other words, the nearest producing well to the shut-in Navajo Tribal "E"3 is contacting and is in effective pressure communication with a minimum of 342 acres of reservoir.

Q Mr. Eaton, has this pool been on a temporary 80-acre spacing order?

Q Yes, sir. It has.

A In your opinion, based on the data that you have just reconstructed for the Commission, do you feel that one well completed in that reservoir will effectively and sufficiently drain in excess of 80 acres?

A Yes, sir.

Q Do you feel that drilling and developing this field on a spacing pattern more dense than that would simplify and eliminate the drilling

of many unnecessary wells?

A Yes, sir. It would.

Q What is your engineering recommendation to the Commission?

A It is my recommendation that the temporary 80-acre proration order established for the Cha Cha-Gallup Pool be made permanent.

Q Do you have anything else you would care to add?

A No, sir. I believe not.

MR. BUELL: May it please the Commission, that concludes our direct.

May I formally offer Pan American's Exhibits 1 through 6A?

MR. PORTER: There being no objections, the Exhibits will be admitted.

(Whereupon, Pan American's Exhibits 1 through 6A admitted in evidence.)

MR. PORTER: Any questions?

CROSS EXAMINATION

BY MR. NUTTER:

Q Mr. Eaton, the original reservoir pressure was 1,560?

A Yes, sir.

Q And, then, the results of subsequent wells that were drilled with pressure lowered or lower than 1,560 pounds you have drawn these circles around those (indicating)?

A The three circled on Exhibit 3 were drawn on the basis

of that.

Q The three circles colored orange are the results of the special interference test?

A Yes, sir.

Q Mr. Eaton, these circles are perfect drawn circles?

A Yes, sir.

Q Is it your testimony that these sands in this reservoir is taken in by the radius of the circles or on a radial basis?

A Yes, sir. Substantially so. Maybe not perfect; no radial drainage is perfect. We tried to make a duplication of the reservoir conditions.

Q The radial flow formula used was the last one you find in the books?

A Yes, sir.

Q But if it were elliptical, using pressure interference data from a well down the strike of the pool, this might not come out to be 343 acres; it might be somewhat less than that if it were drawn on an elliptical basis?

A Yes, sir. That would be possible. I will point out that this shut-in well, in reference to nearby wells, it is not necessarily in the center of the pool. There is apparently some effect across the dip of the pool.

Q Likewise, this orange circle may include some that may not be productive?

A The orange circle assumes that this area is producing.

Q The sand is thinning out at the time you drilled Navajo "E" Number 3, is it not?

A Definitely. I believe the Navajo Tribal "E" 2, which is the nearest well to the shut-in well, had a thinner sand section than the shut-in well itself.

Q If you will proceed further southwest, to the southwest side of the orange circle, there might be no sand thickness at all, is that correct?

A That could be; yes, sir. I don't know where the productive limits are.

Q One more question: Assuming that the interference data is correct, either on newly completed wells as compared with the old original pressure on the special interference test; is there any data as to how effective the data is of the drainage? You show a decrease, but does it show how effective the drainage is?

A I can acknowledge it better by referring to Mr. Kelly's exhibit which shows the difference in effectiveness in drainage over 40 acres, 80 acres, and 160 acres. I can answer it this way: The bottom-hole pressure observed on this interference test well in September, 1961, very clearly approximates the average Cha Cha-Gallup Pool pressure at the same time. It is in an area that has been developed for a considerable length of time. It is not a step-out area where there are undeveloped areas, areas of undeveloped oil on beyond the new well, as was the case in the Wood Oil unit and Gallinas Canyon unit.

Q Do you have any estimates as to recovery per acre or economics of the 40-acre well versus 80 acres; have you done any work on that?

A I can only say that I am substantially in agreement with Mr. Kelly's estimates. No, sir, I haven't done any particular work on that.

Q You have made no estimates as to barrels per acre or foot or barrels per acre?

A I will answer that this way: I worked on the northwest Cha Cha engineering committee and on the southeast engineering committee, and on both the committees it closely approximates the estimates made by Mr. Kelly.

Q What was the estimate of percentage of recovery of the original oil in place that would be made?

A We ran a terbal during the early life of this pool on a Pan American Univac machine. It came up with a recovery factor of 13.7 per cent of the oil in place. Data that we have obtained since then leads me to believe that that is high.

Q Mr. Eaton, one further question: You have been observing fields in the San Juan Basin for a considerable length of time. Has it been your experience, or have you observed that in quite a few cases the recovery from the Gallup sands has been higher as time went on than it was originally estimated?

A I believe the opposite has been my observations.

Q The Gallup is sorrier than indicated at first?

A Perhaps I have been too optimistic to begin with. I don't believe I have ever had an opportunity to be on the other side of the fence. I have always been on the high side.

Q I see.

MR. NUTTER: I believe that is all.

MR. PORTER: Anyone else have a question?

Witness may be excused.

(Witness excused.)

This concludes the testimony in the case.

We will hear any statements that anyone would like to make for the record.

MR. BRATOON: Howard Bratton for Humble.

This reservoir is an example of the wisdom of the establishing of a temporary proration unit in excess of the minimum. We know that the Commission is conscious of the fact, that temporary proration of width or spacing is necessary, if it is continued in the field to a later date, whereas it is more difficult to attempt to expand from temporary proration than a permanent spacing. Thus it is important that large proration units be in effect while the reservoir is being drilled and continued in effect while necessary data is being gathered to determine after completion what is needed to minimize the economic waste and physical waste of natural resources.

In this instance it is evident from the performance data from the reservoir, the only evidence presented here today is

that it could be effectively drained by proration units in excess of 40 acres in that portion of the field. It has already been developed on the 80-acre proration.

Based on that, Humble will concur with the application of Benson-Montin-Greer that the temporary rule be made permanent.

MR. VERITY: That the conclusions that were drawn one year ago from the meager information that was available at that time; that is, meager in comparison with what is here today; that these mathematical and conservative engineering conclusions were accurate as has been demonstrated by the fact that predictions were made a year ago are now demonstrated in the overall field production.

We think that this is significant in showing that geological engineering, if not absolutely accurate, is a sign, and certainly a dependable one, and engineering conclusions that are drawn on accurate information is reliable.

We think the Commission did proper a year ago in establishing a minimum of 80 acres. We think it should be continued.

MR. PORTER: Any further comments?

MR. WALSH: Reservoir performance data indicates to El Paso Natural Gas, --

MR. PORTER: I believe you will have to come closer so the reporter can get this statement.

MR. WALSH: -- indicates to the El Paso Natural Gas Products Company that 80 acres can efficiently and economically

be drained by one well, and in fact, to develop on 40 acres would not be economically feasible production.

We will not burden the Commission with additional evidence. In view of the facts presented by Benson-Montin-Greer, we believe clear and convincing evidence presented, that one well will efficiently drain not only 80 acres but in excess of 80 acres.

We recommend the present temporary rule providing for 80 acres be made permanent.

MR. PORTER: Any further comments?

I believe Mr. Morris has some communications.

MR. MORRIS: Yes, sir. I have three communications which I will offer into the record but will not read verbatum, from Tenneco Oil Company, Texaco, Inc., and Southern Union Production Company, all concurring in the application of Benson-Montin-Greer for permanent 80-acre proration units in the Cha Cha-Gallup Oil Pool.

MR. PORTER: If there is nothing further to be offered, we will take the care under advisement and pick up the Southeastern Nomenclature Case 2401.

STATE OF NEW MEXICO)
) ss
COUNTY OF BERNALILLO)

I, CECIL R. LANGFORD, Court Reporter, 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 machine shorthand 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.

NOTARY PUBLIC

My Commission Expires: