

BEFORE THE
OIL CONSERVATION COMMISSION
SANTA FE, NEW MEXICO
AUGUST 30, 1961

EXAMINER HEARING

IN THE MATTER OF:
CASE 2359

TRANSCRIPT OF HEARING

DEARNLEY-MEIER REPORTING SERVICE, Inc.

PHONE CH 3-6691

ALBUQUERQUE, NEW MEXICO



NEW MEXICO OIL CONSERVATION COMMISSION

EXAMINER HEARING - ELVIS A. UTZ

SANTA FE, NEW MEXICO

REGISTER

HEARING DATE AUGUST 30, 1961 TIME: 9 A.M.

NAME:	REPRESENTING:	LOCATION:
<i>P. O. T.</i>		
<i>2 J. M. Hight</i>	<i>U. S. G. S</i>	<i>Farmington Dec 1951</i>
<i>R. T. Loomis</i>	<i>Shell</i>	<i>Farmington</i>
<i>John E. Hill</i>	<i>Shell</i>	<i>near Farmington</i>
<i>John E. Hill</i>	<i>Shell</i>	<i>Farmington</i>
<i>L. A. Yoon</i>	<i>Shell</i>	<i>Farmington</i>
<i>F. J. Loomis</i>	<i>Shell</i>	<i>Farmington</i>
<i>R. T. Loomis</i>	<i>Shell</i>	<i>Farmington</i>
<i>John E. Hill</i>	<i>Shell</i>	<i>Farmington</i>
<i>John E. Hill</i>	<i>U. S. G. S</i>	<i>Farmington</i>
<i>C. R. Black</i>	<i>TEXACO</i>	<i>Farmington</i>
<i>William E. Loomis</i>		
<i>John E. Hill</i>		
<i>John E. Hill</i>		

NEW MEXICO OIL CONSERVATION COMMISSION

EXAMINER HEARING - ELVIS A. UTZSANTA FE, NEW MEXICOREGISTERHEARING DATE AUGUST 30, 1961 TIME: 9 A.M.

NAME:	REPRESENTING:	LOCATION:
Pete Porter	OCC	Santa Fe.
J. J. McQuay	U. S. G. S	Farmington (17)
R. R. ROBISON	Shell	Farmington
Hub & Kell	Shell	Los Angeles
W. A. Crowley	Shell	Farmington
J. A. Yore	Shell	Roswell
B. T. Miller, Jr.	Austral Oil	Houston
R. L. Essary	Shell Oil Co.	Roswell
Howard Bratten	Harvey (Independent)	Roswell
Warren M. Marshall	Shell Oil Co.	Farmington
W. W. Ryals	U. S. G. S	Farmington
C. R. Black	TEXACO Inc.	Midland
William R. Loar	Sevron (Independent)	Tulsa
L. P. W. P.	Shell	Santa Fe
Foster Morrell	Independent	Roswell, N.M.

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NAME:

REPRESENTING:

LOCATION:

Ralph Z Gray
Jason Kellahi
✓ R R MARMOR
Frank Darden

Hudson & Hudson
Kellahi & Fox
SINCLAIR
Newmont Oil Co

Artesia
Santa Fe
MIDLAND TEXAS
St. Worth, Texas

BEFORE THE
OIL CONSERVATION COMMISSION
SANTA FE, NEW MEXICO
AUGUST 30, 1961

IN THE MATTER OF:

Application of Shell Oil Company for a pilot water flood project in the Townsend-Wolfcamp Pool, Lea County, New Mexico. Applicant, in the above-styled cause, seeks permission to institute a pilot water flood project in the Townsend-Wolfcamp Pool with water injection initially to be through the Texas Pacific Coal & Oil Company State "J" Well No. 2, located in the NE/4 SW/4 of Section 10, Township 16 South, Range 35 East, Lea County, New Mexico.

Case 2359

BEFORE:

Elvis A. Utz, Examiner

EXAMINER HEARING

MR. UTZ: Case 2359.

MR. MORRIS: Application of Shell Oil Company for a pilot water flood project.

MR. SETH: Oliver Seth appearing for the Applicant. We have one witness, Mr. Utz.

MR. UTZ: Are there other appearances in this case?

You may proceed and be sworn.

(Witness sworn.)

ROY LEE ESSARY.

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

DIRECT EXAMINATIONBY MR. SETH:

Q Would you state your name, please.

A Roy Lee Essary.

Q By whom are you employed, Mr. Essary?

A Shell Oil Company.

Q How long have you been employed by Shell, and in what capacity?

A I have been employed 7 years by Shell, the first year on the training program, the next 2 years well setting and general exploitation field operation, 2 years of general well stimulation, and the last 2 years in the reservoir engineering section. The past 6 years of this have been spent in Southeast New Mexico.

Q What is your educational background?

A I graduated from the Colorado School of Mining in 1954, a degree in Petroleum Engineering.

Q Are you generally familiar with this Townsend-Wolfcamp Area?

A Yes, sir.

Q Have you had previous experience with any similar field in that part of the state?

A Yes, sir; Kelmat-Wolfcamp Field, which is quite similar, and located on a trend with this, approximately 10 miles to the west.

Q Are you on that Kelmat Committee?

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A Yes, sir; I am on that Committee.

MR. SETH: May he testify?

MR. UTZ: Yes. He is qualified to testify.

Would you spell your name, please?

THE WITNESS: E-s-s-a-r-y.

Q (By Mr. Seth) Would you state, please, to the Commission, what is the general purpose of Shell's Application in this case.

A Our general purpose is to institute on an experimental basis a pilot water flood to determine response to water injection in the Townsend-Wolfcamp Reservoir.

Q Do you have any other preliminary statements you want to make, Mr. Essary?

A No, sir.

Q Do you have a plat showing the location of the proposed pilot program?

A Yes, sir.

Q This Exhibit has been marked Shell Oil Company Exhibit 1. Would you state, please, what this Exhibit shows?

A This Exhibit is a structural contour map on the W-5 marker within the Wolfcamp formation. It shows well locations, leasehold owners, and the performance of the wells as of June 30, 1961.

Q How is the proposed pilot flood area shown on this Exhibit?

A The proposed pilot flood is outlined with hatched



lines.

Q What is the legal description of the water flood.

A The test area consists of Section 10, Township 16 South, Range 35 East.

Q Now, would you give us a little bit of background on this well? Before we leave this Exhibit, I notice there is a line generally Northeast Southwest through the Area. What does that connotate?

A The study of the Engineering Committee. The Engineering Committee in their study came to the conclusion that this field should be divided into two portions as far as performance is concerned. Even though there is a common reservoir, there is a change in lathology such that the performance of the North Area is substantially different from the performance in the South Area. This has been determined by pressure build up surveys and well performance. The South Area has good inter-well communication, and the North Area, the inter-well communication is quite poor.

Q Now, you spoke of the Engineering Committee. What is the formal title of this Committee?

A The Townsend-Wolfcamp Engineering Committee.

Q Made up of representatives of operators in the field?

A Of all operators in the field; yes, sir.

Q Give us a little background on the field.

A The Townsend-Wolfcamp Field is located approximately 5 miles west of Lovington, New Mexico, in Central Lea County,



discovered in May, 1952, by Wilshire Oil Company, Townsend's No. 1. The field produces from a fossiliferous crystalline limestone basic at the depth of 10,400 to 10,700 feet. There was no original gas-oil contact, and no oil-water contact has been evident at Townsend. The reservoir is a dissolved gas dry reservoir with an average weighted porosity of 8.8 per cent. Permeability ranges from less than one tenth of a millidarcie to greater than 2,000 millidarcies. Original reservoir pressure was 259 pounds. Saturation occurred at 3,583 pounds. The present reservoir pressure is approximately 400 pounds.

Q Do you have any data on reserves?

A Yes, sir.

Q Just in general terms, if you like.

A I have an exhibit, here, that I will present in just a moment, if I might.

Q Yes, sir; do that.

A Just one second. In October, 1958, the operators met and approved a formation of an Engineering Committee to evaluate the means and methods to increase ultimate recovery. The Committee determined the original oil in place by two methods: Volumetrics indicated the South Area to have some 27,860,000 stock tank barrels of oil, where the North Area had 10,800,000 stock tank barrels. Material balance confirmed the South Area essentially with the calculated original oil in place of 15,330,000 stock tank barrels. The Engineering Committee then decided to average



these two figures and use an original stock tank barrel in place in the South Area of 26.6 million barrels. The North Area, the pressure data was too inconclusive and sporadic to run a valid material balance. Their decision was to eliminate the North Area from the consideration for secondary recovery due to the impermeable nature of the reservoir.

I would like to present as Exhibit 2 --

Q You are referring to what has been marked Shell Oil Company Exhibit 2?

A Yes, sir.

Q What does that show?

A This shows -- I might mention something else. In the study of this field, the Engineering Committee omitted those wells north of Township 16 South as being rather scattered and did not pertain directly to the bulk of the work to be done.

Q But they are within the limits as defined by the Commission?

A Yes, sir; they are within the limits defined by the Commission but not as defined within the study.

Q Go ahead with Exhibit 2.

A Exhibit 2 shows the decline, approximate decline curve of from the beginning of the field to June, 1961. Two curves are shown, one, the total field performance, and the other consisting of the South Area. The South Area is also called the Fairway, as a localized nomenclature.



Q Now, this indicates your per cent of primary completion, does it?

A This is shown by this. The present compute is 10,874,000 barrels of oil; accumulated reserves are one million, approximately 1,376,000 barrels of oil, for the resulting primary ultimate of some 12.25 million barrels of oil. These figures indicate that at present the field is approximately, the South Area, pardon me, is approximately 89 per cent depleted, primary recovery.

I would like to further present Exhibit 3, which shows the pressure performance of the South Area.

Q Now, referring to Exhibit 3. What does that show?

A Exhibit --

MR. UTZ: Let me ask a question on Exhibit 2. The total reserves as of 7-1-61 is covered by the figures 10,874,000?

THE WITNESS: Yes, sir. This is not an official approximation by the Committee. It is my personal estimate. The Committee finished the report some time ago, and I have brought it up to date.

MR. UTZ: Proceed.

MR. SETH: Please refer to Exhibit 3, and state what it shows.

A Exhibit 3 shows the reservoir pressure versus the cumulative oil produced, and shows for the most part the differential material balance calculations are verified by actual field



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performance. During the past few months, the actual measure of pressures are somewhat higher than those calculated by the differential balance.

Q How are the actual pressures taken?

A The actual pressures were measured by bottom hole pressure bombs. As shown also, here, the extrapolation of the reservoir pressures indicate that the 12,250,000 barrels ultimate is a reasonable estimate for the South Area.

Q Do you have some data on the status of the wells at the present time?

A Yes, sir.

Q You have before you Exhibit 4, what does that show?

A Exhibit 4 presents the status of the wells at present in a tabular form by company.

Q Now, this is just in the study area, again, is it not?

A Yes, sir; this is in the study area, but it does include both the North and South Areas. I would like to point out that at present there are 57 wells producing in the South Area, out of a total of 69 wells.

Q Now, in that first column, there, the figures in parentheses, those were for the wells producing less than 200 barrels per month; is that right?

A Yes, sir. These are based on an average decline in the field wells that are producing 200 barrels or less per month, have a remaining life of one year or less. So the addition of the shut-



in wells and the wells in parentheses indicates that within approximately one year's time, we expect nearly one third of the wells in the South Area to be shut-in.

Q This also indicates the companies that are participating; does it not?

A Yes, sir. The asterisk-marked companies are those participating in the pilot flood project. One company, Brunson & Laughlin, with the double asterisk, is within the pilot area. They are not participating as far as paying their equitable share of the project, but they have signed a side agreement where they agree to allow us to inject water, and they do not hold the operators liable for damage to this well caused by the injection of the water.

Q Now, do you have any other comments on Exhibit 4?

A No, sir.

Q Do you have some data on decline?

A Yes. The apparent recovery efficiency, based on the predicted primary ultimate in the South Area and the estimated original oil in place is 46 per cent, which seems very high for this type reservoir. The primary efficiency by differential material balance to a 400 pound abandonment pressure was 40 per cent. This is also quite high for a depletion type reservoir. I wanted to make this point at this time. We will refer to it again.

The Committee, in their secondary recovery investigation,

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investigated pressure maintenance first due to shrinkage in the reservoir. However, the pressure at the time of the Committee's report was only 600 pounds, and the pressure maintenance would have only recovered an additional 500,000 barrels of oil at over \$2,000,000 estimated cost. The only reasonable approach to secondary recovery in this field was water flooding. The residual oil saturation after primary depletion is calculated at 25.4 per cent. The residual oil saturation, after primary by differential material balance, is 28.6 per cent. We ran displacement tests on two plugs and one hole core. The residual oil saturation after flooding these cores to 99.9 per cent water cut was 47.7 per cent. This, of course, is unreasonably high, and the value could not be used. Normally, you would expect between 25 and 35 per cent residual oil saturation after flooding of reservoir of this type. If we assume a residual oil saturation after water flood of 30 per cent, our calculated values are less than this, and therefore, we would have no recovery by water flood.

As stated before, the estimated primary recovery efficiency appears quite high. This could be due to some factor such as the original oil in place being too low, the figure used being too low. For instance, oil draining into the reservoir from the North Area, insufficient net acre feet used in the calculations, too low porosity in the calculations, or too high a value of water saturation used in the calculations. So for purposes of evaluation, the Engineering Committee arbitrarily



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increased the original in place by 20 per cent, resulting in 31.9 million barrels per day in the South Area. Utilizing this figure, they calculated the recovery efficiency to be 34 per cent, and the residual oil saturation after primary to be 32 per cent. Utilizing these data, they computed at the increased recovery by secondary methods with the conformance factor of 60 per cent, was 2.4 million stock tank barrels of oil, resulting in a profit of 75 per cent, or \$1,442,000 on a capital expenditure of \$1,931,000. Pay out would occur in three years. Total life of the project was seven years. They investigated two pilot areas. The cost on one pilot area, a regular five spot pilot area was \$319,000. The second regular five spot pool on the project that was investigated would cost \$208,000. They submitted this report to the Committee with the recommendation that the field be allowed to deplete through primary means. The Townsend Field Operators Committee met in August of 1960 to discuss the Engineering Committee report, and they decided that the report was acceptable. They decided further that a regular five spot water flood was not justified due to the calculations not warranting water flooding in this field and also the high cost of instituting a pilot flood. But, they further decided that the magnitude of oil remaining in the South Area after primary, that is some 10,000,000 stock tank barrels of oil, should warrant some effort toward evaluating the response of this reservoir to water injection. Therefore, they instructed the Engineering Committee to investigate the feasibility,



the capital expenditure requirements for a water injection project which could later be expanded to a full peripheral type flood.

Q Why was this particular area selected over the others?

A The Engineering Committee studied the field, and they selected Section 10, Township 17 South, Range 35 East for a test area for the following reasons: The pressure and GOR data indicated that this area should represent a fair average of present reservoir saturation conditions. The entire area is on common royalty acreage.

Q Is it all State?

A It is all State land. The net pay figures within the area are relatively uniform and not excessively thick. The generally low primary reserves in offset wells reduced problems of indemnification.

Q Will the proposed well fit in with the ultimate pattern of the peripheral flood if you go in that direction?

A Yes, sir. The proposed injection well, which is now temporarily abandoned, will fit into any future peripheral pattern. Further, the status of the injection well chosen, that is being temporarily abandoned at present, eliminates immediate concern over forfeiture of production.

Q Now, in the preparation, have you prepared some cross-sections of the proposed pilot area?

A Yes, sir.



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Q These cross-sections are indicated on Exhibit 1, are they not?

A Yes, sir. These cross-sections are indicated on Exhibit 1.

Q Will you refer, first, to Exhibit 5, and tell us, please, what this shows?

A Exhibit 5, which is a cross-section, A prime, is an East West cross-section through the pilot area. This shows Texas Pacific Coal & Oil Well State J No. 1, New Mexico State J 1, State J No. 2.

Q Superior Oil Company State J No. 26, what does it show, generally?

A This shows the porosity as indicated by microlog in the various wells. It shows the presently perforated intervals in those wells, and shows the status as of June 1961. Further, it shows in the injection well the proposed perforations to be instituted prior to the injection program in the injection well. As you notice here, the zone is overlaid by a shale wedge. This wedge disappears, as shown on Exhibit 1, just north of the middle of the test area.

Q East and West. It shows it to be fairly uniform?

A Yes, sir. The producing zone East and West is quite uniform.

MR. UTZ: That is the flow interval?

THE WITNESS: The net pay figures vary somewhat, however.



Q (By Mr. Seth) Is the net pay fairly uniform throughout the test area?

A The net pay is fairly uniform throughout the test area; yes, sir.

Q Do you have a number North South cross-section?

A Yes.

Q This has been marked Exhibit 6. Would you tell us, please, what that shows?

A This is the North South cross-section through the test area and through the injection well.

Q Is this B-B prime, as shown on Exhibit 1; is that right?

A Yes, sir.

Q Go ahead.

A This shows the producing zone overlaid by the shale wedge. As you notice, north of the Lea State A No. 4, the producing zone becomes quite thick, and the shale wedge disappears. This further shows that the immediate area of water injection is rather uniform and not excessively thick. Beyond the first north line offset wells, the pay does become quite thick.

Q Is there anything else on this exhibit you want to tell me?

A No, sir.

Q You are referring back to Exhibit 5 that included the cross-section of the well where you anticipate the first response?

A Yes, sir.



Q We will cover that later.

A Yes, sir.

Q Do you have an isopack of the area?

A (Indicating.)

Q This isopack has been marked Exhibit 7. Would you describe the details on it, please?

A Exhibit 7 is an isopack of the test area, and shows the relative uniformity of the net pay throughout the test area.

Q What are the figures opposite the well?

A The figures on the right hand side of the well are net pay figures as picked by the Engineering Committee.

Q What does this generally show with relation to your proposed tests?

A This shows that the net pay, even though varying throughout the area, is rather uniform, and there are no abrupt changes in net pay figures in the test area.

Q Would you anticipate a reasonably uniform flood pattern as a result of that?

A The flood that we anticipate instituting is only expected to affect the direct offset wells, and through these wells the uniformity is such that we expect a fairly uniform response.

Q Is there anything further about that isopack you want to discuss?

MR. UTZ: By "offset well", do you mean the No. 1 Well



directly east?

A No, sir. We expect in all directions, actually we expect response only in four wells through the length of time of this injection program. That is the east offset, the northeast offset, north offset, and the west offsetting wells.

Q (By Mr. Seth) Do you have a diagram of the completion of the proposed injection well?

A (Indicating.)

Q This has been marked Exhibit 8. What does this diagram show?

A Exhibit 8 is a schematic diagram showing the casing and cementing program of the proposed injection well Texas Pacific Coal & Oil State J No. 2. It further shows the work program that we intend to perform prior to instituting injection into this well. The existing perforations, the operator tells us, possibly are in communication with each other; and therefore, we propose to squeeze all existing perforations and re-perforate only those zones that are indicated porous and permeable by well logs.

Q Give us a little detail on your preparatory work as far as cementing and casing?

Q How do you mean, sir?

Q That is shown on this Exhibit. Would you describe a little bit what procedures you are going to take before you feel the well is completed for injection purposes?

A As outlined in the work program, we intend to run two-

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inch tubing with packer, squeeze the existing perforations at 10,550 feet to 10,592 feet with 300 sacks of cement. We then will drill out the cement to a depth of 10,610 feet, and pressure test the casing. We will then spot 500 gallons, 10 per cent mud clean out agent on bottom, pull tubing, and perforate selected intervals opposite the Wolfcamp. Would you like those read into the minutes?

Q No.

A The selected intervals are shown on the Exhibit. We will then run tubing with the packer, displace this MCA to the formation. We will then swab back this acid load, set the packer at approximately 10,500 feet, and begin water injections.

Q Do you believe this method will adequately protect the shallower formations?

A Yes, sir. Originally this formation was cemented with 300 sacks of cement. No top of that cement was picked or estimated on the completion program, but an additional 300-sack cement squeeze should be sufficient to protect shallower formations.

Q Including any fresh water?

A The fresh water, of course, is covered by two strings of casing cemented to the surface. The 3 3/8-inch casing is set at 353 feet with cement circulating the surface. The 8 5/8-inch casing is set at 563 feet with cement circulating to the surface.

Q This is within the Lovington Water Basin?

A Yes, sir.



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MR. UTZ: These strings are presently in the well?

THE WITNESS: Yes, sir. This is the condition as it exists today.

MR. UTZ: You will attempt to pressure test from 10,500 up --

THE WITNESS: To the surface; yes, sir.

Q (By Mr. Seth) Is there anything further on this diagram at this time?

A No, sir.

MR. UTZ: What type of packer do you intend to use on these?

THE WITNESS: That hadn't been specifically stated as such, but the District Engineer indicated that they would use a hook wall packer. Now, this well should take that water on packing throughout the entire injection program, no surface pressure whatsoever. Now, the packer, of course, will have inhibited water behind the tubing, and this, of course, will be sufficient to hold that packer in place. We did not intend to put a permanent packer in the well at this time.

MR. UTZ: Thank you.

Q (By Mr. Seth) Tell a little bit about your injection program, please.

A We hope to inject into the Wolfcamp formation through Texas Pacific Coal & Oil State J No. 3, approximately 100,000 barrels of water per day to a maximum of 500,000 barrels of water



in order to determine if an oil bank can be formed, and further to obtain data to estimate and verify fluid saturation data as we had it today. We anticipate response in the east offset in approximately 2 1/2 months with 45 barrels of water injected water break through. We allocate at three months with 90,000 barrels of water injected. The north offset State A No. 4, we expect response in 9 months with 270,000 barrels of water injected and water break through in 12 months, 350,000 barrels injected. Brunson & Laughlin Machris No. 32-10, the northeast offset to the injection well, we expect response in 11.51 with 350,000 barrels of water injected, and water break through in 14 1/2 months with 436,000 barrels injected. The last well to respond should be Texas Pacific Coal & Oil Company J No. 1. We expect this response 13 1/2 months with 405,000 barrels of water injected, and we do not expect water break through into this well. Of course, these calculations are based on some assumptions that of necessity had to be made.

Q The present extent over life of the flood is 500,000 barrels as it stands now?

A Yes, sir. The Engineering Committee has agreed that if nothing responds within the 500,000 barrels injection program, then the field undoubtedly is not subject to water flood.

Q Now, what is your source of water that you plan to use?

A Several sources of water were investigated. It was decided to obtain saline water from the Santa Rosa Formation at an



approximate depth of 1,600 feet for the pilot project. Several sources of this water were investigated, and it was finally decided to re-enter Humble State AL No. 1, through hole in the Northwest Quarter, Northwest Quarter of Section 10, Township 16 South, Range 35 East.

Q Is that shown on your Exhibit 1, there, as the source well?

A Yes, sir.

Q It is to the southwest of the test pilot area; is it not?

A This is indicated on Exhibit 1-A in the South Area; yes, sir.

Q Approximately how far is it from the injection well?

A 7,500 feet.

MR. UTZ: What formation was it?

THE WITNESS: Santa Rosa, sir.

Q (By Mr. Seth) Do you have a log on that well?

A We have a log.

Q Now, you are referring to Exhibit 9?

A Exhibit 9 is a radioactive log of the west offset to the proposed source well. We do not have a log through this interval in the source well.

Q As far as you can determine, though, this would be a typical log of that locality?

A Yes, sir. This sand is quite uniform throughout this



area, and should fairly well represent the characteristics of the sand to be found in the source wells.

Q What does this show?

A This is presented to indicate the proposed source zone, the approximate depth, and the well --

Q This well produces the required quantity of water as near as we can tell now?

A As far as we can determine, we expect that it will be able to produce the required amount of water. This is based on the porosity indicated of some 25 per cent or greater, and the apparent cleanness of the sand, and the apparent thickness of the sand. We expect some 35 feet of net pay in the source well.

Q If the pilot flood is successful and you go to a complete flood, there are other water sources that would be sufficient for that purpose?

A Yes, sir. There is some thought that this particular formation would not be able to provide water for the entire flood. If the flood is successful, there are other sources that will provide water for the full-scale flood.

Q Do you know how the source well was completed?

A Yes, sir. We have Exhibit 10, which I now present, showing the present status of the source well.

Q Now, would you describe, briefly, what this shows?

A This shows that at the present time in the source well we have 13 3/8 inch casing set at 440 feet with cement circulated

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back to surface. We have 8 5/8 inch casing set at 4,638 feet with cement circulated back to surface. And, we have a portion of the 5 1/2 inch casing that has been shot off at 4,580 feet. This was cemented at 10,587 feet with 900 sacks. There is a cement plug covering the top of the 5 1/2 inch casing stub.

Q Will this completion method adequately protect the shallower formations?

A Yes, sir. This, of course, would be a source well, and no pressure is to be put upon the casing. However, we will test the casing for leaks and so forth prior to instituting the completion program.

Q Is there anything further on Exhibit 10, there?

A No, sir; unless there are questions.

Q Do you have anything further on the source well?

A No, sir; not on the source well.

Q Do you want to give the surface facilities on this thing?

MR. UTZ: The 8 5/8 was circulated?

THE WITNESS: Yes, sir.

Q (By Mr. Seth) Do you have a diagram of the surface facilities?

A Yes, sir. May I present that as Exhibit 11?

Q Tell us what this Exhibit shows?

A This is a schematic diagram of the surface facilities to be placed at the source well location. It consists of the



500-barrel storage tank which will have a propane gas blanket, the centrifugal pump which has a capacity of approximately 1,200 barrels per day at 50 pounds per square inch pressure, a water meter and the beginning of the line pipe. This is 2 1/2-inch LPO pipe or actual used tubing, well tubing. 50 pounds per square inch is the pressure that should be required to provide 1,000 barrels per day to the injection well at zero injection pressure.

MR. UTZ: That was 50 PSI?

THE WITNESS: Yes, sir. As previously stated, we expect that this well will take this entire amount of water with no surface pressure required, at the rates intended.

Q (By Mr. Seth) Do you have anything further on 11 which you would like to discuss?

A No, sir.

Q In your opinion, will these facilities in the plan provide a reasonable and adequate test of the water flood possibilities for this area?

A The proposed pilot will provide the information that the Engineering Committee will require for their further evaluation. As I stated previously, this is to determine if an oil bank can be formed by the injection well. The operators unanimously agreed that the probability of success, based on calculations, is not too great; but they are willing to spend some \$60,000.00 to verify the calculations that have been made.



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Q Are you presenting this data as a representative of the operating group --

A Yes, sir.

Q -- that is going to operate the test; is that correct?

A Yes, sir; that is correct.

MR. SETH: I believe that is all. Do you have anything further, other comments you would like to make?

THE WITNESS: No, sir.

MR. SETH: We would like to offer Exhibits 1 through 11, Mr. Utz.

Have these been prepared under your direction and supervision.

THE WITNESS: Yes, sir.

MR. UTZ: Without objection, Exhibits 1 through 11 will be entered into the record in this case.

(Whereupon Applicant's Exhibits 1 through 11 received in evidence.)

MR. SETH: That is all of our direct case.

MR. UTZ: Mr. Essary, do you consider that this flood should come under Rule 701 of the Commission?

THE WITNESS: Yes, sir.

MR. UTZ: Have allowables in accordance with that Rule --

THE WITNESS: As far as allowables; no, sir, I do not. This flood, the response we can not formally predict response in any well. We anticipate response, and under the terms of the



operating agreement each operator will be responsible for his own allowable. We do not expect any response that will approach top allowable producing status in any of the wells. The wells in this area, as you might know, are making some 10 barrels per day or less, except for 32-10, and this is just one month's production after installation of gas lift after having been shut in for some time. So present capacity of these wells would be 10 barrels per day. Top allowable is some up, and I do not expect that much in any one well, and the operators, themselves, when they obtain response, will then go to the Commission and request increased allowables.

Q Which area do you consider to be the best reservoir?
The South Area?

A Yes, sir. The South Area is, definitely.

Q The permeability?

A The permeability is quite good. Pressure performance throughout the field is quite uniform. Pressure communication is good, and wells that are completed later, except on the extreme eastern end, had essentially the same reservoir pressure as other wells that have been producing for some time.

Q Now, let me get clear as to how much oil you believe the pool on the flood test area contains. Now, that would be subject to recovery through this water flood?

A This calculation, as we suggested before, our calculations indicate that they are non-recoverable. But, this is



unreasonable. Our saturation at present is essentially what we would expect our final saturation to be after injecting water; and this proposed injection well program is an experimental program entirely to determine if we can recover this oil by some means. Our calculations show that we will not recover any additional oil by this, but this, of course, is unreasonable.

Q You don't have any estimate, then, as to how much oil you might recover?

A No, sir; not additional oil by the injection of 500,000 barrels of water. If we can build an oil bank, and this is, of course, the problem at hand, some additional oil will be recovered. But, as to say how much, this, we can't say. If this is successful and we expand this to a full peripheral flood, we would expect at least 50 per cent of primary which would amount to some 6,000,000 barrels of oil if this pilot is successful, and if it is expanded to the full South Area.

Q With regard to your water source, have you been in touch with the State Engineer?

A Yes, sir; we have applied for a water lease on this land. We have submitted an application to the State Engineer. It has been published twice. It will be published on September the 5th for the final time. If there are no protestants, then we should begin our program immediately thereafter to obtain water from this source. This source has been used, or has been applied for and obtained in the Vacuum Field to the south by Phillips,



and there were no protestants to that application.

Q Santa Rosa, what kind of water should this be?

A As far as we can determine, this water should be brackish or saline. In verbally, Phillips informs me that water that they tested by wire line test in the Vacuum Field Area a few miles to the south, the chloride content was approximately 8600 parts per million. In this area, we have utilized the logs that were available through this shallow sand which are pretty scarce. We estimate a saline or chloride content of some 10,000 parts per million.

Q Yes, sir.

MR. UTZ: Are there other questions of the witness?
Mr. Nutter.

Q (By Mr. Nutter) Mr. Essary, as I understand it, now, this heavy black line that runs around Exhibit 1, is the limit of the area that was studied by the Engineering Committee; is that right?

A Yes, sir. I took this particular plat from a plat that was drawn for the Engineering Committee's work. It was available, and indicated what I wanted to indicate. This line only indicates the area that was studied by the Engineering Committee, but further to the south it indicates the approximate position of the zero isopack line.

Q I was just wondering if that was zero sand thickness around that area?

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A It isn't zero thickness. It is a zero porosity line. This of course, is an estimate, and is based on some dry holes drilled to the south of that that were impermeable and non-productive of any fluids. To the north, as you see, there are wells to the north of this line, and perhaps in this area it ought to be dashed rather than solid.

Q There has been some production outside that line?

A Yes, sir; to the north.

Q All the wells drilled to the south of this line have been dry holes?

A Yes, sir; on the Wolfcamp formation.

Q The line runs diagonally across the pool which is a large broken line --

A Yes, sir.

Q As the division of what you call the North Area and the South Area?

A Yes, sir.

Q Now, the decline curves that were shown on one of the exhibits, being Exhibit 2, are the wells that are south of the heavy line, or the wells that are in Township 15 South, and then the other part being the wells in 16 South?

A No, sir. Township 15 South refers to the total field, only. As carried by the Oil Conservation Commission, the total field would include those wells in Township 15 South, the northern most wells indicated on Exhibit 1. The data accumulated by the



Engineering Committee, which I used a portion of, a great deal of in this case, consisted only of the production statistics on those wells south of Township 15 South.

Q I see.

A And so total field will not conform to Oil Commission records, and this I wanted to bring up. The South Area does only include those wells south of the area. I might add that the South Area further includes Skelly Hobbs D No. 1, which the Oil Commission -- This is in the Northeast Quarter of the south of the Northwest Quarter of Section 17, Township 16 South, Range 35 East. This well is carried in the Eidson Field by the Oil Commission, and this was included in the South Area.

Q How about that Amarado Well directly east of it?

A No, sir. That was not included. The amount of pay there is essentially zero.

Q And it is carried by the Commission in the Eidson Pool?

A Yes, sir. That is not carried in this report.

Q Well now, on the decline here, on Exhibit 2, you show that as of July 1st you have a cumulative production in the South Area of 10.7 million barrels.

A Yes, sir.

Q Now, this 1.376 that you are estimating would be on primary recovery without the addition of water injection?

A Yes, sir. This entirely represents the principal performance of the field.

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Q And a primary ultimate of 12 1/4 million barrels?

A Yes, sir. This is somewhat higher than the Engineering Committee estimated some year and a half ago. The field appears to be performing slightly better than what they anticipated; but the best estimate now would indicate 12 1/4 million barrels of water ultimate in the South Area only.

Q Now, what was the basis of the Engineering Committee increasing their estimate of reserves to 31.9 million barrels?

A This was an arbitrary increase. The people on the Committee felt that it was unreasonable to inject water and not recover any additional oil. However, all calculations indicated that primary residual oil saturation after primary would be less than what we could get after injected water and, of course, since this was unreasonable and they assumed that perhaps we don't know all there is to know about this reservoir, we might be as much, say, as 20 per cent in error, or even throw our volumetrics and our material balance figures not within reasonable limits. So, as an arbitrary figure for purposes of discussion and analysis we arbitrarily increased the stock tank barrels of oil in place by 20 per cent.

Q It was a 20 per cent factor?

A Yes, sir; a 20 per cent factor. And then they conducted the water flood calculations. The idea was that if we are 20 per cent off, would it still be profitable. If we were 20 per cent off, it would make only a 75 per cent profit on the total project.



and would only result in 2.4, I believe I said, million barrels of oil to be recovered in addition to primary.

Q Did the Engineering Committee have a figure in their volumetric calculation of original oil in place per acre foot?

A I believe they have that; yes, sir. I think that was 250 barrels per. I'd have to look that up.

Q I just wondered if they had used an acre foot calculation which, if that were in error, would explain the differential as far as the volumetric calculations of reserves.

A Yes, sir.

Q But there was more or less conformity by material base?

A Yes, sir. As I stated, it was confirmed in the South Area the volumetrics indicated 27.9 million stock tank barrels, and the material balance indicated 25.5, somewhat less than the 27.9. So the Engineering Committee decided that since this was a close agreement, and they didn't know which was the more valid to figure, they averaged the two and used 26.6.

Q It would appear, in view of the Committee increasing the reserves to 31.9, that maybe volumetric was closer than material balance?

A That would seem so; yes, sir. In a reservoir this large, of course, one per cent difference in porosity would result in quite a large volume of oil. Further, the water saturation was determined by capillary pressure curves only, and it was estimated at 25 per cent. This corresponds to the very fine porosity in a

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sample with 9.8 porosity.

Q Is there any evidence at all of any water driving in this pool, or is it solution gas driving it entirely?

A No, sir. We have water, primarily, on the Shell ETA Lease to the west end of the field. This is in Section 8, Township 10 South, Range 35 East. This area represents the only area producing significant amounts of water.

Q Those per cents are relatively higher; are they not?

A Those are indicated on Exhibit 1 as the middle figure. Now, the Eidson Field, which geologists feel produces from the equivalent stratigraphic interval, which is immediately to the west of the Townsend Field production, significant quantities of water, and this does have an oil-water contact. However, none was encountered in the Townsend Field.

Q I note that in the extreme east end of this field some of the wells are currently producing at relatively high rates. Is this due to a better quality of pay, or just what is the situation there?

A This is the result of more recent development. These, the saturation figures, of course, would be higher and the reservoir pressure would be slightly higher than in the main part of the Fairway.

Q Well now, the bottom hole pressure that you mentioned earlier being 400 pounds, I believe it was, the average for the entire south end of the field.



A Unfortunately, many of the wells are either on pump or in condition such as to make it undesirable or impossible to obtain bottom hole pressure data. This 400-pound figure is based upon the Engineering Committee report of May, I believe. There were only three wells in the Fairway which had bottom hole pressure data. If you notice on Exhibit 2, the bottom hole pressure declines.

MR. SETH: I believe that is 3 probably.

THE WITNESS: This one here. You notice that the last 3 points on this curve are arithmetic bottom hole pressures for the South Area. Some time after approximately the end of the Engineering Committee's work, many of the wells went on pump or were shut-in, and consequently aerially weighted bottom hole pressure was not too meaningful since there were so many blank spots in it; and this is only an approximate bottom hole pressure.

Q Well now, on arriving at your primary ultimate on Exhibit 2, you come up with 12 1/4 million, which would correspond to a 200-pound pressure on Exhibit 3. Is not what you were doing, taking pressure down to the 200-pounds?

A Not necessarily. This particular field seems to be producing quite well. Some well that, perhaps there is some gravity segregation in this, you don't know, but the permeability is such that we expect the pressure to be somewhat less than the anticipated. But 200 pounds abandonment pressure would be a reasonable pressure, and this does confirm this Exhibit 2, does comply with the statistics.



Q How about GOR?

A The GOR at present is approximately 6,000-to-1 total field. They are quite high in various parts of the field. I have those available, but we find that the, in recent months the structural higher wells have exhibited some tendency to be higher-ratio wells. This was not true originally. It appeared that the high gas saturation areas were independent of the structure. However, those that are higher on structure do have a higher gasoline ratio.

Q As a general rule, are those higher ratios due to a decrease in the amount of oil produced and the oil production remaining relatively constant?

A This, I did not investigate in preparation for this. This, I think, the Committee has not met on this, but I and others feel at present there is some segregation of goods in the reservoir.

Q You think there is a gas cap in the reservoir at the present time?

A I think there is at least a possibility that we are now having some minor amounts of gas segregation, and possibly secondary gas forming in the higher structural positions.

Q Well now, what will be your plan in the event that this pilot project works to conduct a peripheral flood around the south edge of the pool near this zero porosity line.

A This, of course, would have to be determined after we

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observe the response of the injection well. But the present thinking is that we would institute a peripheral flood. A regular five spot flood would possibly prevent some difficulties such as the extremely thick pay zone in the north part of the Fairway above the shale line. We feel that we can flood the entire field quite well, probably, by injecting along the zero isopack line; yes, sir.

Q Well now, we have the isopack for only a small area, here, but I notice that some of the wells do have considerable thickness. What is the thickness when you get up into the Fairway?

A The net pay, now -- if you would refer back to the cross-section, the north south cross-section, it perhaps might be more significant than the actual net pay. The net pay figure had not been isopacked. However, I don't know just how much that does mean because the intervals of pay are not necessarily correlatable from well to well. Exhibit 6 shows the thickening of the gross producing zone. And I think this is more significant and, of course, a peripheral flood in this injection well would be underneath the shale, and then after flooding out this section under the shale, then the thicker part of the reservoir would come under response flooding.

Q Do you think it will be possible to flood the upper portion of the pay near the line where the pay wedges out by flooding under the pay, down south?

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A Yes, sir; I do. Of course, we cannot correlate porosity from well to well. We get cases that apparently there are zones of porosity in the top and bottom half of the wells, but to correlate them and try to pick out zones of porosity and trace them throughout the field on log data, it cannot be done, and we feel that within this producing zone that there is variable permeability, and our present feeling is that we will be able to flood the entire Fairway from injecting into these wells under the shale.

Q The entire pay?

A Yes, sir.

Q North of the shale wedge?

A Yes, sir. We do feel that we will be able to do that. Of course, if this proceeds like it ought to, we would probably, I am sure, on this peripheral flood as we flooded out offsetting wells, we would transfer our injection program to these offset wells, and this would move eventually, and we would be eventually injecting wells into it.

Q Would you have, then, a peripheral flood along the north line, also?

A You mean the injected lines?

Q Do you mean by wells in the North Area, or injecting by the southern wells?

A Excuse me. I mean the north part of the Fairway, not into it. As far as we can determine now, and also based on the



performance of our injection program, we are using one of these North Area wells as a disposal well. This is indicated on Section 8, in the Northeast of the Northeast of Section 8, Township 35 East; Township 16 South, Range 35 East, Shell State ETA No. 1. We are injecting water into this well, and we are getting indication of the injectivity of this North Area.

Q Are you injecting into the Wolfcamp pay?

A Yes, sir; and this was a depleted well that was abandoned, and we obtained permission and did inject into the Wolfcamp pay. We have no response in offset wells, and the pressure is now becoming quite excessive, and we do have an indication of what we might expect were we to try secondary recovery in the North Area. But, as I stated previously, inter-well communication is quite poor. Offsetting pressures are meaningless, and in the 72-hour build up, those wells in the North Area are not completely built up, where as those in the South Area have been built up in 72 hours.

Q Well, in the event the flood is carried out field wide, would any effort be made to communitize the field?

A No, sir. It would be a unit of all the operators who are now working together, even on this pilot flood. Each is sharing his own costs, with the exception of one or two who are such a small interest and so remote that they didn't feel they could join. But, 10 of the major operators, which are indicated on Exhibit 7, I believe, the tabulation, those operators are 100

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per cent behind this project, and they would be expected to join in the full-scale flood. They anticipate that they would join.

Q Mr. Essary, would you plan to, on initial flooding, to use any produced water for this injection, or use only Santa Rosa water?

A Of course, it would be more efficient to just take water from one source, in the Santa Rosa if we obtain permission from the State Engineer, with no protestants, to use this water, and if it will provide the required 1,000 barrels per day, then we would expect to only use this water. This would minimize our treating and gathering system problems. If this source well were incapable of producing the required amount of water, this could be supplemented, and we had considered supplementing it with the produced water. Now, the bulk of the produced water is produced in Section 8, 16 South, 35 East, which is quite close to the source well. And this could be tied into the line thereafter for treatment and injected into the injection well with probably a minimum of surface installation. The present production of water from the Townsend Field in this Area is of the magnitude of 300 barrels per day, and if we could obtain 500 more from the Santa Rosa, we would have our 1,000 barrels per day for injection.

Q So, even if the Santa Rosa should fail to meet your demands, you would have enough water to complete the project?

A Yes, sir.

Q Has any test been made of the Santa Rosa water to

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determine whether it is compatible with the formation water?

A No, sir. Of course, this would be accomplished prior to injecting the water into the reservoir, but we have no Santa Rosa water available for the compatibility tests in this area.

MR. NUTTER: I believe that is all.

MR. UTZ: Are there other questions of the witness? If not, the witness may be excused. Are there other statements to be made?

MR. SETH: That is all we have.

MR. UTZ: The case will be taken under advisement.

MR. BRATTON: Harvey Bratton of Harvey, Dow & Hinkle on behalf of Humble Oil & Refining Company. Our connection with the matter is in connection with the source water. As has been stated, the source is in Township 16 South, Range 35 East, Section 16, and Shell is in the process of obtaining a commercial water lease on this area. Humble has an existing State Oil & Gas Lease on the Section 16 source section, and while it has no objection to Shell's utilizing the water for this project, it does want to make it clear, so that there will be no misunderstanding, that under Humble State's Oil & Gas Lease, it has the right to use water from the lands, and it does not waive any right it may have to use that water in connection with any present or future operation. I realize, of course, that the right to utilize water is not a concern or a question of this Commission, not within its jurisdiction, but we just wanted to state, so that there would be

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no misunderstanding.

MR. UTZ: Mr. Bratton, is Humble participating in this pilot water injection project?

MR. BRATTON: Yes, sir. They have been an active member of the Committee right along; have they not?

MR. ESSARY: Yes, sir.

MR. UTZ: Yes, sir.

Are there other statements? The case will be taken under advisement.

(Whereupon the Hearing of
Case 2359 was concluded.)

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

I, MICHAEL P. HALL, 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 notary seal
this 30th day of August 1961.

Court Reporter - Notary Public

My Commission expires:

June 20, 1965

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 2357, heard by me on (Aug. 30), 1961.

Richard H. [Signature], Examiner
New Mexico Oil Conservation Commission

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