BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
February 15, 1961

IN THE MATTER OF:

Application of Tennessee Gas Transmission Company for the promulgation of special rules and regulations governing the Totah-Gallup Oil Pool, San Juan County, New Mexico. Applicant, in the above-styled cause, seeks an order promulgating special rules and regulations governing the Totah-Gallup Oil Pool, San Juan County, New Mexico, including a provision for 80-acre oil proration units.) Case 2184

BEFORE:

Honorable Edwin L. Mechem
Mr. A. L. Porter
Mr. E. W. Walker

TRANSCRIPT OF HEARING

MR. PORTER: We will take up next Case 2184.

MR. MORRIS: Application of Tennessee Gas Transmission Company for the promulgation of special rules and regulations governing the Totah-Gallup Oil Pool.

(Short recess.)

MR. PORTER: Hearing will come to order, please.

MR. BRATTON: If the Commission please, Howard Bratton, Roswell, New Mexico, appearing on behalf of the applicant, Tennessee Gas Transmission Company. I have associated with me in the case Mr. Eldon Young, attorney from the State of Texas, and also, appearing on behalf of Aztec Oil and Gas Company, Mr. Quilman Davis, associated

with me. Tennessee has one witness.

MR. PORTER: Any other appearances in the case?

MR. BUELL: Guy Buell, for Pan American Petroleum Corporation.

(Witness sworn.)

MR. PORTER: I would like to announce at this time that this application, through error, was advertised twice. I think our Legal Department was overenergetic last week. The case was also advertised for the 23rd of February, I believe, so we will proceed to hear the case at this time and dismiss the case on the docket for the 23rd.

JOHN J. LACEY

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

DIRECT EXAMINATION

BY MR. BRATTON:

Q Will you state your name, address, and by whom you are employed?

A My name, John J. Lacey. I live in Durango, Colorado, and I am employed as a petroleum engineer with Tennessee Gas Transmission Company.

Q How long have you been so employed by Tennessee, Mr. Lacey?

A Approximately four years.

Q Does your area of supervision cover the area including

the Totah-Gallup Field?

A It does.

Q Are you familiar with the Totah-Gallup Field and with the application in Case 2184?

A Yes, I am.

Q Have you previously testified before this Commission as an expert witness?

A Yes, I have.

MR. BRATTON: Is the Commission satisfied with the witness's qualifications?

MR. PORTER: Yes, sir, we are.

Q (By Mr. Bratton) Mr. Lacy, your Exhibit No. 1 is a sheet of tabular data and your Exhibit 2 on the board is a map. Referring first to Exhibit No. 2, describe where the area about which we are talking here is located?

A The Totah-Gallup Field is located just immediately south of the town of Farmington, New Mexico, and northeast by two miles, approximately, of the Cha Cha-Gallup Field. We have outlined in red the proposed limits, or acreage we would like to include in the Totah-Gallup.

Q This is in Township 29 North, Range 13 West?

A Yes, it is.

Q Now, referring back to your Exhibit No. 1, the tabular data, pertinent data as to the pool, would you run through that briefly?

A Well, the field was discovered in September of '59 with the completion of the Tennessee Glenn H. Callow 8, which was completed as a dual producing well from the Gallup and Dakota formations. Subsequently additional development in the 29, 13, has continued, and until quite recently the development has become quite rapid and there were, as of the first of the year, 15 producing wells in the area outlined, with no dry holes. However, that has probably been increased as of right now.

Q Have all of those wells been drilled on an 80-acre spacing pattern, where 80 acres could be dedicated to them?

A Yes, they have. The first few wells in the field were completed as an upper zone in the Dakota, dual completions, and subsequent development has been such that 80 acres, consisting of half of a quarter section, could be assigned to any well.

Q What is the depth of the pay?

A Approximate depth of the pay is 5600 feet.

Q Refer to your reservoir data, Mr. Lacey, and go through that briefly, if you will, please.

A The reservoir data shows that the average porosity of the pay, of the sand, is approximately 14% and the average permeability is 106 millidarcies, and average water saturation, based on capillary pressure data, 29.7%. This data is based on cores from three wells in the field.

Q What three wells are those?

A Those three wells are Tennessee's Glenn H. Callow 13 in

the Northwest of 33; the Glenn H. Callow 9 in the Southeast of Section 28, and Aztec Oil and Gas Hagood 9-G, I believe, in the Northwest of Section 34.

Q Now, is your average permeability in each one of those cores approximately the same as the average of the three?

A Yes, it is. All of the cores exhibited a permeability range from less than 1 millidarcy to as high as 600 millidarcies.

Q But those are stringers, but the average of each core would be substantially the same?

A Substantially close to this 106, right.

Q Do you have any idea, Mr. Lacey, are these permeabilities you are talking about approximately the same as in the Cha Cha-Gallup?

A From the data I have seen the porosity and permeability in the Totah-Gallup is probably slightly better as an average than in the Cha Cha-Gallup Field.

Q Is there anything else you care to point out in connection with your tabular data?

A Well, along with the reservoir data there has been a bottomhold fluid sample taken on our Callow 9 from which we have obtained PVT data, showing that the oil has approximately a solution gas-oil ratio of 615 cubic feet per barrel and a shrinkage or volume factor 1.377, and approximately 41 gravity oil at 60 degrees F. I might point out that there is not yet a pipeline serving the field, but there is one being constructed by Four Corners Pipeline which

will probably be in operation within six weeks, and there will be an oil outlet for the field.

Q Refer to your Exhibit No. 2, now, Mr. Lacey, and explain what it is and what it depicts?

A Exhibit No. 2 is an isopachous map of the lower Gallup sand from which the Total-Gallup Field produces, and the nearby Cha Cha-Gallup Field. It is based on a contour interval of five feet, and these pays, these intervals, were picked from electric logs, primarily, on the completed wells in both of these fields. It shows in the Totah that actually the field has not yet been defined, the limits of the field, in either the Northwest or Southeast direction. The plat also indicates that both the Totah and the Cha Cha Fields are offshore sand bar developments and they trend in a Northwest Southeast direction similar to other Gallup producing fields in the San Juan Basin.

Q You believe the limits are fairly well defined to the Northeast and Southwest?

A Well, they have not been defined in the sense a dry hole, non-productive well has been drilled. However, we believe that, because of the thickening and thinning that exists across these fields going in a Northeast Southwest direction, that there is probably a barren non-productive streak between the Cha Cha and Totah-Gallup fields.

Q You are approaching the commercial limits of the thickness of your pay?

A Right, which would be approximately four or five feet.

Q And the area outlined in red is the area which you proposed for the Totah-Gallup Field, and the area to which the rules would apply?

A Right. Initially we propose that the rules would apply to the area outlined in red, but that it be extended as additional development would indicate extensions of the field.

Q Refer now to your Exhibit No. 3, Mr. Lacey, and explain what it shows.

A Exhibit No. 3 is a structure map contoured on the top of the lower Gallup. It shows essentially that the structure is the regional dip of the San Juan Basin and that the structure has very little to do, actually, with the accumulation of oil or the producing limits of the field, and that there is essentially a stratigraphic type field.

Q Out of curiosity, Mr. Lacey, to the Northwest there, is this field liable to run right into the City of Farmington?

A It is very possible that it might. It is very close to the city right now.

Q Is there anything further that you care to point out with reference to Exhibit No. 3?

A I might point out that, to date, no gas-oil contact has been encountered in the field, and that wells both structurally high and low have exhibited similar oil productivity.

Q Refer to your cross section, which is Exhibit No. 4.

A Exhibit 4 is a cross-section of electric logs which goes in a Northeast, Southwesterly direction starting in the Cha Cha-Gallup Field and going across Tennessee's lease in the Totah-Gallup. It shows where the wells are producing, the completion interval, and that, essentially, the reserves are contained in the sand at the very base of the Gallup formation as shown in the yellow. It also shows that, going in this traverse direction, perpendicular to the longitudinal axis of the field, there is a definite thinning or feathering, pinching out on the edges of the field which suggest to us, or we are convinced that the Cha Cha and the Totah probably are not continuous as a reservoir.

Q Your index of this cross-section is shown on the lower left-hand corner?

A The index map for the cross-section is shown in the lower left-hand portion of the cross-section.

Q Mr. Lacey, I notice that the Tennessee Gas and Oil No. 12 and No. 9 were both completed in considerably larger intervals than the Tennessee Gas and Oil No. 15?

A That is correct. Tennessee Gas's 8, 9, 11 and 12 were early completions in the field and are dual completions. At that time we felt that the zone indicated just above the yellow, and below the line indicating the top of the lower Gallup, would contain some recoverable oil and would contribute. However, we have since felt that we get better wells and most ofthe recoverable oil is contained in only the clean sand which is indicated by the yellow.

Our recent completions are all completed in just that sand zone and exhibit productivity equal to or better than the earlier completions.

Q From the cores, and from your electric logs and cross-sections, does all the information indicate that there is a continuity of this sand throughout the pool?

A Yes, within the given area or pool there is a very definite continuity, and it can be correlated rather easily.

Q Is there anything else you care to point out with reference to this cross-section?

A None, except, possibly, that in the Cha Cha-Gallup Field, which also has a productive zone which is not present in the Totah at all, which is indicated on the cross-section on Pan American's Hyde 2 and Benson-Montin-Greer 4, indicated by that lower sand interval.

Q Refer, then, to your Exhibit No. 5, Mr. Lacey, and explain what it shows with relation to the pool?

A Exhibit 5 is a graphical presentation of the performance to date in the field, and bottomhole pressures that we had available which are essentially on Tennessee's Callow lease. It shows that the field is under a very active stage of development as indicated by the large increase in daily average producing rate in December and the number of wells in December. However, the most important part isthe pressure data at the top which shows that initial bottomhole pressures taken on wells immediately after potential tests have come in at decreasing values, indicating that

the field is very definitely being drained and that communication exists over a large area.

Q Your pressures have declined; your No. 8 came in at approximately 1640 pounds?

A That's correct. It was the discovery well. The data shows that each subsequent completion, essentially, has come in at slightly lower values, and the one pressure survey we had available was taken in April of '60 which is just slightly below the line between these initial pressures. This same pressure data is exhibited in a tabular form on Exhibit 6, which was all the pressure data we had available to us at the time we prepared this exhibit.

Q And these exhibits, 5 and 6, reflect that your pressures have dropped from 1634 in your discovery well to 1473 in your latest well?

A That's correct.

Q And that there has been a steady decline; every successive well is lower than the previous one?

A Right, and you would expect additional development wells would exhibit initial bottomhole pressures on trend with this line shown on Exhibit 5.

Q This indicates to you, as an engineer, that there is communication and that the undrilled acreage is being drained by the wells previously drilled?

A Yes. It indicates very definitely that this is so. This can be seen quite readily on Exhibit 6 when the Callow 11, a

pressure taken on this well in October 31, 1960, with a 1558 hour shut in, had a pressure datum of 1562, and the initial pressure on the Callow 13, October 10 of '60 with a 78 hour shut in was 1552, or very close to the long shut in period, which indicates to me that there has been very definite communication in drainage oocurring.

Q Is there anything else you care to point out in connection with either Exhibit 5 or 6?

A No. I can't think of anything just right now.

Q Refer, then, to your Exhibit No. 7, Mr. Lacey, and explain it, please.

A Exhibit No. 7 is the gas-oil relative permeability ratio data we obtained on cores from our Callow No. 13. Basically, what this data shows is a very unfavorable relationship between the relative permeability of oil to gas, which, in a field of this type, which we believe to be of a depletion drive type, that the primary recovery is going to be fairly low since these curves are, in effect, what control the recovery from a depletion drive field solution.

Q Do I understand this indicates that the gas, relatively, is of a type to be more permeable as compared to the oil and that, therefore, you are not going to sustain your drive mechanism for too long?

A Right. It indicates that when a sufficient amount of gas saturation has developed in the reservoir, that gas, relative to oil, is going to flow very easily and the oil is going to be left behind while the gas is going to flow into the well bore and dissi-

pate the reservoir pressure.

Q This reflects in your predictions of performance for the field?

A That's correct.

Q Turning then to your Exhibit No. 8, Mr. Lacey, which supplements Exhibit No. 7.

A Exhibit 8 is a performance prediction of the field based on the data we had available which included this KGKO data in Exhibits 7, PVT data from the Callow 9, and it shows that we should recover approximately twelve and a half percent of the oil in place, of the original oil in place under primary producing mechanism of depletion drive, a fairly low recovery.

Q Does this type field, in your opinion, lend itself to secondary recovery?

A In view of what appears to be the large amount of oil that is going to be left in place I think that the field has very definite possibilities under secondary recovery.

Q In which event 80-acre spacing would be even more feasible to recover all of the recoverable oil that can be taken out?

A I would say yes.

Q Is there anything else you care to point out with relation to Exhibit 8?

A No. I believe it pointed out primarily the low recovery.

Q Now, Mr. Lacey, please explain Exhibit No. 9, if you will.

A Exhibit No. 9 is a graphical, or a pictorial representation

of a pressure gradient around a typical well on 40 acres, and an 80-acre drainage area. This particular exhibit is based on Darcy's radial flow equations and, considering the characteristic annular rings about a well bore indicate the well's production at a specific pressure in the reservoir, and given producing rate. This exhibit assumed approximately 326 reservoir pressure and a producing rate of about 4 barrels a day, which would be close to the economic limit of a well, and it shows that at the outer extremity of a drainage radius of a well on 40 acres or 80 acres would be less than two pounds, which, in effect, would say one well on 80 acres would recover 99% of what two wells on 40 acres would recover.

Q Mr. Lacey, as I understand it, as you draw a circle around your well bore, based on a 40-acre pattern, and a larger circle, based on an 80-acre pattern, at abandonment pressure, the pressure differential between those two circles would be approximately three pounds; is that correct?

A That's correct. That is the difference in the pressure at the extremity of those drainage radii.

Q From that you conclude you would recover approximately 99% of the oil on an 80-acre?

A As compared to two wells on 40 acres, that's correct.

Q Whatever difference there might be would be further minimized if secondary recovery or pressure maintenance is feasible?

A Right.

Q Turning to your economics, Mr. Lacey, refer to your

Exhibit No. 10.

A Exhibit No. 10 is just an estimate of reserves on a volumetric basis using the average value of porosity and water saturation and shrinkage that we had available from cores and considering average pay thickness of nine feet, and we are going to be, on 80-acre spacing, talking in terms of recoverable oil of 51,000 barrels which is not too high considering the depth and expense of drilling these wells.

Q Do you have any idea, Mr. Lacey, how this compares with the estimated recoveries over in the Cha Cha-Gallup Pool?

A As I understand there has been an engineering committee in the Cha Cha-Gallup Field, formed by the operators in that field, and they have come up with percent recovery of the same order of magnitude of this 12½%.

Q Go on to your Exhibit No. 11, please.

A Exhibit No. 11 is just an estimate of cost and income from a typical well in the Totah-Gallup Field based on 80-acre spacing, considering that sometime in its life it will be required to artifidally produce the oil with a pumping unit. This exhibit shows that, even under 80-acre spacing, that the profit to the operator is going to be very small, something on the order of $24,000 for a $72,000 investment. This is going to be a profit above the investment in drilling the well and expense of operating it. This does not consider the pipeline. In other words, the net value of the oil here considered the trucking charges which are currently in

effect in the field. There is going to be a profit, and the economics are going to be improved somewhat when the pipeline becomes operative because we will be paying considerably less to the pipeline to transport our oil than we will to the current truckers, probably on the order of 25 cents a barrel less.

Q That would increase your total profit no more than $10,000?

A That's right. We are talking about maybe 10% increase in the profit.

Q From this, Mr. Lacey, do I take it that a development on a 40-acre spacing pattern would be either a dollar-swapping or a losing proposition?

A Well, since the average pay in the field, as shown on Exhibit 2, is going to be nine feet or less, this shows that on 40-acre spacing we are going to be talking about an out of pocket loss to the operators if they develop or try to develop that type of spacing pattern. A little clearer picture of this is shown on Exhibit 12, which considers various net pays and various well spacings of acres per well, and you can see quite clearly that on 40 acres with less than eight feet of pay you are going to be below a breakeven point, and that on 80-acre spacing, with eight to ten feet of pay, that you are actually rather marginal in economics.

Q Do you have anything further you care to explain with reference to Exhibit No. 12?

A No, I believe that essentially explains it.

Q Mr. Lacey, what rules is Tennessee requesting in this pool?

A We are requesting that the field be put on a temporary 80-acre spacing and that operators be permitted to drill in either quarter-quarter section of an 80-acre proration unit.

Q And the 80-acre proration unit to be the north, south, east or west half of a quarter section?

A Right.

Q Mr. Lacey, will you explain something of the topography here with relation to the possibility of a fixed spacing pattern in this area?

A The topography of this field, the field lies, like I say, just south of Farmington along the bluffs of the San Juan River. The surface elevation of offset wells varies as much as 350 to 400 feet. There are large canyons going back for a considerable distance off of these bluffs, and if an operator were required to drill a well at a specific quarter-quarter section it might cause considerable additional expense in locations and roads, which is one reason we would think it might be better than an operator be given a little more margin or leeway in selecting where to drill his development wells to keep the cost to a minimum.

Q You are not asking any change in the statewide gas-oil ratio limitation?

A No, we are not.

Q You are not otherwise asking for any change in the statewide rules?

A No.

Q Is there anything further you care to state in connection with this case?

A No, I can't think of anything offhand.

Q Were Exhibits 1 through 12 prepared by you or under your supervision?

A Yes, they were.

MR. BRATTON: We would offer in evidence Tennessee's Exhibits 1 through 12.

MR. PORTER: Without objection the exhibits will be admitted to the record.

MR. BRATTON: We have nothing further to offer at this time.

(Short recess.)

MR. PORTER: Hearing will come to order. Mr. Bratton, did you conclude your direct examination?

A Yes, sir.

MR. PORTER: Any questions of the witness?

BY MR. NUTTER:

Q Mr. Lacey, there are 15 wells currently completed in this pool, is this correct?

A That was as of the first of January. I believe now there are probably more completions, probably those seven that were being drilled -- I have shown, at the first of the year there were 15 completions and seven wells under various stages of drilling and

completion. I assume some of those have been completed, and there has probably been additional wells staked.

Q Of the 15 that were completed as of the first of the year, how many belong to Tennessee?

A Eight.

Q 8 through 15?

A Yes.

Q On your Exhibit 6 you showed the pressure on seven Tennessee wells. Didn't you have the pressures available on any of the wells belonging to any other operator?

A At the time we made this exhibit we had no pressure information from the other operators. I understand there is some now available.

Q If the pressure information were plotted on Exhibit 5 for these wells that belong to other operators, would it follow along the same curve you have depicted here for your wells, or do you know?

A I would say depending on where they were completed and the time they were completed, some would fall along this trend and some probably would show, if they were a considerable distance away from our Callow lease, would probably show some pressures approaching our 9.

Q Do you feel the pressure you took on your 15, 1475 pounds, represented the reservoir pressure at the time that pressure was taken?

A You are speaking with reference to the one, 1861 on the

Callow 15?

Q The latest pressure you had there, yes, sir.

A It is possible and probably very probable, that this pressure is not completely built up to a true static pressure. However, we believe that it is very nearly static as we pointed out previously that initial pressure on 78 hours on the Callow 13 was very close to a pressure resulting after a 1500 hour shut in on the Callow 11, so we believe that within 72 hours the bottomhole pressure of a given well, I'll say of an average well in the field, will probably be very close to true reservoir pressure.

Q Have you ever plotted any pressure build-up curves on any of these wells?

A Yes, sir, we have.

Q Within 72?

A Within, I would say, within 72 hours at this stage of the depletion in the reservoir, 72 hours is adequate to obtain a representative pressure of the reservoir.

Q What percent of the ultimate pressure do you think you can obtain in 72?

A I would say in excess of 90 percent.

Q Now, this core data that you used, you have 14.2% porosity and 29.7% water saturation; this is from three cores which you had available, is this correct?

A Right. The porosity is the weighted average of cores from three wells. The water saturation is capillary pressure data

of four samples on our Callow 13 over the range of permeability existing in the core.

Q Three cores from which you obtained your porosity data, what portion of thefield were those wells in?

A What part of the field?

Q Yes.

A Those three wells are the ones that probably have a considerably above average net pay thickness. As I pointed out, the wells are our Callow 13 --

Q What is the location?

A NW/4 of NE of 33, showing 16 feet of pay; our Callow 14 in the SW/4 of Section 28, and Aztec Oil and Gas Hagood 9-G in the NW of 34, so that this core data comes from wells that are probably very more than average net pay, and it is possible that cores from wells with, say lesser pay, might exhibit lower porosity and lower permeabilities.

Q Your 9.9 feet of net pay was determined from what, Mr. Lacey?

A From the isopach map on exhibit. Of course, with the field still being undefined in at least two directions this average number could change and the exact number won't be known, I would say, until the productive limits have been defined.

Q You haven't defined the productive limits either on the flanks of the pool or on the end?

A I would say on the flank it has been close to what we

would consider the commercial limits, these have been reasonably defined.

Q On account of the thinning of the pay?

A Right.

Q Where is that No. 15 well, Mr. Lacey, that you had your most recent pressure on?

A That well is located in the NE/4 of Section 28.

Q Would that be in the SE of the NE of Section 28?

A Right, the SE of the NE, that is correct.

Q And the No. 9 well is directly south of it?

A That's correct.

Q Those two wells are drilled on 40-acre spacing with relation to each other, aren't they?

A They are drilled in adjacent 40-acre tracts, that is true. This Callow 15 is an example. It was drilled that way because of the topography I have previously mentioned, the bluffs. If that had been put inthe NE of the NE quarter-quarter, the location expense would have been considerable.

Q It would also have been getting closer to the thinner portion of the reservoir, too, wouldn't it?

A That's correct.

Q It directly offsets the No. 9 well which was one of the earliest completions you had in the pool, is that correct?

A That's correct.

Q The fact it was brought in with a relatively low bottom-

hole pressure, 1475 pounds, at least proves that interference was coming from an old well on a 40-acre location, or what?

A Yes, I'd say yes.

Q So this is evidence, actually, of 80-acre drainage?

A We might carry this point a little bit further. Look at well No. 13, initial pressure of 1552. At the time that well was completed the offset to the east, Aztec Oil and Gas Hagood 6-G, I don't believe had been completed. That well was drilled at a a location that was approximately a half mile from the nearest producing well and the pressure at that location when that well was completed indicates a drainage had occurred which would indicate that drainage pressure interference had occurred on the order of half a mile.

Q That is on No. 13?

A Right.

Q What is the bubble point of the oil here, Mr. Lacy?

A It is approximately 14.63 or 14.65.

Q If the 1473 pounds represents the current reservoir pressure, then the reservoir is approaching the bubble point, is it not?

A Right, except probably the 1473 is, I would not say it is the average static reservoir pressure through the entire productive limits. We show this merely to show that pressures at those locations was less than what we would have gotten had we drilled the wells initially, or first.

Q You don't have any bottomhole pressures taken prior to the initial potential on the well?

A No.

Q All taken after the potential, 72-hour shut down?

A Right. Of course, the average of four wells we had in April, that average pressure of four wells is a little bit lower than that trend of those initial pressures on the completions, which is what you would normally expect.

Q Incidentally, were those four wells 8, 9, 11 and 12?

A I believe that's correct. It shows those early April and late March, right.

Q Do you think there is any possibility that the fact that you are now completing in only one interval of the Gallup pay, where you used to complete in the entire interval, would cause a smaller pressure to be indicated on the wells?

A No, I do not. I believe that it is, essentially most of the recoverable reserves in the oil field exist in just that sand, and that the upper intervals we had completed in are contributing very little oil and contain very little recoverable reserves.

Q Is there any indication the upper part of the pay contains more gas than the lower part?

A We have no data to indicate that.

Q You didn't get any change in ratios after you started perforating the lower sections?

A No, we did not.

Q If a recovery factor of 12½% held true, it would probably indicate secondary recovery will be profitable in this area, don't you think?

A I would think so. We hope to, ourselves, with other operators in the field, initiate a study of secondary recovery at an early date.

Q No such studies have been initiated yet?

A No, they have not, but we anticipate there will be in the near future.

Q If this proves successful, recovery for 80 acres will be in excess of 58,000 barrels you have indicated in Exhibit 10?

A I would say yes, very definitely.

BY MR. PAYNE:

Q Mr. Lacey, how many wells in this pool are capable of making an 80-acre allowable, which would be, I believe, 164 barrels a day?

A I think there are five wells which have either a limited producing capacity or have, now, a gas-oil ratio in excess of 2,000 to 1.

Q You say there are 15 wells total?

A There are more completions right now than that. I would say there are closer to 20 completions now in the field.

Q Out of the 20 you are only sure of five that couldn't produce an 80-acre allowable?

A Right.

Q As I understand it you are asking for a one-year temporary order?

A That's correct.

Q Do you propose to take interference tests in the interim period?

A We will. During this period we propose to accumulate additional data, pressure data and performance data in order that we might come back for a hearing then to establish permanent 80-acre spacing, which would include interference data.

Q Do you consider this pool to be rate sensitive?

A I would say no. We have no data that would indicate that.

Q You don't feel that the reservoir energy will be dissipated by having an 80-acre allowable rather than a 40?

A I would say no.

Q I believe you testified, in answer to a question by Mr. Bratton, since the secondary recovery might be a factor in this pool, that you felt 80-acre proration units would be advantageous?

A That's right.

Q Could you explain that a little more in detail as to why it would be?

A I would say that on 80-acre spacing, by keeping the wells further apart you could, if you go to waterflood, you could expect the wells to produce longer before they started cutting water or large amounts of water, and I meant that more in the sense that 80-acre spacing would certainly not be detrimental as compared to 40's.

Q It might be, might it not, patternwise, if you can run your proration units either direction and locate your wells on either end of the 80?

A Well, it would depend on what kind. When we talk about secondary recovery project, we might not be talking about a pattern flood, line drive or end to end type project, in which case the pattern of the wells would have very little effect on the recovery.

Q It is pretty hard for you to tell at this time whether a line drive flood could be utilized in here since the outlines of the pool are not delineated?

A That is true. All I am saying is, by the same token, you can't say that secondary recovery might be harmed by having wells in any alternate quarter-quarter section.

Q Mr. Lacey, is there any way you can use this pressure information which indicates drainage from one well to the other to determine the efficiency of such drainage?

A I would say not by itself. You will have to have some additional performance, production data to go with it.

Q Do you feel that you have the data, permeabilities, and porosities, et cetera?

A Well, of course, we are still in a very early stage of the field, both pressurewise and productionwise, so it is difficult to say that if we now have sufficient data to conclusively prove how efficient the field may or may not be.

Q Mr. Lacey, what disposition is being made of the casing-

head gas in this pool?

A At the present time there is no available outlet for the casinghead gas.

Q Do you know if it is contemplated that there will be any gathering system installed in this area?

A I have not heard of one being installed. However, we plan, in the immediate future, to consider the possibilities of collecting the casinghead gas or recovery of LPG's from casinghead gas to see how profitable such a thing might be.

Q Are the gas-oil ratios rising in the pool?

A Some of the wells have exhibited some high gas-oil ratios. I believe there are four wells that have high gas-oil ratios and there has been some slight increase on an average, but generally the wells come in with an initial gas-oil ratio very close to this solution gas-oil ratio of 615 cubic feet.

Q If the Commission grants your application and goes to 80-acre proration units with subsequent increase in allowable, the casinghead gas will be flared or vented at a higher rate than it now is?

A That's correct.

BY MR. PORTER:

Q Mr. Lacey, figuring your economics here, the value of your recoverable reserves, you included only oil there. I suppose you are not considering casinghead gas?

A That's correct. Since at the time that this economic

estimate was prepared we were not selling the casinghead gas we didn't feel justified in assigning any value to it.

MR. PORTER: Anyone else have a question?

BY MR. NUTTER:

Q What is the maximum amount of oil any well has produced?

A I can't answer that accurately as I don't have the data before me, but I would say on the order of 40 or 50,000 barrels.

Q Would that be your No. 8 well?

A Right, our 8 or 9 or 11, one of those early completions.

Q How much is that well capable of producing at this time, say the No. 8?

A The No. 8 at the present time is exhibiting a gas-oil ratio above 2,000 to 1 and is penalized.

Q That was going to be my next question, what the ratio of that well is.

A I don't recall just what it is, 2500 or 2800, on that order.

MR. PORTER: Any further questions?

REDIRECT EXAMINATION

BY MR. BRATTON:

Q On the basis of all available information you have at this time, is it your opinion that one well in the Totah-Gallup field will economically and efficiently drain in excess of 80 acres?

A Yes, it is.

MR. BRATTON: I believe that is all.

MR. PORTER: Does anyone else have a question? Witness may be excused. Mr. Bratton, does that conclude the testimony of Tennessee Gas Transmission Company?

A Yes, sir.

MR. PORTER: Does anyone else desire to present testimony? Any statements to be made?

MR. DAVIS: Quilman Davis, appearing on behalf of Aztec Oil and Gas Company. Aztec is the holder of leases in this Totah-Gallup of approximately 3500 acres of which about 2 sections, or 1280 acres are within the limits as proposed by Tennessee, initial limits of the pool. We are hopeful the rest of it will be in the pool. We feel -- and in that connection, we now have 12 completed Gallup wells as of today, and have one drilling. We plan to continue our development as we have done before on 80-acre pattern. We feel further that on the question of flaring casinghead gas, as was pointed out a moment ago there will be some additional flaring as a result of the 80-acre allowable. However, the same situation is occurring over in the Cha Cha area, south and west, and we feel confident that if arrangements are made in there for casinghead gas recovery we will have the same thing in the Totah. I personally know several people are looking at the possibility of plants up there in the hopes it will be economical to put in a gasoline plant.

As a result, Aztec concurs in the application presented by Tennessee, and supports their position, and urges this Commission to grant 80-acre proration units and the corresponding 80-acre

allowable.

MR. BUELL: Guy Buell for Pan American Petroleum Corporation. It is Pan American's recommendation to the Commission that permanent 80-acre units be adopted with the normal 80-acre allowable. It is our opinion that these data are conclusive with respect that one well in this pool will drain 80 acres. We see no need for a temporary order. With respect to the flare gas, I might point out to the commission that it might expedite having the casinghead gas saved at the 80-acre allowable rate, which will, as has been pointed out, increase the gas rate. The handling of gas in this area is going to be marginally economic, at least. The more gas available the easier it will be to save.

MR. BRATTON: If the Commission please, I didn't prepare this application for temporary rules. As Mr. Buell said, I actually believe the evidence presented here is more than sufficient to justify a permanent order, and I might add that the notice of the Commission is sufficiently broad to cover a permanent order, and I would concur in the recommendation of Mr. Buell that a permanent order be entered in this case. I believe it is justified by the evidence which has been presented.

MR. DAVIS: Aztec also concurs in that application.

MR. PORTER: Does anyone else have anything to offer in this case?

MR. PAYNE: We received a communication from Texaco, Inc., Big Chief Drilling Company, both supporting the application of

Tennessee.

MR. PORTER: Nothing further to be offered in the Case 2184, Commission will take it under advisement and hear Case 2185.

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 24th day of February, 1961.

June Paige
Notary Public - Court Reporter

My Commission expires:

May 11, 1964

I N D E X

E X H I B I T S

NUMBER	EXHIBIT	IDENTIFIED	OFFERED	ADMITTED
Ex.#1	Tabular data	3	17	17
Ex.#2	Isopachous Map	3	17	17
Ex.#3	Structure Map	7	17	17
Ex.#4	Cross-Section	8	17	17
Ex.#5	Performance Data	9	17	17
Ex.#6	Pressure Data	10	17	17
Ex.#7	GOR Data	11	17	17
Ex.#8	Performance Prediction	12	17	17
Ex.#9	Pressure Gradient Data	13	17	17
Ex.#10	Reserve Estimates	14	17	17
Ex.#11	Cost Estimate	14	17	17
Ex.#12	Spacing Data	15	17	17

BEFORE THE
OIL CONSERVATION COMMISSION
SANTA FE, NEW MEXICO

March 7, 1962

EXAMINER HEARING

IN THE MATTER OF:

Application of Tennessee Gas Transmission Company for the establishment of 80-acre oil proration units in the Totah-Gallup Oil Pool, San Juan County, New Mexico.

Case 2184 will be reopened pursuant to Order No. R-1882 to permit the applicant and other interested parties to appear and show cause why the Totah-Gallup Oil Pool should not be developed on 40-acre proration units.

CASE NO.
2184

In the matter of the application of Tennessee Gas Transmission Company for the establishment of 80-acre oil proration units in the Totah-Gallup Oil Pool, San Juan County, New Mexico.

Case 2184 will be reopened pursuant to Order No. R-1882 to permit the applicant and other interested parties to appear and show cause why the Totah-Gallup Oil Pool should not be developed on 40-acre proration units.

CASE NO. 2184

BEFORE:
Daniel S. Nutter, Examiner
A. L. "Pete" Porter, Secretary-Director of Commission

TRANSCRIPT OF HEARING

MR. NUTTER: The next case is No. 2184.

MR. WHITFIELD: The application of Tennessee Gas Transmission Company for the establishment of 80-acre oil proration units in the Totah-Gallup Oil Pool, San Juan County, New Mexico.

MR. FEDERICI: William R. Federici, Attorney-at-Law, Santa Fe, New Mexico, appearing on behalf of Tennessee Gas Company. I have one witness, Mr. John J. Lacey of Tenneco Oil Company.

MR. NUTTER: Are there any other appearances?

MR. BUELL: For Pan American Petroleum Corporation, Guy Buell.

MR. KELLY: For Sun Ray Mid-Continent, Booker Kelly, of Gilbert, White & Gilbert in Santa Fe.

MR. SWANSON: For Aztec Oil & Gas, Dallas, Texas, Kenneth Swanson, associated with local counsel.

MR. NUTTER: Are there any others?

(No response.)

MR. NUTTER: Would you proceed, Mr. Federici?

JOHN J. LACEY,

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

DIRECT EXAMINATION

BY MR. FEDERICI:

Q Would you state your name and address and by whom you are employed?

A My name is John J. Lacey. I am a resident of Durango, Colorado and employed by Tenneco Oil Company as District Engineer in their Durango office.

Q Have you previously testified before the Commission as an expert?

A Yes.

MR. NUTTER: May we have the spelling of the witness's name?

A L-a-c-e-y.

BY MR. FEDERICI:

Q Are you familiar with the application in this case, No. 2184?

A Yes, I am.

Q Do you have certain exhibits to present in connection with this case?

A Yes, I have three exhibits. I would like to re-number

them as 13, 14, and 15.

MR. FEDERICI: I might ask the Examiner whether that might not eliminate some confusion. I notice in the original presentation there were twelve exhibits and I would suggest that these be numbered 13, 14, and 15.

MR. NUTTER: This was advertised as the original case number?

MR. FEDERICI: Yes.

MR. NUTTER: All right. That will be fine, 13, 14, and 15.

BY MR. FEDERICI:

Q Would you explain to the Examiner what Exhibit 13 is?

A Exhibit 13 is a map of the area in the vicinity of the Totah-Gallup Field showing the present completions and outlines in red the present field limits of the field.

Q Is there anything else you want to add with reference to Exhibit No. 13?

A No, I believe not. It just shows the deviation area I am talking about.

Q Now, with reference to Exhibit No. 14, will you explain to the Examiner what that is?

A Exhibit 14 is a pictorial representation of the performance history of the field and showing a bottom hole pressure data.

Q Exhibit 14 is --

A Exhibit 14 is a graphic illustration of the performance

history of the Totah-Gallup Field, showing the well completions, the average daily producing rate for the months of production, the average producing G.O.R. as reported on C-115 from January of '61 and the bottom hole pressures taken on Tenneco Oil Company's Callow which is in the field.

Q Is there anything else with reference to Exhibit 14 which you wish to state at this time?

A Well, the most important portion of Exhibit 14 is the upper portion of the exhibit showing the bottom hole pressure data obtained on Tennessee's Callow wells. It shows the initial bottom hole pressures obtained on these wells, immediately after their potential tests. It shows that each successive completion from No. 8 to 18 had lower bottom hole pressures with each successive completion. It also shows the results of two bottom hole pressure surveys, one taken in April of 1960 on four wells, and one taken in June of 1961 on seven wells. It also shows the results of a bottom hole pressure taken on the Callow 13 in December, 1961 after a 124-hour shut-in. The bottom hole pressure data shows that drainage has occurred on the lease and that the present completions are effectively draining the reservoir at the present time. And that is about all that shows.

Exhibit 15 is a tabular datum of the bottom hole pressure information on Tenneco's Callow lease. Exhibits 14 and 15 are up-to-date revisions of the original Exhibits No. 5 and 6 in the previous -- presented with the previous testimony. I might add

that the exhibits 1 through 12 that were originally presented are essentially applicable with this continuation of the case and that the data presented at that time is still substantially correct.

Q Do you have any other matters that you would like to present at this time?

A No, I have not, except a short statement to the effect that Tenneco Company believes that the present well spacing -- 80-acre well spacing is adequately draining the reservoir and that the bottom hole pressures in the older portion of the field which was first developed indicate that depletion has occurred and that it would be completely uneconomical to attempt to infill-drill acreage on the 40-acre space and that we would like the temporary rules made permanent.

MR. FEDERICI: We offer in evidence Applicant's Exhibits Numbers 13, 14, and 15.

MR. NUTTER: Tenneco's Exhibits 13 through 15 are admitted in evidence.

(Whereupon, Tenneco Oil Company's Exhibits Nos. 13, 14, and 15 were admitted in evidence.)

MR. FEDERICI: I think that's all.

MR. NUTTER: Are there any questions of Mr. Lacey?

MR. MORRIS: Yes.

MR. NUTTER: Proceed.

CROSS EXAMINATION

BY MR. MORRIS:

Q Mr. Lacey, what has Tenneco found to be an average well cost in this field?

A The average well cost, excluding articifial pumping equipment and leased storage and production facilities, is approximately $55,000.

Q That is exclusive of the lease equipment?

A Storage tanks, separators, heater treaters, [illegible], flow lines.

Q Now, what is the average depth of the wells that Tenneco operates?

A The average depth is approximately 5,500 feet to the producing zone or horizon.

Q Mr. Lacey, do you have any information concerning the recoverable reserves on primary production that have actually been experienced in Tenneco's wells?

A I don't believe I quite understand your question. The wells are not yet ultimately depleted by primary means.

Q Let me ask it another way: First of all, what type of drive do you believe you have in this reservoir?

A We believe the drive is a volumetric depletion type. I think we have stated we believed that this was the drive in our original testimony and we showed on Exhibit 8 in the previous testimony an estimate of approximately 12½ per cent primary recovery from primary means.

Q Would you say you had a solution gas type of drive?

A Yes.

Q And you estimated 12½ per cent recovery factor?

A Of the original oil in place under primary means, yes.

Q What estimate would you make primary and secondary combined as the recovery factor?

A We believe that secondary recovery by water flooding would increase the ultimate recovery to approximately 25 or 26 per cent.

Q Would you say that these figures are about average figures for a solution gas type Gallup reservoir?

A Yes. I would say that these estimates are very near the average for Gallup.

Q They are not below average?

A For the Gallup formation in the San Juan Basin I would say they were very typical.

Q Now, based upon your 12½ per cent recovery factor, what would be your estimate of the amounts of oil to be recovered by one well on an 80-acre tract?

A I believe we presented in the previous testimony an exhibit --

Q Did you use the 12½ per cent recovery factor in your original exhibit?

A Yes, we did.

Q Then the exhibit would reflect the economics of the recovery on an 80-acre unit using that 12½ per cent factor?

A Yes, that's correct.

Q Mr. Lacey, would you summarize your reasons for believing that one well will drain at least 80 acres in this pool?

A The bottom hole pressure information that we have obtained to date has shown that each additional completion has an initial bottom hole pressure less than what we observed in the discovery well to the bottom hole pressure obtained in December on our Callow No. 13, which is one of the highest productivity wells in the field and which we believe after 124-hour shut-in is very representative of the reservoir pressure in this area of the field. It shows that the reservoir pressure in the field in this area has declined from an original bottom hole pressure of 1,634 psig to a present bottom hole pressure of 673 psig and that the field is adequately being drained with the present completion.

Q Is Tenneco planning to drill any additional wells in this pool?

A At the present time we are not planning to drill any additional wells.

Q To your knowledge, do you know whether any additional wells are planned by other operators?

A At the present time I do not know what the plans are of other operators. However, I would think that the field is essentially developed on 80-acre spacing with the exception of one or two undrilled locations.

Q And a substantial portion of this pool has been committed to various pressure maintenance projects, some of which are already

approved and under way; is that correct?

A That's correct. As I understand it, the greatest majority of the fields,-- by that I mean, in excess of eighty per cent -- has already been submitted for pressure maintenance projects.

Q In view of that fact -- strike that. In view of the fact that the pressure maintenance projects have been approved with respect to the present drilling of wells on 80-acre units, do you believe that that would be another factor for the Commission to take into consideration in making the 80-acre rules permanent?

A Yes, I do.

MR. MORRIS: I have no further questions, thank you.

BY MR. NUTTER:

Q Mr. Lacey, it would appear from the production curve as reflected by Exhibit No. 14 that this pool peaked out in the month of August. Would that be correct?

A Yes, sir. That is substantially correct.

Q Now, the decline from August to the latest month shown here would be December, I believe. Is that the normal decline or does this reflect decline due to the shutting in of certain of the wells in December, also?

A The December production in the pool was restricted by a considerable amount as a result of the no flare order issued by the Commission, at which time all of the wells and tank batteries had not been connected to the Jalou Gas System, so that the

production in December is not really -- the average production in December is not really representative of what the field is capable of producing.

Q If it hadn't been for that shut-in order would the December production have been on this curve, would you estimate?

A I would estimate that the average daily rate, had the no flare order not restricted production, would be slightly less than November production.

Q Approximately what figure, Mr. Lacey?

A The November production was approximately 4300 barrels a day, so I would say somewhere between 4,000 and 4,300.

Q Now, what about this marked decrease in production from October to November?

A I believe that that is a result primarily from the natural decrease in productivity of the field.

Q I also note a marked increase in G.O.R.'s from the month of September to on through November.

A The G.O.R.'s in the field -- because of the fact that the field is undergoing a rather rapid depletion -- G.O.R.'s taken in the early part of 1961 from which the average reported gas production on the C-115 is made, was really not representative of the producing G.O.R.'s in November, and in November new G.O.R.'s were taken in the field during October and November, and that the jump in producing G.O.R.'s is a result of the new test.

Q What do the G.O.R.'s reflected on Exhibit 14 indicate?

What are they based upon?

A The average producing G.O.R. as shown on Exhibit 14 is based on the gas production from the various leases on the C-115.

Q So it was estimated from the old G.O.R. test?

A That's right.

Q So this would probably be higher if you had the true production figures?

A Yes. Jalou Gas Company is taking all of the producing gas from the field. They started taking this gas in December, so that I would say from January of 1962 forward, the gas production can be accurately determined from the figures obtained from Jalou, so that the average producing G.O.R. from January, 1962, forward will be very accurate.

Q But what I meant was, prior to the time G.O.R. was in operation, from November back, the G.O.R. is probably not correct.

A That's correct. The gas production, for example, in September is based on G.O.R. tests that were taken in March of '61, and the gas production as shown on this exhibit in September is probably low to the true amount of production.

Q You stated a moment ago that this field is being depleted rapidly. Do you think the relatively high allowables for the original have had any detrimental effect on the ultimate recovery of the pool?

A We have no data to indicate that.

Q So these allowables actually wouldn't have had any

effect on the ultimate recovery of the pool?

A We have no data to indicate that.

Q So these allowables actually wouldn't have had any detrimental effect as far as you know?

A Yes.

Q I notice on this bottom hole pressure decline curve that you have two points representing an average, one being four and the other seven wells. Are these the only field-wide or lease-wide averages that you have available?

A That's correct. I believe other operators have taken bottom hole pressures in the field. However, they are not available to me at the present time.

Q With the exception of the two averages and the one test on the Callow 13, all these other pressures are initial pressures?

A That's correct. The other pressures were taken immediately after the well was potentialed and shut in for 72 hours so that there was no withdrawal from the wells.

Q Did you have a pressure build-up curve on the Callow 13 when you took it in December?

A No, sir. I do not have a pressure build-up on the Callow 13. However, I might refer to Exhibit 13 --

Q Yes.

A -- which shows the bottom hole pressure taken on the Callow 13 on October 13, 1960, after a 78-hour shut-in period, was 1552. At approximately the same time on the Callow 11, on

October 13, 1960, a bottom hole pressure of 1562 was obtained after a 1558-hour shut-in. This led us to believe that the Callow 13 was capable of being stabilized to the reservoir pressure within approximately -- after a 72-hour shut-in and the 124-hour shut-in on the well taken in December -- is probably fairly representative of the reservoir pressure in this area.

Q Then you do feel that you had a substantially stabilized condition as far as pressure is concerned?

A Yes, we do believe this is so.

Q Are the characteristics of the pay in the No. 13 and 11 well substantially the same?

A The pay in 13 is thicker and probably better than the 11. The Callow 13 is located in the very best portion of the pool.

Q What has been the maximum recovery that Tenneco has obtained from any one well, Mr. Lacey?

A I do not have the exact recovery from individual wells; however, my opinion is that the Callow No. 8, the discovery well in the field, probably has the largest recovery to date in the field.

Q Approximately how many barrels a day does it produce?

A I would say 100,000 to 150,000 barrels.

Q Now, Exhibit No. 10 in the original hearing of this case indicated you were using a recovery factor of 12.5 % based on material balance calculations. Now, have any material balance calculations been run on this pool since the hearing a year ago?

A Yes, sir. There have been other estimates made in the early part of 1961 which suggested that the recovery might be as high as 15½ %, but we have no data available to suggest that this 12½ % is going to be in very much error.

Q It wouldn't be wrong?

A That's right.

Q Has any subsequent development since the original hearing indicated anything other than this 9.1 net feet of pay which you had used at that time?

A No, sir. There has not. I believe that the 9.1 feet average pay used in the original testimony is probably high to the present average with all the development wells that have been drilled.

Q Would this be due to probably some edge wells having been drilled since the original data was available or not?

A Yes, sir. There have been some additional edge wells drilled and I believe at the northwest end of the field even in the Fairweather Field, the net pay is not as thick as it was encountered on Sections 27, 28, and 34, identifying that portion of the field having the greatest amount of pay.

Q I presume you would still say 70.2 barrels per acre foot?

A Yes, as a composite average recovery from the field, I would say 70.2 is still substantially correct.

MR. NUTTER: Are there any further questions of Mr. Lacey?

(No response.)

MR. NUTTER: You may be excused.

(Witness excused.)

MR. NUTTER: Do you have anything further, Mr. Federici?

MR. FEDERICI: No, sir.

MR. NUTTER: Does anyone have anything further they wish to offer?

MR. BUELL: Yes, Mr. Examiner. We have one witness.

MR. NUTTER: We will take a fifteen-minute recess and then proceed.

(Recess taken at 10:45.)

MR. NUTTER: The hearing will come to order, please. Mr. Buell?

MR. BUELL: Pan American has one witness, Mr. Examiner, who has not been sworn.

GEORGE W. EATON, JR.,

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

DIRECT EXAMINATION

BY MR. BUELL:

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

A George W. Eaton, Jr., employed by Pan American Petroleum Corporation as a senior petroleum engineer in Farmington, New Mexico.

Q With respect to the February 6th portion of this case, have you had made available to you all the reservoir data that was submitted at that time by Tennaco?

A Yes, sir; I have.

Q Have you also had made available to you all the data presented by Tenneco here today?

A Yes, sir; I have.

Q Mr. Eaton, based on your analysis of such data, what is your opinion as a reservoir engineer with respect to the drainage area of a well in the Totah-Gallup Oil Pool?

A My examination of the data presented in the original testimony, together with the data presented earlier this morning by Tenneco, combined with the data which I intend to submit, convinces me that a well in the Totah-Gallup Pool is capable of draining well in excess of 80 acres. It is therefore my recommendation that the temporary rules providing for 80-acre proration units in this pool be made permanent.

Q Mr. Eaton, I direct your attention to what has been marked as Pan American's Exhibit 1. What does that exhibit reflect?

A Our Exhibit 1 is a map of a portion of the San Juan Basin in San Juan County, New Mexico, showing the location of the Totah-Gallup Pool and the Cha Cha Gallup Pool.

Q On that exhibit, how have you designated the defined limits of each of those pools?

A The Totah-Gallup Pool is outlined in red; the Cha Cha

Gallup Pool is outlined in green.

Q Have you shown the wells in both pools with the conventional blue dots?

A Yes, sir.

Q Looking at that portion of Exhibit 1 that reflects the defined limits of data, what is the significance of the two circles within the limits of that pool? I believe it looks like one is red and one is green.

A One of those circles is red and the other is green. They depict the areas or wells where we have positive evidence of pressure interference on newly completed wells.

Q Let's discuss the area within the green circle first. From which well did the data come which allowed you to plot that green curve?

A The data came from the Aspen Federal No. 1-11 in the Totah-Gallup Pool.

Q Would you look at what has been marked as Pan American's Exhibit No. 2 and state what that reflects?

A Exhibit 2 is a tabulation of the pertinent data regarding the bottom hole pressure which were obtained on the Aspen Federal 1-11 Well which showed evidence of interference. It also shows a calculation of the pressure interference area displayed by this bottom hole pressure measurement.

Q Using the data contained on Exhibit 1 in conjunction with Exhibit 2, would you state for the record the significance,

from the standpoint of well drainage, that these data reflect?

A The Aspen Federal No. 1-11 was completed on August 2, 1961. It was immediately shut in for a period of 72 hours, after which a bottom hole pressure measurement was taken. At a datum of plus 200 feet, the bottom hole pressure measurement so taken amounted to 1,337 psig. Now, this pressure measurement compares to an original reservoir pressure in the Totah-Gallup pool at the same datum of 1,623 psig, or a loss in reservoir pressure at this location amounting to some 286 psig.

Q If this well was completed and this pressure run, what was the nearest well then producing in the field to the Aspen Federal No. 1-11?

A At the time the Aspen Federal No. 1-11 was completed, the nearest producing well was Gallegos Canyon Unit Well No. 99, which is located some 1,450 feet distant from the Aspen Federal No. 1-11.

Q Mr. Eaton, what is the area within a circle the radius of which is 1,450 feet?

A 151 acres.

Q Does the data then indicate to you that in this area of Totah, that one well was effectively draining a minimum of 151 acres?

A Yes, sir. That is what these data show.

Q All right, sir. Now, let's go on to the red circle on your Exhibit No. 1. From which well was the data obtained that

enabled you to plot that circle?

A The data for that red circle came from Gallegos Canyon Unit No. 92.

Q All right, sir. Would you look at what has been marked as Pan American's Exhibit 3 and state briefly for the record what that exhibit reflects?

A Exhibit No. 3 is a tabulation similar to Exhibit No. 2, showing the pertinent data regarding the bottom hole pressure measurement on Gallegos Canyon No. 92, together with a calculation of the indicated interference area displayed by that last pressure measurement.

Q Would you use the data on Exhibit 3 in conjunction with Exhibit 1 and state for the record the significant data obtained on the completion of this well?

A Shortly after completion on May 1, 1961, Gallegos Canyon Unit No. 92 was shut in for a period of 64 hours, after which a bottom hole pressure measurement at a plus 200 foot datum was obtained. This pressure measurement amounted to 1,535 psig, which compares to an original reservoir pressure in the Totah-Gallup Pool of 1,623 psig. The loss of pressure in Gallegos Canyon Unit No. 2, due to interference from production from other wells, amounts to 88 psig.

Q At the time that well was completed and that pressure run, what was the nearest then producing well?

A The nearest producing well at that time was Aztec Oil &

Gas Company's Hagood No. 13-G, which is located some 1,850 feet distant from Gallegos Canyon Unit Well No. 92.

Q What is the area of a circle the radius of which is 1,850 feet?

A Two hundred forty-six acres.

Q Do these data then indicate to you that a well in the Totah-Gallup Pool at this stage of depletion was draining a minimum of 246 acres?

A That is what these data indicate.

Q Mr. Eaton, have you made reservoir engineering studies of the Cha Cha Gallup Pool as well as the Totah-Gallup Pool?

A Yes, sir; I have.

Q You have also served on engineering committees, have you not, that have made engineering studies of both of these pools?

A Yes, I have.

Q Based on that background, Mr. Eaton, would you say that these two pools are similar or dissimilar?

A My background on these two pools suggests to me that they are very similar in nature both as to the characteristics of the reservoir rock as well as the characteristics of the reservoir fluid.

Q Would you look at what has been marked as our Exhibit No. 4, Mr. Eaton, and briefly state for the record what that exhibit reflects?

A Exhibit No. 4 is a comparison of the pertinent reservoir

data for the Totah-Gallup and the Cha Cha Gallup Pools. Exhibit No. 4 includes pertinent data pertaining to the characteristics of the reservoir rock as well as the characteristics of the reservoir fluid.

Q Mr. Eaton, these data appear to be self-explanatory. Would you like to just comment generally on the comparison or maybe pick out one or two items and comment on that?

A I believe it would suffice to say that there are an adequate number of instances here where these average characteristics are different. It definitely shows that these are two separate accumulations but in only one perimeter is there only substantial difference between the characteristics of the two reservoirs. Now, that perimeter which does show some substantial difference is in the average permeability. The Totah-Gallup Pool has an average permeability of 143 M.D.

Q In other words, Mr. Eaton, the order of permeability in Totah is approximately 300 % greater than in Cha Cha?

A It is approximately three times the average permeability in Cha Cha.

Q Mr. Eaton, have extensive interference tests and data been obtained in the Cha Cha Gallup Pool?

A Yes, sir, at the pool-ruled hearing on the Cha Cha Gallup Pool in October, 1961, extensive pressure interference data were presented to show positive evidence of pressure interference over large areas in the Cha Cha Gallup Pool.

Q How have you designated on Exhibit 1 those areas in Cha Cha where interference data have been obtained?

A Areas in the Chaw Chaw Gallup Pool where positive evidence of pressure interference has been obtained are marked with a brown circle.

Q Did you say a large brown dot?

(Laughter.)

A Yes, sir.

Q Mr. Eaton, with respect to Cha Cha, now, does that pool have permanent rule?

A Yes, sir, it does.

Q What provision is made with respect to proration units?

A The Cha Cha Gallup Pool rules provide for 80-acre proration units. The significant portion of Exhibit 1 as pertain to the Chaw Cha Gallup Pool in the distribution of the pressure interference data is that in the Cha Cha Gallup Pool we had evidence of interference from one end of that pool to another. There are six brown dots on Exhibit No. 1 which are strung out from the extreme northwest end of the pool to the extreme southeast end of the pool.

Q So, with respect to Totah, Mr. Eaton, you not only have physical affirmative data with respect to the drainage area of a well, but you can also confirm that data by an analogy with Cha Cha?

A Yes.

Q Mr. Eaton, in your opinion, do you think that the Totah-Gallup Pool could be economically developed on a 40-acre pattern?

A No, sir; it could not be.

Q In that connection, Mr. Eaton, I will direct your attention now to what has been marked as Pan American's Exhibit No. 5. What does that exhibit reflect?

A Exhibit No. 5 is an economic analysis showing the average economics for the drilling of an average Totah-Gallup Pool well on 40 acres.

Q Mr. Eaton, these data appear to be more or less self-explanatory, so rather than burdening the record with an item-by-item resimé, I will just ask you to state for the record whether or not a profit or a loss would result from 40-acre development.

A Development on a 40-acre pattern would result in a loss of $21,000 per well.

Q Now, Mr. Eaton, you prepared this economic analysis prior to the commencement of gas sales from Totah, did you not?

A Yes, sir.

Q So therefore there is no income from gas included in the data on this exhibit?

A That is true.

Q Have you since that time and prior to the hearing, calculated the amount of income that would be derived from gas sales?

A Yes, sir; I have. The average 40-acre well in the

Totah-Gallup Pool would realize an income to the working interest of approximately $5,000 due to gas sales, so, including gas sales in the economic analysis would result in a net loss on the average well amounting to approximately $16,000.

Q Mr. Eaton, you heard the testimony of Mr. Lacey where the no flare order was discussed?

A Yes, sir.

Q Do you agree with Mr. Lacey that at the present time wells in Totah are producing less than the top allowable rate due to the no flare order?

A Yes, sir; I agree with that.

Q So, actually, if 40-acre development was necessary, and the pool was developed on a 40-acre basis, you would simply have twice as many wells producing the same amount of oil?

A That is true. Under the present conditions there would be no more oil produced with twice the number of wells as there is at the present time.

Q Mr. Eaton, assuming that the pool limits are now defined, approximately what would be the total cost to drill this pool down to a 40-acre density?

A At the present time there are approximately 60 wells in this pool. Now, assuming an average well cost, plus the average cost to equip that well for production, including artificial lift and the necessary lease equipment, assuming that that average cost is approximately $65,000, it would require an expenditure of

approximately $4,000,000 to completely develop the Totah-Gallup Pool to a density of 40 acres per well.

Q An expenditure of four million dollars and not another barrel of oil produced from the pool?

A That is true.

Q Mr. Eaton, in view of all your testimony, do you feel that if the Commission should adopt the current temporary rules as permanent rules, do you feel that that action on the part of the Commission would serve conservation as well as protect the correlative rights of all the owners of interest in the pool?

A Yes, sir.

Q Do you have anything else you would like to add at this time, Mr. Eaton?

A I don't believe so.

MR. BUELL: Mr. Examiner, that concludes our direct. At this time I would like to formally offer Pan American's Exhibits 1 through 5, inclusive.

MR. NUTTER: Pan American's Exhibits 1 through 5 will be admitted.

(Whereupon, Pan American Petroleum Corporation's Exhibit Nos. 1 through 5, inclusive, were admitted in evidence.)

MR. NUTTER: Are there any further questions of Mr. Eaton?

MR. MORRIS: Yes.

MR. NUTTER: Mr. Morris.

CROSS EXAMINATION

BY MR. MORRIS:

Q Mr. Eaton, calling your attention to Exhibit 5, what recovery factor did you use for primary production?

A 10.7 %.

Q Now, what factor would you expect, including both primary and secondary recovery in this pool?

A I am in concurrence with the estimate made by Mr. Lacey of somewhere in the range of 25 to 28 % for total recovery, primary, plus pressure maintenance, secondary.

Q Does Pan American have any present plans to drill additional wells in this pool?

A No, sir.

Q Pan American is the operator of two pressure maintenance projects that have already been approved in this pool by the Commission; isn't that true?

A Yes, sir; that is true.

Q Were those projects planned and approved in contemplation of 80-acre proration units?

A Yes, sir; they were. Let me put it this way: They were planned with the contemplation of present development. Now, in all instances Pan American's leases are not necessarily drilled to an 80-acre density.

Q Mr. Eaton, with respect to your Exhibits Nos. 2 and 3, where you have arrived by calculation at an area of pressure

interference somewhat in excess of 80 acres, does this area of pressure interference merely show what acreage is in communication as a result of these tests?

A It shows that the new well on which these pressure measurements were taken, the acreage on which that well was located, had already been depleted somewhat by production from other wells. To strike an arc between the nearest producing well and the well on which the new data were obtained, why, it is simply a minimum area that is being affected. In the case of this Aspen Federal No. 1-11 Well at the location at which that well was located, the reservoir had undergone a 286-pound pressure drop. Now, that means that on further from the nearest producing well it would become less and less, but certainly the area being affected by production is much larger than the area indicated by the circle.

Q Would you say, then, that your calculations on Exhibits 2 and 3 show communication rather than intending to show efficient and economical drainage over the given area?

A In my opinion the two are essentially the same.

Q In determining economic drainage, don't you have to take into account at what point the well will cease producing below a certain number of barrels per day, at which time it would become uneconomical to operate the well?

A Yes, sir; that is true.

Q So, from that standpoint, your two exhibits do not show economic drainage but merely show communication?

A That is true. I will qualify it to this extent: There, of course, is some insignificant difference between recovery on 160 acres and on 40 acres, but the only way it can be shown just how much that is, -- because obviously you can't drill it one way and then another way to another density to determine it -- so the only route left to us is by these theoretical calculations. Now, what the range of porosities and permeabilities that we have here in the Totah-Gallup Pool are can be shown from these theoretical calculations where that difference is very small.

MR. MORRIS: I have no further questions, thank you.

BY MR. NUTTER:

Q Mr. Eaton, I note that your reserves in barrels per acre foot of 70 correspond fairly closely to Mr. Lacey's of 70.2 barrels per foot as presented in the original hearing. You do show quite a bit of difference in your net pay thickness and your water saturation. Would the lower water saturation and the lower net pay thickness be off-set by your lower recovery factor that you have used?

A Well, let me say this: The net pay thickness would not account for any differences in the recovery per acre foot; the water saturation could.

Q The water saturation here then is off-set by the recovery difference?

A There is possibly a difference in the porosity values that we used, too, that might account more than the difference in

the water saturations.

Q Well, you used 14.3 and you used 14.2. They are very close.

A Well, I'll tell you what I did to estimate my recovery in barrels per acre foot: I took the estimate in original oil in place per acre foot prepared by this Totah-Gallup engineering committee and then I multiplied that value prepared by the engineering committee by my own recovery factor and that came to 50.

Q Has Pan Am run any recovery calculations in this Totah-Gallup Pool?

A Not in Totah-Gallup. We did fairly recently in the Chaw Chaw where we ran one. We had such better data with which to do that in the Cha. Cha. and the pools are so similar that in all of our own company engineering work we have used the one that ran in Cha. Cha. just as if it had been run on the Totah-Gallup Pool. That is where my 10.7 % recovery factor came from. I feel pretty good about this. It was prepared before the surveys of 1961 were conducted, and once the data from the field-wide gas-oil survey were made available to us, we put it unto our balance and it fell on the curve, and we felt it was confirmed and we were in the right range.

Q You feel the data, then, for Cha. Cha. would be applicable here for Totah?

A Yes, sir. Put it this way: We don't have any data that would suggest to us that it is not applicable, and in lieu of

that, well, rather than run a new material balance on a lot less--what we consider a lot less reliable data in Totah, we have just used Cha Cha material balance to predict the performance of the the Totah reservoir.

Q Any material balance calculation in this pool would be subject to question inasmuch as you haven't had accurate gas production figures available through the prime life of the pool; isn't that correct?

A To attempt to feed back into the material balance calculation field performance data from which it might be used to predict future performance, you do need good gas production data.

Q So what have you done to obtain good gas data?

A In the case of the Cha Cha Gallup Pool this is one reason why we feel we have better data in the Chaw Chaw Gallup Pool. In the Cha Cha Callup Pool Pan American properties were developed right along with the remainder of the pool. That is the way we differ in the case of the Totah-Gallup Pool. We were almost Johnny-come lately's in the case of the Totah-Gallup Pool. In the case of the Chaw Cha Gallup Pool we periodically ran our gas-oil ratio surveys across individual tank batteries, which gave us a field for what was occurring in these various areas of the Chaw Chaw Gallup Pool in which we operated. Now, we fed those gas-oil ratio data across individual tank batteries back into the cumulative production in the reservoir fluid sample and computed a KGKO curve from field performance data.

MR. NUTTER: Are there any further questions of Mr. Eaton?

MR. BUELL: Yes.

REDIRECT EXAMINATION

BY MR. BUELL:

Q Have you reduced this material balance that you were speaking of to a presentable exhibit form?

A I could present it as an exhibit in one copy here. I didn't intend to necessarily --

MR. BUELL: Would the Examiner like to have that submitted as an exhibit in this case?

MR. NUTTER: If you would, please, Mr. Buell. Is that the only copy of it you have?

A I have the original. I think that it might be quite interesting for you to take a look at this exhibit, from this standpoint --

MR. BUELL: That is identified as Pan American's Exhibit 6.

A That exhibit might help explain why there is so much difference between the gas production in September, 1961, as was brought out earlier, and what it was in November and December and still is at the present time. You will note that that gas-oil ratio curve is very steep in that range where the recovery factor is in between five and seven per cent of the oil in place, and that happens to be approximately where we were in late summer of

1961. So you would expect great changes in this past four or five months in the gas-oil ratio and hence in the gas production.

RECROSS EXAMINATION

BY MR. NUTTER:

Q So that you feel that this pool has peaked out as far as the G.O.R. is concerned and would be tending downward now?

A No, sir. I believe that the gas-oil ratio has not reached its peak, although the actual ability of the pool to produce gas is probably very close to its peak. That may sound like I am talking now with both corners of my mouth, but the reason for that is that after the gas-oil ratio reaches a certain value, then the capacity to produce oil decreases and they compensate for each other. In fact, our predictions show that the actual ability to produce gas will decline although the gas-oil ratio itself is still increasing.

MR. NUTTER: Are there any further questions?

MR. BUELL: May I formally offer Pan American's Exhibit No. 6?

MR. NUTTER: Yes. It will be admitted.

(Whereupon, Pan American Petroleum Corporation's Exhibit No. 6 was admitted in evidence.)

MR. PORTER: I have one question, Mr. Eaton.

BY MR. PORTER:

Q Mr. Eaton, a while ago I believe that you and

Mr. Buell were deliberating on some testimony to the effect -- somewhere I heard the statement that if a pool was drilled on 40 acres, not one barrel of additional oil would be recovered. Would you care to change that to "any substantial amount of oil"?

A What we were talking about is not one barrel of additional current production. We did not intend to imply that not one additional barrel of cumulative would be recovered. It is my opinion that it would not be a substantial amount of additional cumulative, but I would not go on record as saying that not any more would be.

MR. NUTTER: You would wish to imply that not four million dollars worth of oil would be recovered?

A Yes, sir; I would imply that.

MR. NUTTER: Does anyone else have anything further to offer on case number 2184?

MR. SWANSON: Aztec Oil & Gas.

MR. NUTTER: Mr. Swanson?

MR. SWANSON: Aztec Oil & Gas has tried to keep current in the situation on the Totah-Gallup Pool. It was our feeling, and as it has turned out, I believe we were correct in assuming that the testimony would very clearly show the undesirability from an economic standpoint of developing this pool on 40-acre spacing. In the study we have made, the only point that perhaps might be mentioned that would add anything in addition to what we have heard today is that we made a study of the bottom hole pressures of wells

upon completion, and in all cases it was apparent that the newly completed wells which were at locations off-set by wells which were producing at that time came in at bottom hole pressures which were below those of new wells which were not off-set. There is no question but that that communication exists over wide areas in the pool, and we would like to concur with Tenneco and Pan American in requesting that the 80-acre spacing would be made permanent.

MR. NUTTER: Thank you. Mr. Kelly?

MR. KELLY: Sun Ray Mid-Continent joins Tenneco's and Pan American's request for establishment of a permanent 80-acre proration units in the Totah-Gallup Oil Pool. Sun Ray has three wells in the pool, and in its opinion all the wells are capable of adequately draining on an 80-acre tract basis.

MR. NUTTER: Thank you. Anyone else?

MR. MORRIS: The Commission has received a telegram from Aston Drilling Company concurring with the application for permanent drilling of this pool.

MR. NUTTER: Anyone else?

MR. FEDERICI: Some reference has been made in this hearing to the original exhibits and I think it might be well if we incorporated at this time the testimony and the exhibits from the original hearing and incorporate them in this hearing, and we move that that testimony and those exhibits be introduced in evidence.

MR. NUTTER: I think it might be automatic inasmuch as it is the same case, but if not, it will be done, Mr. Federici.

Does anyone else have anything further on Case No. 2184?

(No response.)

MR. NUTTER: If not, I will take the case under advisement, and the hearing is adjourned.

* * * *

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

I, ANITA OSWALD, COURT REPORTER in and for the County of Bernalillo, State of New Mexico, do hereby certify that the foregoing and attached transcript of hearing was reported by me in stenotype and that the same was reduced to typewritten transcript under my personal supervision and contains a true and correct record of said proceedings, to the best of my knowledge, skill and ability.

Anita Oswald
COURT REPORTER

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 2184, heard by me on 3/7, 1962.

....., Examiner
New Mexico Oil Conservation Commission

INDEX

EXHIBITS