BEFORE THE
OIL CONSERVATION COMMISSION
SANTA FE, NEW MEXICO
SEPTEMBER 30, 1959

IN THE MATTER OF:

Application of Southwestern Hydrocarbon Company for an order abolishing the Sawyer-San Andres and South Sawyer-San Andres Oil Pools in Lea County, New Mexico, and creating the Sawyer-San Andres Gas Pool; or in the alternative for an order extending the horizontal limits of the South Sawyer-San Andres Oil Pool to include the NE/4 of Section 6, the N/2 of Section 5 and the NW/4 of Section 4, Township 10 South, Range 38 East, Lea County, New Mexico, and removing all gas-oil ratio limitations for wells in said pool; or in the alternative for an order combining the Sawyer-San Andres and the South Sawyer-San Andres Oil Pools, as well as the intervening acreage, and removing all gas-oil ratio limitations for such pool.

CASE NO. 1763

BEFORE:

Mr. Daniel S. Nutter
Mr. Oliver Payne

TRANSCRIPT OF PROCEEDINGS

MR. NUTTER: The hearing will come to order, please. We will take next Case 1763.

MR. PAYNE: Case 1763. Application of Southwestern Hydrocarbon Company for an order abolishing the Sawyer-San Andres and South Sawyer-San Andres Oil Pools in Lea County, New Mexico, and creating the Sawyer-San Andres Gas Pool; or in the alternative for an order extending the horizontal limits of the South Sawyer-San Andres Oil Pool to include the NE/4 of Section 6, the N/2 of

I N D E X

Section 5 and the NW/4 of Section 4, Township 10 South, Range 38 East, Lea County, New Mexico.

MR. CAMPBELL: Mr. Examiner, Jack Campbell, Campbell and Russell, Roswell, New Mexico, appearing on behalf of the Applicant.

MR. BRATTON: Howard Bratton, Hervey, Dow and Hinkle, appearing on behalf of Alamo Corporation.

MR. CAMPBELL: I have one witness. I believe Mr. Bratton has a witness.

(Witnesses sworn.)

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J O H N A. S H E L D O N, a witness called by and on behalf of the Applicant, having been duly sworn, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. CAMPBELL:

Q Will you state your name, please?

A John Sheldon.

Q Where do you live, Mr. Sheldon?

A Roswell, New Mexico.

Q What is your profession?

A I'm a consulting geologist. I am on a retainer for Southwestern Hydrocarbon Company.

Q Will you give the Examiner a brief description of your educational and professional background?

A I was graduated from Texas A. and M. College with a B. S. in petroleum engineering in 1951. From that date through October '58, I was employed by Gulf Oil Corporation in various capacities in the geophysical and geographical department. At the time I left Gulf, I was subsurface geologist, and I have been on a retainer from Southwestern Hydrocarbon Company for one year.

Q During that time, have you continued working in the area that is involved in this application?

A Yes, sir, I have.

MR. CAMPBELL: Are the witness' qualifications as a geologist and engineer acceptable?

MR. NUTTER: Yes, sir. Please proceed.

Q (By Mr. Campbell) Mr. Sheldon, are you acquainted with the application of Southwestern Hydrocarbon Company in the case now pending?

A Yes.

Q You are aware, are you not, that that application was prepared and filed in such a manner that it contains several possible alternatives in connection with this matter?

A Yes.

Q Since the filing of this application, have you and Southwestern Hydrocarbon Company come to a conclusion as to the method that you propose to request the Commission to use in this field?

A Yes. In view of our subsurface studies, pre-existing

wells, and the wells that we have just completed NE/4 of Section 6, the N/2 of Section 5 and the NW/4 of Section 4, Township 10 South, Range 38 East, Lea County, New Mexico, we feel that in order to continue development, or continue exploration in the area, that we could not do so through any means other than the classification of, or reclassification of Sawyer-San Andres and South Sawyer-San Andres as a Gas Pool, assuming Statewide regulations as to spacing for these wells.

Q Then you are requesting that the area referred to in the application be defined as a Gas Pool, is that correct?

A Yes, that is correct.

Q Mr. Sheldon, I'm going to refer you to what has been identified as Exhibit Number 1, which I believe is the exhibit, large exhibit on the board there on the right, and ask you to state what that is?

A Exhibit Number 1 is a subsurface structure map contoured on the top of the San Andres formation, contouring intervals of 25 feet.

Q Just a moment. Now, will you refer to that particular map and tell the Examiner what interests Southwestern Hydrocarbon has in that area?

A Southwestern Hydrocarbon has farmouts by a Federal operating agreement from Union Oil Company and Sinclair Oil and Gas Company. We have 480 acres within the outlined area, and our acreage is concentrated in Section 31 of 9 South, 38 East,

and Sections 4 and 5 of Township 10 South, 38 East.

Q Now, referring further to that particular exhibit, and the map features of it, will you explain to the Commission, the Examiner what your understanding is of the history of this area insofar as nomenclature is concerned, with particular reference to the Sawyer-San Andres Pool and the South Sawyer-San Andres Pool, and the recent nomenclature of this area?

A Well, as I understand it, the Sawyer-San Andres includes Sections 13 and 24 of 9-37, Sections 18, 19, 20, 21, 28, 29, and 30 of Township 9 South, 38 East; that is the last designations, I believe, of an order dated August 18.

Q That order of August 18 added to the Sawyer-San Andres Pool what area?

A Actually added Sections 20, 21, 28, and 29.

Q And deleted the SW of the SW of 28, is that correct?

A Right; right.

Q And then what is the present definition of the South Sawyer-San Andres Pool?

A Well, the South Sawyer-San Andres would include the NW/4 of Section 6 of Township 10 South, 38 East, the S/2 of Section 31 and 32, and the SW/4 of Section 33 of 9 South 38 East, the W/2 of the NW/4 of Section 33.

Q So the way it stands now, the N/2 of Section 31 and the N/2 of Section 32 are not included in any pool?

A Are undesignated at the present time.

Q Now, where is the well that you have recently completed?

A We recently completed our Number 1 Union Federal in the NE/4 of the NW/4 of Section 5, Township 10 South, 38 East.

Q That is not presently included within the defined limit of any pool, is it?

A It has not been assigned, it has not been annexed to the South Sawyer as yet, but it is a direct offset to that pool.

Q Now, is the area outlined in red on Exhibit Number 1, the contour map on top of the San Andres, the area that you now propose to include within a single gas pool?

A Yes, it is.

Q It would involve the addition of Section 25, and the N/2 of Sections 31 and 32, and the NE/4 of Section 6, N/2 of Section 5, and the NW/4 of Section 4, is that correct?

A Yes, that is correct.

Q Now, referring to the contour on top of the San Andres, which is the one appearing on your right on the board there, and the first item on Exhibit 1, will you state what that is, and what it indicates?

A Well, it is my interpretation, according to the subsurface strata here, that we definitely indicate the presence of a subsurface structure which is centered in the area outlined.

It indicates probable closure, and I feel that the closure does exist. Our West-East point of dip, or critical dip would be to the North, and we don't have sufficient control to show a reversal there. However, it is a pretty well defined subsurface feature, and it shows that the present limits of the South Sawyer and the Sawyer, show that both fields are included on this one subsurface feature. Actually, one is located in the Northwest flank in the North half of the structure, and the other is in the Southeast flank of this subsurface structure. We feel that at this time that our, we have in the outlined area, we have 14 wells that have been drilled. I believe two or three in that area, let's see, two in the area actually their initial targets were the Devonian; and one was plugged back and completed as a gas well in Section 25, whereas the other well in Section 20, the Warren Number 1 Border Unit is, right now is the only dry hole in the outline.

Q Have there been some gas wells drilled that have not been produced in the area?

A Well, all our gas wells are presently shut-in; at least, those wells are currently designated as gas wells. Our well was completed on August 15th this year, and its status is now shut-in.

Q Based upon the information you have, as indicated by the contour map on top of the San Andres, is it your opinion that it might be reasonably said that the area encompassed in the

red line there, is a common source of supply?

A Yes, that is our opinion, based on our subsurface and engineering studies in the area.

Q Now, refer to the other contour map which appears on the left there, which I believe is a contour on the porosity of the San Andres?

A It is contoured on top of the zone. It is usually designated in this area as a San Andres porosity, it is actually the top of the first porosity, it is found in the San Andres dolmite, and may or may not be continuous.

Q What does that particular contour indicate, particularly in relation to the --

A It shows that our San Andres porosity, at least this map indicates, that we do have closure, that structure would be, you'd have to classify it as a structural trap, rather than a stratographical trap; it is conformable to the top of the San Andres line, so the marker that was used, or this type of porosity is definitely a good marker to map on in the area.

Q Now, in connection with your studies, and in connection with these contour maps, have you prepared any cross sections in the area?

A Yes, I prepared two cross sections.

Q Refer first to the one that appears as the third item on Exhibit Number 1.

A That would be a generally North-South cross section.

Q Here is a large scale. Now, referring to that North-South cross section, would you identify the wells and explain to the Examiner what that indicates in reference to your prior testimony?

A This North-South -- generally, the general direction is a North-South cross section, North on the left and South on the right. We have traced off that portion of the electric, or gamma ray neutron log in the vicinity of the San Andres porosity. And here, we are submitting this to support our contour maps on the porosity, showing that we, this at least from the Robinson Brothers Number 1 Unit Federal, is a plugged and abandoned well in the SW/4 of Section 5, extend North to the SW/4 Number 1 Union Federal, North to the what is now Union Number 1 Crosby Federal originally drilled as the George Livermore Number 1 Crosby Federal, and further North to Section 29, the Alamo Number 1 McCormick, then on to the Alamo Number 1 Federal and the Gulf Number 1 Banbert Federal.

Q How does that particular cross section generally confirm your contours on the top of the porosity?

A Well, I've shown by markers here; actually, it is kind of hard to see on this blown up scale, on the small one it is more apparent; but we picked the top of the first porosity in the San Andres, and here in the North-South cross section we show that we do have an apparent closure. This part here is just a little , to the North, dip between these two wells, would be

primarily suggestive, at least the change of depth. Another thing that this cross section will show is that there is a considerable difference from a quantatitive approach of the porosity in this area; we start out with a pretty well developed porosity zone that has been divided into upper and lower porosity down the flank, porosity of total footage, porosity footage, porosity diminishes as you go up to the top of the structure. I have actually outlined in red here zones of which we would interpret as porosity like, strictly from electric or gamma ray log bases, and it shows here that your porosity does diminish over the top of this structure. And, from that relationship, comparing that with production histories and subsurface data concerning porosity and permeability that we would also, our permeability would diminish over the top of this feature, and relative permeability to gas as compared to oil would be increased.

Q Now, have you made a similar cross section East-West?

A Yes, sir. East-West cross section is a generally East-West cross section.

Q It's the last item on the Exhibit Number 1?

A This cross section primarily shows an East-West turnover or closure in an East-West direction. Now, this is a generally East-West, and we try to keep most of the wells in the New Mexico portion, we could place some wells on the buckshot over here, but this will show variations in porosity across this way too (indicating), but we do show quite a bit of turnover.

This is highly magnified, comparing a horizontal scale to a vertical scale, but it is enough to suggest that we do have a subsurface feature in the area.

Q It tends to confirm the structure?

A It confirms our structure. Also, we can see where we have a pretty well developed porosity here in the Texas-Pacific Coal and Oil Federal Number 1, the porosity again diminished over the top of the structure. This one particular log is a microlog on the Ohio Number 1 Caruth Federal, which is a shut-in gas well.

Q You have recently completed a well, as you have indicated, in the southern portion of this area, have you not?

A Yes.

Q Do you have a log of that well?

A This log is displayed here.

Q I believe that is contained, Mr. Examiner, in Exhibit Number 2.

A That's the lower portion of the log?

Q Will you explain to the Examiner the log of that well, and its completion data testing information you might have on it?

A Well, actually we can see the front of the log here, the log portion of the San Andres; we topped our San Andres porosity at 4935, or minus datum of 990. We drilled to a total depth of 5,000 feet, and on the basis of combining our core analysis with gamma ray neutron log interpretation, we felt that

our best chances for completing this well would be in this upper zone of porosity, which is shown right here (indicating). You have a hard spot that separates it from the lower zone of porosity; we did perforate roughly 15 feet of lower porosity.

Another reason for attempting completion in the upper porosity was on the basis of the failures of the Robinson Brothers Number 1 Union and Number 1 Warren-Federal in Sections 5 and 6 not shown on these cross sections, you'll have to refer back to the original subsurface map to the Southwestern Drilling Company Number 1 Atlantic failure, all three wells attempted completions in the lower porosity first and failed; and secondly attemped to complete up in the higher porosity where they didn't have as high a fluid separation, but from structural bases it looked like a better place to complete it.

But I have several reasons why these wells have failed. Some of them I feel had poor water shut-off in their cement job, or squeeze job; or the reason I think which was the primary basis, the wells drilled on the South and West flank there seem to exhibit a much more fractured porosity than wells drilled in the other parts of the area, and I know that when you are dealing with fractured porosity, you are subject to quite a bit of co-mingling or communication between water, oil and gas, if you have three distinct levels. So we went ahead and completed in our upper porosity first, and we feel that we have a well that is commercial, commercially, that we could actually not only return our investment

but make a moderate profit.

Q What would the test on that well reflect?

A Our test comprised of 4. back pressure test that was run by Sinclair Oil and Gas Company by Ray Lauer, their gas analyst, and on the 24-hour point which we consider to be the most important point, it is actually the longest test in the whole series of pressure checks, the well potentialed or gauged at 1,538,000 cubic feet of gas and roughly eight and a half barrels of fluid, which we estimate roughly six and a half barrels of acid water, a barrel and a half of salt water, and a trace of oil which we estimated at a half a barrel of oil.

One characteristic of the test indicated that as you open the choke sizes and reduce the bottom hole pressure, that the well tends to make additional fluid, or your quantity of fluids are increased. However, our well shows that we are producing quite a bit of salt water with the gas, so that is another reason that we at this time, we would not attempt to complete in the lower porosity. We had three failures to the South of us and also indication in the hard spot of the core analysis that there exists a high water saturation.

Q Mr. Sheldon, you are aware, are you not, that in the area of the South San Andres Pool where your well is situated, there is a limiting gas-oil ratio of 2,000 to 1?

A Yes, I'm aware of that.

Q That there is no such limiting ratio in the Sawyer-

San Andres Pool at the South?

A Right.

Q Assume that 2,000 to 1 ratio remained in effect in the South area where your well is situated, could you operate your well and could you drill on any of the additional acreage you have available to you?

A We could not, because income from gas which would be our sole source of income, would be restricted so it would be very uneconomical.

Q If you were permitted to produce this as a gas well, and if this area is defined as a gas pool, is there any market for the gas that might be produced?

A Yes, we have been approached by Sinclair Oil and Gas, who have recently laid a pipeline to the area extending Southwest out of the Buckshot Pool, and tying it into the line I believe from the Crossroad pools to the Gladiolia plant, and they have approached us on purchasing the gas; and as yet we have not discussed prices, but as soon as we completed the well, they approached us immediately.

Q In your Exhibit Number 2, the first item appears to be a letter dated August 12, 1959, from Sinclair Oil and Gas Company, and in that letter did they advise that they would provide marketing facilities for gas if you could produce the gas?

A As I remember the letter, they indicated they wanted to be considered a prospective purchaser of gas, of gas production,

and I don't recall that any other statements were made other than that.

Q Is any of the gas being produced in the area now being marketed?

A As I understand it, I don't believe so, at least out of the New Mexico portion.

Q And with a limiting gas-oil ratio, you would be unable to produce enough gas to make it attractive for a purchaser, is that correct, or yourself?

A That is correct.

Q For what reason, Mr. Sheldon, do you feel that this should be classified as a gas pool?

A Well, from our studies, which combine subsurface studies from a geological standpoint and also from studies made from production data and also some of the engineering data taken from some of the other wells in the area, we feel that the reservoir contains over the greatest percentage of the acreage enclosed in this outline, will be predominantly gas. Your permeabilities and porosities are such, which I hope I exhibited on this cross section, where your proper porosities have been reduced over the main portion of this structure, and also in this area where your porosities and permeabilities have been reduced, it actually makes up, I would say, in excess of 75 percent of the acreage in that particular area, that I feel that your production or your, or let's say on yar permeabilities would be more conducive to

producing gas.

Now, all the wells, as I understand it, drilled in this area, as all the other areas, that have penetrated the San Andres porosity in the Lea County, have initial show of porosity at the start, but your San Andres porosity is primarily a pinpoint porosity, is very tight as a whole, and we are counting on fractured porosity as being our main reservoir in this area.

Q If this reservoir is developed as a gas reservoir, with the regular Statewide spacing pattern of 160 acres, will you be able to, from an investment point of view, continue to develop the acreage that you have available to you?

A We feel that based on our current subsurface engineering data made available as of this date, we could continue operations of the area; though they will be somewaht marginal, it is by no means, it is not an attractive area from an exploration standpoint, but on a thoroughly correct spacing and cautious development, I believe that the operators can make a moderate income.

Q Do you believe that that can be done without causing waste?

A I don't believe that we'll have any waste; I feel you will have more waste under an oil well type spacing.

Q Why is that?

A Well, on the oil well type spacing you will be drilling less than 160-acres, and I actually believe that gas, at

least from the standpoint of the gas, that we can drain 160 acres, we can drain 160 acres from our gas, but if you space it less than 40's -- well, actually that is a hard point right there to come by.

Q Do you believe that the only way that you can economically recover the recoverable portion of the resources under this area is to treat this as a gas reservoir, and sell the gas and produce the oil that you get with the gas?

A We feel that is the only route right now.

Q So that you would lose ultimate recovery of oil and gas if some relief of this nature is not provided, is that correct?

A Yes.

Q Now, refer to your exhibit Number 2, Mr. Sheldon, and advise the Examiner what you have included in that exhibit by way of the additional information?

A Well, I have included a letter and test results of our 4. back pressure test. Now, this test was run for our own accord, we felt we had a gas well at the time of the completion, and so, as I understand it, we have to get State permission. If once they classify this as a gas well, the State will request us to run a 4. back pressure test. Now, this test was run according to the rules and regulations, however, we did not get a straight line on our pressure, on our pressures here on this plot of our various amounts of production with your pressure. Our 24-hour point and our first pressure point line up in a straight line,

in that it was roughly 45 degrees, which I believe is optimum, and the result indicated that we have a calculated absolute open flow of 1,292,000 cubic feet.

Next, we presented a copy of our log which we submitted to the United States Geological Survey when we completed the well, and it contains complete well history. And the other exhibits would be a photostat of the lower portion of the gamma ray neutron log, and a verifax copy of the core analysis.

Q Do you have anything further at this time that you wish to add, Mr. Sheldon?

A No.

MR. CAMPBELL: That's all the questions I have at this time.

MR. NUTTER: Any questions of Mr. Sheldon?

MR. PAYNE: Yes, sir.

CROSS EXAMINATION

BY MR. PAYNE:

Q Mr. Sheldon, what are the gravities of the fluids in the area?

A Most of your oil that has been produced in the area I believe runs around 25 to 28 gravity, and it varies; at least that's the figures I think that Cactus Petroleum has.

Q And how about the gas-oil ratios of the various wells in this general area?

A I believe another witness could give you those gas-

oil ratios; I have a general idea, I know that in some of them, well, if we calculate a gas-oil ratio on our well, if we assume that our well produced half a barrel of oil, would be in excess of three million to one, which would be excessive. I think there is another left, one other well that has a gas-oil ratio in excess of three million to one, and I want to restrict my testimony to that of a geological nature.

QUESTIONS BY MR. NUTTER:

Q Mr. Sheldon, what control do you have to draw these contour maps that you have submitted here?

A The control, I think I show that there are 14 wells contained within the area.

Q Within the red outline?

A Within the red outline, and there is three additional wells to the South,and some of the wells to the North in the vicinity of the Sawyer Devonian pool.

Q Now, all of these, I presume that all of these wells by which you show a minus number --

A A minus number is a minus datum, reference is subsea.

Q But these are the tops of the San Andres formation on the wells that you had the control on?

A Right, subsea datum.

Q Now, how many wells are currently producing within this red area?

A Right now I believe we have, let's see, I believe I have here tabulated, one, two -- five oil wells or wells that are

classified as oil wells, some of which are high gas-oil ratio. Pardon me, there is seven.

MR. CAMPBELL: Mr. Nutter, I might say that Mr. Keller has the production history and the present production status of these wells, and we will present it. This witness probably does not have that data at hand.

A It is not at hand.

MR. NUTTER: I was going to ask the witness a geological question as soon as I established how many wells there were in the area, Mr. Campbell.

Q (By Mr. Nutter) Now,there are seven producing wells in this area?

A Right.

Q Now, are those all producing from the same interval of porosity, for example, that your Southwestern Hydrocarbon Number 1 Unit are producing from?

A I think you can see from this cross section in this general East-West cross section that Texas-Pacific Coal and Oil well down in Section 33 is producing in the upper portion of the San Andres porosity; Western Number 1, Great Western, completed their well in the lower portion which is considered the second porous zone, if you wanted to break the porosity down.

Q Now, you don't have the information on the gas-oil ratios and so forth, the other witness will furnish that?

A I believe so.

Q What interval is the Alamo Number 1 McCormick producing from?

A It is producing from the lower porosity.

Q How about the Ohio Number 1 Caruth?

A The Ohio Number 1 Caruth is owned by the Western Natural Gas, but it is a shut-in gas well and it is completed in the upper portion of the porosity.

Q Is the DeKalb Number 1 Ohio a producing well?

A It is producing oil from what I interpret to be the upper portion of the San Andres porosity. If we compare it to a common datum, let's see, one minus 1,000 feet from subsurface, we can see that we've got various points here from a structural standpoint, that we've completed these wells. Texas-Pacific Coal and Oil completed theirs in the upper, and as I understand it is still a gas-oil well. Great Western, I mean, Western Number 1 Federal completed, from a structural standpoint the perforations are lower in this section, and they completed it as a high gas-oil ratio.

Q How do you account for this, as you go from one well to the next that the optimum seems to vacillate between upper porosity and lower porosity?

A Some of the operators complete their wells solely on the basis of core analysis.

Q Do you know enough about the gas-oil ratio in this area, whether there is a general correlation where the wells are

completed and the excess oil ratio of the well?

A Well, I feel that, all I can do is surmise, I feel that over the major portion of the area that I have outlined on this subsurface structure map, that I think we are going to end up with, over the central portion, has extremely high gas-oil ratio wells, which I would classify them as gas wells.

Q Have you been able to determine whether there is any portion of that structure that seems to have a higher gas-oil shows than another?

A I would say the higher portion.

Q Do you think this is a gas cap situation with an oil rim around it, or an oil pool below it?

A It would be kind of hard to say that, because on the South side of our well we have dry holes that were completed, I mean, that produced as high as 90 percent water.

Q You stated that was in that fractured porosity, didn't you?

A Well, I would say to an extent you do have fractured porosity over the whole area, but it seems to be more pronounced on your steepest flanks of this structure, which would be the West flank and possibly the South flank here.

Q I believe you also stated, Mr. Sheldon, that if you had completed your well in other than the upper porosity, that perhaps you would have gotten a higher saturation of water?

A Well if -- that would be correct.

Q Do you think there possibly could have been a higher saturation of oil also?

A No, if there was a possibility of getting increased oil saturation, I think it would be immediately coned out by water, because there would be such a thin interval.

Q I see.

A Now, where we do have some of our lower gas-oil ratio, I could tell you, which seems to be a unique situation, which I think can be explained; geological areas where you have a general dip, or from a structural standpoint where we have re-entries of the contours, and as I said before, your porosity seems to increase as you go downdip in a vertical extent, and also in percentages, but it is, over-all it is rather a spotty situation. But some of those wells like the DeKalb well, it is low enough downdip where I think he completed their well to about 16 barrels a day, which is definitely uneconomically. I note Texas-Pacific Coal and Oil well had a very low gas-oil ratio, but I'm led to believe now from talking to the lease pumper, that the gas seems to be on the increase, apparently on the increase, I don't have any factual data to support that.

Q As far as you know, is your well, the Southwestern Hydrocarbon Number 1 you own the highest, is it the best gas well in the pool, or in the area? Does it have the highest potential?

A I don't know what basis Gulf, originally, the Devonian Company drilled their gas well up in the northern portion of

Section 18, it was turned in for 2,700,000 cubic feet.

Q And that is a shut-in gas well now?

A That is a shut-in gas well presently, and that was in this area of the original Sawyer pool.

Q Now, is that completed in the upper or lower porosity?

A I believe that well is completed open hole, and I would have to check my total depth, but I have an idea it is open to the whole zone of porosity. Yes, that would be open hole, so I would say the whole zone of porosity that was penetrated by the drill bit is exposed.

Q And you don't know the gas-oil ratio of that well?

A They turned it in as 2,700,000 cubic feet per day.

Q Do you know the amount of liquid it made?

A No, my sources of information, which were major oil companies' completion cards, does not say anything about liquid content.

Q Perhaps the other witness will be able to answer that. Mr. Sheldon, the Commission in its order R-199, which was entered November 13th, 1952, exceptsthe Sawyer-San Andres Pool from the gas-oil ratio requirements of Rule 506. In that order, the Commission found that the following, quote, "The following pools in Eddy, Lea, Chaves and Roosevelt Counties, New Mexico, by reason of their low productivity of oil and gas, should be exempted from those rules". Do you feel now that those wells that have been completed as gas wells should be exempted from

the rule?

A Unlimited volume?

Q Yes, sir, this was an exception from the gas-oil ratio limitations.

A Well, I believe that all these wells in this area that can produce either gas or oil are going to have to be exempted in order to get anything out of the wells.

Q Would this still come under this same reason that the original Sawyer Pool was exempted, that is, because of its low productivity of oil and gas?

A Well, I believe that this definitely is a marginal area, if that is what you are getting at, that it should not be prorated; if so, I think that any future development will be, continuous production of these wells, will be very uneconomical.

Q You wouldn't produce this well unless you had a gas connection for it, would you?

A No, we couldn't. We wouldn't have anything to produce but gas.

Q Even if it were classified as an oil pool, you wouldn't produce it?

A No, I don't see how we can -- well, you could produce it under your unlimited gas-oil ratio, but we feel that it would be most uneconomical, and at the same time, if we feel that an offset well was drilled to our well, that both wells would, at least their ultimate recoveries would be greatly reduced.

As I said before, we feel that this predominantly is a gas pool, and it seems to be, that's based on our subsurface and engineering studies, and we feel that the volume of gas, recoverable gas, compared to the recoverable oil, will be very much higher, or very much greater.

Q If the pool were to remain classified as an oil pool, do you think there should be any gas-oil restrictions at all, gas-oil ratio restrictions, or should it be completely unlimited as the Sawyer Pool is at the present time?

A Well, I wouldn't go -- I mean, I wouldn't recommend any restrictions at all, because I think that you would end up shutting in all the wells that are currently producing, because the production is very marginal; there is only one particular well I think making around 25 barrels a day, but if you --

Q You think that is a gas well, or an oil well?

A Right now it is classified as an oil well, but I feel it has high enough of a gas-oil-ratio, that I personally would classify it as a gas well. If you restrict the gas production, you will also restrict the oil production when you hook your well back, because you will be putting more back pressure on your formation; at least, that seems to be the character of our well, varying the choke sizes.

Q Would you have any recommendation on how a well should be handled if it were determined that it were an oil well, and this is a gas pool?

A It is my understanding in some pools in New Mexico, that an oil well drilled in a gas pool will be allowed to produce its top allowable, unit allowable, or that allowable that would be given to it under an oil pool classification, and it should be drilled -- we feel on an economic analysis of area, that it wouldn't be profitable to drill up anything less than 160-acre spacing; so we would even recommend a 160-acre spacing on an oil well.

Q Well now, if you did have a gas pool, and a well was encountered which may or may not be an oil pool, what criterion would you recommend to the Commission they use to judge whether that well is a gas well or an oil well?

A I rather study the situation a little more before I make a statement to that effect, or present a criterion.

Q Do you think there is a possibility of encountering an oil well in this area?

A I think the possibility is remote; on one particular area we might have a possibility of getting another oil well over on this side over here (indicating), down in this area, but I believe that on the basis of our subsurface contours that most of this area will be high gas-oil ratio.

Q Do you think there is any direct communication between this area and the Buckshot Pool in Texas?

A They are producing out of comparable zone, what we call the San Andres porosity, but right now I couldn't make a

statement on that, I don't think that we have sufficient evidence. My subsurface maps suggest, some contours over here suggest a break, from a structural standpoint, but we are producing out of the same porosity, but your developments of porosity are very erratic. I think that your Buckshot is primarily a stratographic trap, where your updips limits are terminated by termination of porosity.

Q Has the suggestion that there are two separate areas, has that been substantiated by dry holes in the area?

A There is one or two dry holes in the area, but I'm not actually prepared to make a positive statement to that effect, but I believe those wells were drilled previous to the discovery on the Buckshot pool. I'm not that well acquainted with the area.

Q What is the Buckshot pool, is that a gas pool, or oil pool?

A It is a gas pool.

MR. NUTTER: Does anyone have any further questions of Mr. Sheldon?

(No response.)

MR. NUTTER: He may be excused.

MR. CAMPBELL: I would like to offer Applicant's Exhibits 1 and 2 in evidence.

MR. NUTTER: Applicant's Exhibits 1 and 2 will be received in evidence. It is 10 minutes after 12:00, I think we will recess the hearing until 1:30.

(Recess.)

AFTERNOON SESSION

1:30 P.M., WEDNESDAY, SEPTEMBER 30, 1959

MR. NUTTER: The Hearing will come to order, please. I believe we are on Case 1763.

MR. BRANTON: If the Commission please, Alamo Corporation would like to support the request heretofore made in this case by Southwestern Hydrocarbon. Our evidence will be presented by one witness, by Mr. Keller.

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W. O. K E L L E R, a witness called by and on behalf of Alamo Corporation, having been previously sworn, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. BRANTON:

Q Will you state your name, address, and occupation, please?

A W. O. Keller, of Fort Worth, Texas, consulting petroleum engineer.

Q Mr. Keller, I believe you have previously testified before this Commission?

A Yes, sir.

Q Mr. Keller, have you made a study of the area encompassed in the Sawyer-South Sawyer area involved in Case Number 1763?

A Yes, I have. I might explain that in June of this

year the Alamo Corporation came to us for our ideas about what they should do in respect to developing that area. And at that time, we investigated the area and concluded that it could not be economically developed as an oil field, but that it looked like there was a good opportunity that it could be economically developed as an -- a gas field. Now, of course, the primary reason for this conclusion was that almost without exception the oil wells, or oil and gas wells, or pure gas wells drilled in the area are not what I would call economical wells; that is, the reserves and productivities of the wells is so low that it is not an attractive business proposition to drill them as oil wells. In many of the cases, the value of the indicated gas reserves in the wells far outweigh the value of the oil.

Q Based upon your studies in this area, have you prepared certain exhibits reflecting the structure of the area, and the producing history and the core analysis information of the area?

A Yes, sir, I have tried to.

MR. BRATTON: Excuse me a minute. Off the record.

(Discussion off the record.)

Q (By Mr. Bratton) Referring to Exhibit Number 1 --

MR. NUTTER: How are these -- have these actually been identified yet, Mr. Bratton?

MR. BRATTON: Exhibit Number 1 is the structure map; we'll mark that Exhibit 1.

(Thereupon document referred to above was marked Alamo Corporation's Exhibit Number 1, for identification.)

Q (By Mr. Bratton) Referring to Exhibit Number 1, the structure map of the area, Mr. Keller, will you explain what that is, and what it reflects?

A Yes, sir. If I might, I would like to explain that what I have attempted to do by the exhibits on the board is to present as concisely and as quickly as I can, the pertinent data from which I arrived at the conclusion in respect to the development of this area which I just previously stated.

Before getting into Exhibit Number 1, I would like to explain that the production, the San Andres production from this area, comes from two porous zones located about 700 feet below the top of the San Andres formation. Now, these zones have been recognized and correlated throughout a very large area in the Sawyer area and extending on East and South way down into Texas; in fact, these are the same zones that produce oil and gas in the Lavaland Field, and even in the Sauterne Field. As litological members, they are quite persistent over a large area.

The first zone in the Sawyer area is generally approximately 40 feet in thickness; underlying the first zone is usually a dense break of ten to twenty feet, although in some of the wells, the dense break disappears. Zone two if also in the neighborhood generally of 40 to 50 feet. Now, the structural condition on top of the first zone porosities are depicted on Exhibit Number 1.

The contour interval ahown on Exhibit Number 1 is 20 feet. Also, shown on Exhibit Number 1, by a colored code are the zones of completion in the various wells, that is, the zones of San Andres completions in the various wells located on the map. The wells circled in red are completed in the first porous zone; the wells circled in green are second zone completions. Those wells that are open to both zones will have both a red and green circle around them. The structure in the Sawyer area is what I would describe as an anticlinal nose extending southward as I am indicating; the high is apparently located at this position in the vicinity of the southeast corner of Section 19, Range 38 East, Township 9 South; actually this is the first zone, first porous zone.

MR. NUTTER: Mr. Keller, I believe you mentioned Section 19, didn't you --

A Yes, I did.

MR. NUTTER: -- rather than Section 9?

A Yes, sir, Section 19, excuse me. The regional structure on the first zone of porosity in the San Andres is a broad monocline dipping generally to the South, and the structural anticlinal nose shown on the Exhibit Number 1 in the Sawyer area, is superimposed on top of this regional monoclinal situation.

Now, the accumulation of oil and gas and water not only in the Sawyer area, but on East of the Sawyer area, is a somewhat complicated thing. Generally, there is some correlation between

the occurrence of oil, water and gas with structural position. However, that correlation is not very accurate; there are as many exceptions to it as there are confirmations to it. So actually I think that the accumulation on the position of oil, water and gas structurally is generally controlled to some extent by structure, but probably predominantly by litological conditions; that is primarily the nature of the porosity and permeability development in the various zones. It is not possible to tie down definite oil-water, and gas-oil contacts.

The general character of the two producing zones is reflected by the core analysis data summarized on Exhibit Number 2. I was able to obtain core analysis data on ten wells in the area, eight of which cored the second zone, and ten of which cored the first zone; there are two wells where only the first zone was cored.

I might point out what the character of the producing formation is, as indicated by the core analysis data. First of all, this entire area is very tight, the permeability is extremely low. That's reflected by the core analysis data, and as we will see later, it is also reflected by the low producing capacity of the wells. For example, just -- by the way, I might also add that the core data on the first zone is shown in red on Exhibit Number 2, and on the second zone in green. The permeability, for example, reading off some of the representative numbers, 1.2, .7 millidarcies, .7 millidarcies, .2 millidarcies, .4, 2.7, 3.0,

1.9, 2.7, on the DeKalb well it was 10.3. Now, actually that is not representative because there was one sample in there that had a permability of a hundred and thirty some odd millidarcies, which brought the average up considerably. Coming on down the South end, .9 millidarcies, .7, 2.7 millidarcies. In the Southwestern Hydrocarbon well and the Robinson Federal dry hole, the permeability was 7.3 and 12.7, but unfortunately the zones were water productive in that well where we had this unusually high permeability development for this area. The Western Drilling Company's Atlantic Federal had permeability of 2.7 in the first zone, and 29.9 in the second; again, unfortunately the 29.9 permeability zone was water bearing. So when considering that portion of the cored intervals in these wells that's indicated productive of oil and gas, the permeability development is unusually low, generally less than one millidarcy with a few averaging up 1, 2 and 3 millidarcies.

In respect to porosity development, we have a somewhat similar situation. Without going over the individual wells, the average porosities per zone, by wells rather, is generally from about 5 percent to 9 percent, and averages somewhere around 7 or 8 percent, which is not, compared to other San Andres fields, good porosity development. I would classify it as poor porosity development.

Now, these core analyses data also showed, analyzed the oil saturation, without going into the individual wells, the oil

saturation from the core analysis data, generally averaged from 10 to 20 percent. Now, the unusual thing about the oil saturation picture in the core analysis, regardless of whether the well actually tested water in that zone, or tested oil, or high ratio oil production, or pure gas, there does not seem to be any core analysis with oil saturation, it all has oil saturation whether it is productive of oil, water, or gas, and that's generally true throughout that whole area. I mean, you can drill a well anywhere in that large area north of Slaughter and extending North and West up to the Sawyer area, and you'll get oil shows in the San Andres.

MR. NUTTER: Is this 20 percent oil saturation rather uniform regardless of whether it is oil, water, or gas?

A Well, it is not uniform, it is just haphazard, Mr. Nutter. For example, let me show you, in the Robinson Brothers Union Federal the first zone tested 29 percent oil saturation; the second zone half as much, 14½ percent oil saturation. Yet, on test of those zones, both of those zones produced predominantly water. The first zone which had the highest oil saturation tested 50 percent water, the second zone tested 90 percent water.

Now, as we will see later, the only low gas-oil ratio well, with a possible exception of one well or two wells that I don't have the gas-oil ratio data on, which is the Texas-Pacific Coal and Oil Gandy Number 1, the oil saturation measured in the core in that well in the producing zone, which is the first zone, is

13.1 percent. Yet, in the Southwestern Hydrocarbon well, which had only half a barrel approximately of oil and about a million and a half of gas on test, it had 12.9 percent which for all practical purposes is the same, and yet one of the wells is a gas well, and the other is a low gas-oil ratio well. So what it boils down to is those oil saturations don't seem to have any bearing on what the well will produce. Now, my explanation of that is this: That in the wells that tested oil and water and can't be completed commercially, probably the oil saturation you are measuring in the core is fairly close to what it is in the reservoir.

Now, in the -- in these gas wells and extremely high gas-oil ratio oil wells, probably the oil saturation you are measuring in the core is slightly less than what the true saturation under reservoir condition is. In other words, in those gas wells and high gas-oil ratio oil wells, the oil and gas is, I think, right in the same porous space, and it is impossible to produce the oil without producing the gas, and conversely, because they occupy the same porous space. It is not a gravity segregation situation where you have an oil, a gas-oil contact.

Now, the water saturation measured in those cores generally averages from 25 to 40 percent water saturation. That, I believe, pretty well shows what the general nature of the producing zones are in the area from core analysis data, and it's characterized by very low permeability development, and low porosity development.

Q Referring to your Exhibit Number 3, the productivity and tests of the various wells, do you also have the information from that tabulated, from Exhibit 3, do you have that tabulated, Mr. Keller?

A Yes, sir, I have some of the data shown on Exhibit 3 tabulated on the exhibit, which we might call Exhibit 4.

On Exhibit 3, I've tried to summarize briefly the data in respect to the test and productivity of the various wells in the two zones in the area. Now, just to summarize briefly what that situation looks like, in the Sawyer area I find that there is one low gas-oil ratio oil well that I know of, that is the Texas-Pacific Gandy Number 1 which I previously mentioned. That well produced about 20 barrels per day, and was produced in that capacity from July, so it is about a 20-barrel oil well; and I'm informed that in taking gas-oil ratio tests, the gas is too small to measure, so it is a gas-oil ratio oil well.

Now, there are two wells that produced oil that I don't have, I couldn't get a data on what the gas-oil ratio was; one of those wells is the DeKalb well which produced during July an average of about 13 barrels a day, and the other is the Gulf-Brown well located in Section 19, which during July produced about 4 and a half barrels per day. I've indicated it on Exhibit Number 3, but of those, let's see, the Gulf well is producing from the first zone I believe, and the DeKalb well is also producing from the first zone, so we have one low ratio well, and two small oil

wells that I don't have any gas data on.

Now, in addition, there are ten wells that are either gas wells or gas wells that produce small quantities of oil, which may be thought of as either oil wells with high gas-oil ratios, or as gas wells which produce a little bit of oil. It is a matter of sematics on the thing. But I might run briefly over the productivity of the wells that we have some data on, or about. Starting in the north, the Gulf-Landreth Number 1 well is shut-in gas well which was completed in 1948, and the scout report shows that it tested about 2,700,000 MCF per day. It has been acidized and it has a show of oil, but apparently the oil didn't amount to anything, and it is my understanding that well has been shut-in since that time. Coming on south, the Great Western Drilling Company's Brown Number 1 was tested in June of this year, it tested 270 MCF of gas, 10 barrels of oil, and 4.2 barrels of water, with a gas-oil ratio of 26,200 to 1 from the first zone. Now, that's one of the oldest oil producing wells in the area, it's been producing since 1948 and has produced a little over 31,000 barrels of oil; during July it produced a total, according to reported information, of 22 barrels so apparently it is not produced full time.

Q Mr. Keller, how much oil has been produced from the whole area during the entire life of the area?

A Well, sir, checking the production records in the area, I find that there has been about, 80 or 85,000 barrels of

oil produced since the first well was drilled in the area from the San Andres, and that comes from seven wells, that's the total production to date, and I believe the first was in 1948, so that's about eleven years.

MR. NUTTER: Do you have any idea how much gas has been produced?

A No, sir, I don't, Mr. Nutter. It has not been measured, and you might make some kind of an estimate based on what meager gas-oil ratio you have, but other than that -- I don't think it has been very substantial because,from the areas as a whole.

The next well is the Alamo-Brown well, that well was tested in June of this year, it tested a million seven hundred seventy MCF of gas, plus ten barrels of oil, with a ratio of 173,000 to 1. I already mentioned the Gulf-Brown well, it's, I don't have a test on that well, but it produced four and a half barrels per day on the average in July, and it's produced to date, that is to August 1st, approximately 24,000 barrels of oil and it is down to four and a half barrels apparently.

The DeKalb well, I do not have a test on that well. It produced 12.7 barrels per day on the average in July, and the production record shows that it hasonly produced about 2,775 barrels of oil.

The Western Natural Gas well, Caruth Federal Number 1, had a reported potential of 735 MCF per day, plus ten barrels of oil,

plus 17 barrels of water, with a ration of 73,500 from the first zone; second zone was not tested.

The Great Western-Byers Federal Number 1 was tested in August 1958, tested 320 MCF a day, plus 3 barrels of oil for a ratio of 160,700. That well does not have any recorded production; it is my understanding it's shut in as a gas well.

The Alamo McCormick Number 1 is completed in the second zone; it was tested in June '59 with 946 MCF of gas, and 4.2 barrels of oil, with a ratio of 66,700; and it has produced to August 1st, 1219 barrels of oil.

The Western Drilling Company's Robert Gandy Number 1 well is completed in the second zone, it was -- I have a test on it in June 1959 where it produced a million two hundred eighty-seven thousand cubic feet of gas and about 25 barrels of oil, for a gas-oil ratio of 50,600. It's a fairly recent well, and it has produced about 12,164 barrels of oil as of August 1st.

I've already mentioned the Texas-Pacific well, it is a low gas-oil ratio, about a 20-barrel well. The cumulative production to date is 11,753 barrels.

MR. NUTTER: What was that figure again?

A 11,753 barrels. By the way, these cumulative production figures that I'm testifying to are also shown on this Exhibit Number 1.

The Livermore-Crosby Number 1 well, located in Section 31, is a shut-in gas well. It was completed in 1950, and the scout

card shows a potential of 385 MCF per day.

Then I think the Southwestern Hydrocarbon Corporation well, its status is already in the record, it is a gas well which only produced a trace of oil, and it had an open flow calculated of about a million one hundred thousand, produced a million and a half on test.

Q (By Mr. Bratton) Is there anything further you want to testify to as to the nature or productivity history of the pool, Mr. Keller?

A Yes, there is. We have before us a question of whether this is a gas field or an oil field, and it's been my conclusion after looking at the data that it is neither beast nor fowl, it is a hybrid situation. Actually, most of the reserves in the area are the gas reserves, and I think the gas reserves value-wise and volumewise far outweigh the oil reserves. As I previously mentioned, although there is a general relationship between the occurrence of water and gas on structure, you can't rely on it because of the variations in the permeability and porosity situation. For example, referring to Exhibit Number 1, we've talked about this Robinson Brothers Union Federal Number 1 which tested water and was completed in zone one, and also zone two.

Now, going over East into the Buckshot Field, we can see that in that same interval - by the way, that's a datum of about a minus 1051 on top of the first zone - in that same interval we've got oil wells producing where water was produced; and so to

my mind that illustrates the fact of these litologically changes on the occurrence of production. I mean, had this been a permeable continuous situation, in each of the zones, then you would have to have had cores of datum where water is found and where the gas is found. In the field itself, for example, the Southwestern Hydrocarbon well which is completed in the first zone as a gas well, is at a datum of minus 989, and didn't, produced a little water but not much. It's at a similar datum to this Featherstone well, and also the Western Drilling Company's well. The Western well tested water in the first zone at about the same datum that the Southwestern Hydrocarbon well tested gas, with very little water. Then the Featherstone well tested 158 MCF per day of gas from the first zone, plus 30 barrels of water per day.

Q (By Mr. Bratton) Mr. Keller, if this area were defined as a gas pool and produced as a gas pool, in your opinion would it have any effect on the Buckshot pool?

A Well, let me say this, that my correlations between wells in the Sawyer area that I've been discussing, and the Buckshot area, show that both the areas are producing from the same zones of porosity. Now, as far as I know, there has not been any dry holes drilled directly in between the two, so you must certainly say that there is an opportunity for connection between the two. Now, I think the pertinent question there is whether that actual continuity to whatever extent it does or does not

extend,has any practical significance, that is by practical significance just meeting the question headon, would the withdrawals of gas from the Sawyer area adversely affect the oil recovery in the Buckshot area? Now, I'm not in a position, I don't believe anybody is in a position, to prove either way on that question. I'm of the opinion that the probability is that there will not be any affect on the Buckshot field if this Sawyer area is classified as a gas area and produced as such.

Now, the reason I say that is several fold. First of all, if there is some degree of communication between the two, which is quite likely, I know that that degree of communication is probably very low because of the tight characteristics of the pay zones, and that's not only shown by core data and the productivity of the wells, but it is also shown by this situation I previously pointed out where the same data over here, you'll have water production over here, and then in another place it will be gas, and that is just a result of low permeability and not very effective communication.

Now, by the way, I've pointed out that the productivity of the oil wells is low, I mean we've got a couple of 120 barrel oil wells and 125 barrel wells at the present time, the rest of them are 5 to 10 to 12 barrel wells, but then we get a reported two and a half million gas well, and a million and a half gas well, well, that sounds like a pretty good well. But if we reduce that to terms of oil productivity, that is everything being the same in

respect to permeability and thickness, a million and a half gas well is equivalent to a productivity had it been oil saturated, of about an 11 or 12 barrel a day oil well for the simple reason that the gas itself, the oil is about 128 times more viscous than the gas; so you've got that, of course the rate of flow is going to be directly inversely proportionately to the viscosity.

Now, actually, to my way of thinking, this situation in a way presents a dilemma. My candid opinion is that we don't have, strictly speaking, an oil field and we don't have strictly speaking a gas field, we've got a hybrid. The general situation is that we've got wells that are capable of producing all the way from 300 MCF to a reported 2,700,000 MCF per day of gas. For the most part, the oil wells are 5 to 13 barrels, with the two exceptions that I just mentioned. I think that the gas saturation and oil saturation of those high oil wells are in the same porous space, so you can't produce one without the other; and it is my thought that the best solution to this situation is to allow development of the area as a gas area. It's my opinion that it can't be economically developed as an oil area on 40-acres, the wells are not commercial as oil producers.

Q In your opinion, Mr. Keller, will the greatest ultimate recovery from this area be affected by producing it as a gas pool?

A Yes, sir, in my opinion, it will be, and of course that relies on my previous opinion that I don't think it can be

economically developed as an oil area; if it is not developed, I don't think it will be effectively depleted in that Southwestern Hydrocarbon's acreage can't be put to beneficial use. Now, I also am of the opinion that the production of this area as a gas area, will not be detrimental to the oil recoveries; in other words, on the whole I think it is going to be beneficial to the oil recoveries, oil will be recovered from the gas wells that produce some oil that might not otherwise be recovered.

Q If the area were produced or developed under, as an oil area, do you think there could be any further development in the area, assuming that the penalty ratios were applied?

A No, sir, if the 2,000 to 1 ratio limit was enforced in this area, that would have the effect of making all of the wells, with the exception of one or two, non-commercial, so that is not a practical solution, you just prevent the operator from producing anything. Now, if you did that, in my opinion, you would cause rather than prevent waste, because you would prevent these wells from being produced.

Now, the other thing there that occurred to me, well, you might put a 2,000 ratio limit on there, and with a net provision, not counting the gas that went to legal use that was sold, but what you are doing there is, you are allowing the oil to be produced economically because you can sell the gas and you are preventing waste from that standpoint, but you are also preventing additional development in the area, so I think that would tend to

cause waste of oil and gas, and in fact that would be saying that we are going to let these wells produce like gas wells, but we are going to make them, require that they be drilled like oil wells.

So when you analyze the thing, you consider all the alternatives, the only solution that I could see was to have rules in the area that would permit the area to be economically drilled on a hundred and sixty or greater spacing, so it could be economically developed, and that would be conducive to waste prevention in the area. Anything else I could think of would not accomplish that purpose.

Q That would be your recommendation to this Commission, Mr. Keller?

A Yes,sir.

Q Were exhibits 1 through 4 prepared by you, or under your supervision?

A Yes, sir.

Q Do you have anything further which you wish to state to the Commission in connection with this matter?

A No,sir.

MR. BRATTON: We would like to offer in evidence, Exhibits 1 through 4, Alamo Exhibits 1 through 4, and also we would offer Alamo's Exhibit Number 5 which is a copy of a letter from El Paso Natural Gas Company to Alamo pertaining to marketing of the gas in the area.

MR. NUTTER: Without objection, Alamo's Exhibits 1 through 5 will be entered.

MR. BRATTON: We have no further questions of the witness.

MR. NUTTER: Does anyone have any questions of Mr. Keller?

MR. PAYNE: Yes, sir.

MR. NUTTER: Mr. Payne.

CROSS EXAMINATION

BY MR. PAYNE:

Q Mr. Keller, if this is reclassified as a gas pool, are there going to be any oil wells in it, and if so, how would you, what would you establish as the determining point?

A Well, Mr. Payne, strictly speaking, defining an oil well as a well that produces black oil, yes, there will be a lot of these wells that will be oil wells in that sense because most of them do produce, even the gas wells, a little bit of oil; none of the oil wells in the area presently are capable of producing the normal allowable.

Q Well now, assuming you take an oil well, assuming you take a well that produces 20 barrels of oil per day and practically no gas, do you think that should be classified as a gas well and spaced on 160?

A Well, sir, I don't think that it can be properly classified as a gas well because it is a low ratio well. This is

the Texas-Pacific well we are talking about, but in answer to the spacing on a hundred and sixty, it's not spaced on three hundred and twenty, I mean, my understanding of the effect of spacing rule is that you can't drill them any closer than 40, not -- you are not preventing from drilling them wider than 40, the only thing that prevents you from doing that is completion, and I wouldn't see any harm in not drilling any more oil wells in that area, drilling up the 40's, because I don't think that it would be economical to drill additional 20 barrel oil wells on 40-acres in the vicinity of this 20-barrel well; and actually, Mr. Payne, this area and structure has been known for many years, and some of these wells are eleven and twelve years old, and it never has been developed because the situation is such that it is not economical to develop.

Q Now, I take it that it is your opinion that you can't draw any clearcut gas-oil contact in that area, is that right?

A Yes, sir. For example, the Southwestern Hydrocarbon well at minus 989 on top of the first zone didn't produce any appreciable oil, and yet we have the well, the Alamo well which is 50 feet higher, it tested 10 barrels of oil a day, as I recall. Yes, sir, Alamo-Brown well, and you can study the structural position and the productivity of the well, and there just isn't any correlation between that would define a gas-oil contact, and I'm pretty well convinced myself that the gas and oil produced in these high gas-oil ratio wells actually comes in from the same

porous space as a result of the saturation conditions, and it's not a reflection that you got an oil-gas contact.

Q And that being the case, it is your opinion then that this is not a gas cap in New Mexico over a Texas oil pool?

A Well, Mr. Payne, again I think we have a hybrid situation, from the standpoint that the oil over in Texas and this gas over there too, is not overlain by a gas cap. What happens, we've got an area here that produces oil, in the same zones, that when we move over a few miles this way and it produces gas, and they are the same zones, I'm satisfied; but the only way to my mind that there could be harm done to the oil recoveries in the oil wells would be that the withdrawals of gas were so high in the gas area, and the communication good enough to where you would actually cause oil to migrate up-structure or towards the Northwest and saturate to a greater extent this oil and gas saturated gas producing area with oil, that might reduce recoveries.

Q And since these two zones are both tight, as you testified, it's not likely that that would occur, is that right, this migration of oil up-structure?

A That's my opinion, yes, sir, that I don't think that it is likely to occur.

Q Now, have you seen the three alternatives proposed by Southwestern Hydrocarbon in this case, do you have a docket there?

A Yes, sir.

Q Do you feel that the preferable alternative, looking at it practically and engineering-wise, is that these two oil pools should be abolished, and a gas pool created, do you feel that is the best way to handle it?

A Yes, sir.

MR. PAYNE: Thank you, that's all.

MR. NUTTER: Any further questions of Mr. Keller?

(No response.)

QUESTIONS BY MR. NUTTER:

Q Mr. Keller, your Exhibit Number 5 brings up another problem that has occurred to me. El Paso points out that if in the event satisfactory quantities of gas were available that they would be interested in laying a line into the area. However, they do point out that the actual construction of the facilities would be necessary, as well as they would have to obtain the approval of the Federal Power Commission. The thought occurs to me that sometimes construction of pipeline facilities, and approval by the Federal Power Commission, takes considerable length of time. If these were classified as a gas pool, it would of course of necessity have to be shut-in until such time as the gas could be marketed, I suppose your client is aware of that?

A Yes, sir, it would have to be shut-in until you could sell the gas, because it wouldn't be legal to flare that gas.

Q If it were classified as a gas well?

A Yes, I'm aware of that, and I have advised my client

of that.

Q Another thing, you mentioned that this Robinson well, down there in Section 5, which was a dry hole was structurally as high as the oil producing wells on the Texas side of the State line. Did you hear Mr. Sheldon this morning when he was talking about this well, had encountered some vertical fractures down in there that possibly allowed this water to come into that well, do you think that might have a bearing on the fact that it produced water while the other wells over there produced oil?

A Well, I hesitate to say it does not have any bearing. Now, I am aware that some of the cores show evidence of fracturing; I've concluded, however, that that fracturing isn't at all a significant part of the porosity, that the storage volume is not in the fractures, in my opinion. And I've also concluded that whatever the fracturing there, it does not represent a continuous network that provides any permeability from which the flow to take place.

Now, the reason I conclude that is that, as you know, fractures have very high permeability, and if these fractures were interconnected and provided means of communication of any practical significance, then we would have a lot better oil and gas wells than we have here, because the productivity of the wells reflect the same degree of permeability development as indicated by the core analysis, and they are all very low, which in my opinion couldn't be fractured permeability, I mean, like an Ellenburger

which is fractured permeability, and when you get into those situations, you got extremely high permeability and flow capacities under the fractured system.

My thought about the occurrence of that water, I think is just about like I previously expressed as I think whether or not you produce oil, water, or gas in a particular well depends upon the saturation conditions that exist in the porous spaces, and I think that it, probably the virgin condition at this location, this dry hole is such that it is highly water saturated, it's got some oil saturation, and those saturations are such that they produce predominantly water.

Q Why has not there been a separation of these three components over a period of geological time?

A Well, there is two reasons, to my mind. One reason, as you know, the saturation conditions are bound to be controlled by capillary forces and gravitation forces. Everywhere you have what we've termed gravitation segregation, which is generally in more permeable rock, the saturation does not change. For example, an oil-water contact from 100 percent water to 100 percent oil, it changes from 100 percent water, and there is a transition zone to where the water saturation becomes the so-called irreducible minimum water saturation, that is, that is the amount of water that the capillary forces will hold in the porous spaces under equilibrium with gravity forces. Actually, I think a lot of the zone that's open in these wells, are in these transition zones

between oil and water, and between oil and gas, to where you have both, and sometimes all three saturation conditions available.

Q Now, do you think if you went high enough up on the structure here, you would get out of the water?

A Yes.

Q Did this --

A Well, now you --

Q Did the Lindrith Number 1 well way up there in Section 18, which potentialed for 2,750,000 cubic feet a day, did it make water on its test --

A Let me check that, if I may.

Q -- or liquids of any kind, I should say?

A That was drilled as a Devonian well.

Q Devonian Oil Company?

A Yes, sir, Lindrith. The information I have on that well is that it was acidized between 4890 and 4983, and swabbed; slight show of oil plus 500 MCF of gas, and there is no reported water production although they acidized with 13,500 gallons. Now, actually you get high enough to where you may not produce any water, although there is water saturation in the rock, but it's, it wouldn't flow, it's so low it won't flow and of course the tide of the rock is the higher the water saturation it can accommodate without flowing, that is the higher irreducible minimum water saturation, because right up on top of the structure, one of the highest wells, this McCormick well, it showed water

saturation from cores from 23 to 32 percent. Now, that well didn't make any water. Of course, you've got this Great Western well, on a test in May '59 it produced 4.2 barrels of water, and its high, see, it's at the top of the first zone, it's about a minus 970, which is 20 feet higher than the Southwestern well.

Q Now, the highest well that we've got in New Mexico is the McCormick well in Section 29, is it?

A No, it's located on this little highest point on the nose, but this Devonian well or Gulf well, Lindrith, is minus 884, so it's about 59 feet higher than the McCormick well.

Q So the old Devonian well is the highest in the area?

A I believe that's right, that it is either shut-in or producing. Now, there are some deeper wells drilled up north of there that are higher than that, but -- let's see, only one of them that I see that was tested, this Gulf Gandy Federal, I guess it would be, it tested, the first zone, it swabbed 7 barrels of oil and 67 barrels of water in 10 hours after 21,000 barrels of acid; now, it's higher than the Devonian Lindrith well.

Q It's a dry hole, is it not?

A Well, it's, I believe it is a deep well; no, you are right, it is a dry hole.

Q I don't notice on your exhibits that there are any drilling locations shown in either State; do you know of any locations that are drilling in either State?

A There very probably is; we didn't attempt to show,

to spot any drilling locations on that map, Mr. Nutter.

Q How about, have the productive limits of the oil section in the Buckshot pool in Texas been defined on the Northwest by dry holes or otherwise?

A They have not been actually defined completely. Now, the general situation is this, in Buckshot, referring to Exhibit Number 1 you'll see that the red circle wells, which are zone 1 producers, extend from about this position (indicating) on down South; in other words, from about minus 920 to about minus 1100 on top of the zone one. Now, what apparently happens here as you get below minus 1100, they anticipate that it is going to be water, because these Southwest wells produce some water, as I recall. Now, as you go up North, and you have a datum of minus 1020 approximately, that section becomes more gassy, and there are some high gas-oil ratio wells in that vicinity in zone number one. Now, in zone number two, which are the Green wells, it looks like the most southern production is about a minus 1030 on top of zone one. And I have the impression, I'll have to check this, that zone two tested water on South of there in some places, and as you go further North, it becomes gassy. In fact, at this point where the Dobell Company's Thompson Number 1 gas well is, it is a gas well completed in both zones, so both zones are gassy.

Now, that kind of illustrates what I mean when I was saying that there is a general structural relationship between oil, water, and gas,but it can't be relied on in detail.

Q Has the Texas Railroad Commission as yet formulated any gas pool rules for those wells up there that are gas wells?

A Yes, sir, they have. They have issued rules permitting development of this area from the New Mexico line on East, I'd have to check the map, what we call the West Lavaland extension area, for a distance of 15 or 20 miles, and they have issued rules that permit the drilling of gas wells on 788 acres, plus 10 percent.

Q What do you mean, 788 acres plus ten percent?

A You can assign to a gas well as much as 788 acres plus ten percent. See, that area is not sectionalized, it is divided into leagues and bounds and the 788 acres is an Irish league.

Q Could you furnish us with a copy of the rules of the Railroad Commission?

A Yes, sir, I have a copy.

MR. NUTTER: Does anyone have any further questions of Mr. Keller?

QUESTIONS BY MR. PORTER:

Q Mr. Keller, I believe you recommended that this be defined as a gas pool. Would you have any objection to imposing a limitation of normal unit allowable on any liquids produced from any well in there?

A No, sir, I would think that would be done; I think that should be done. It is my understanding that that is the

general procedure, like where you have oil wells in areas classified as gas fields.

MR. PAYNE: It should be. It is not always done?

MR. PORTER: Not always; you have a definition for an oil well, and in this I don't believe you propose a definition; amounts to the same thing, if you impose a limitation of normal unit allowable.

A Yes, sir.

MR. PORTER: That's all I have.

MR. NUTTER: Any further questions of Mr. Keller? He may be excused. Does anyone have anything further they wish to offer in Case 1763?

MR. MORRELL: I have a statement I would like to make. Foster Morrell, independent, Roswell. I am the owner of working and royalty interests within and near the designated Sawyer and South Sawyer Pools. Past development and production in these pools indicate marginal economic conditions; continuation of designation of the pools as oil pools is not conducive to successful commercial operations or to greatest economic recovery of oil and gas from the San Andres reservoir.

With gas pipeline markets now available, it is essential, in my opinion, to market all gas possible in accord with Commission rules, together with such oil as comes with the gas in order to assure commercial operation and the greatest ultimate recovery of the oil and gas. I endorse the petition of Southwestern Hydrocarbon Company in Case 1763.

MR. NUTTER: Thank you. Any further statements?

MR. KEMPER: I'm Lanny Kemper of Kemper Oil Company in Roswell. We have a substantial interest in this Southwestern Hydrocarbon well, and I would like to concur with Foster Morrell's statement and the testimony, and I will assure you that we are not going to spend any more money there if we can't see some reason, economic reason to spend it.

MR. NUTTER: What is your address, Mr. Kemper?

MR. KEMPER: Post Office box 744, Roswell, New Mexico.

MR. PAYNE: Mr. Examiner, we received communication from Great Western Drilling Company, Western Drilling Company, Longview, Texas, from Kooley and Holcomb, advocating that the application of Southwestern Hydrocarbon Company be granted.

MR. NUTTER: Which one?

MR. PAYNE: The first one.

MR. NUTTER: Does anyone have anything further in Case 1763? We will take that case under advisement.

STATE OF NEW MEXICO)
) ss.
COUNTY OF BERNALILLO)

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

WITNESS my Hand and Seal, this, the 24th day of October, 1959, in the City of Albuquerque, County of Bernalillo, State of New Mexico.

Joseph A. Trujillo
NOTARY PUBLIC.

My Commission Expires:

October 5, 1960.

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 1763, heard by me on 9/30, 1959.

Examiner
New Mexico Oil Conservation Commission