BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
July 18, 1957

TRANSCRIPT OF HEARING

Case 1280

DEARNLEY - MEIER & ASSOCIATES
INCORPORATED
GENERAL LAW REPORTERS
ALBUQUERQUE - SANTE FE
3-6691 2-2211

BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
July 18, 1957

IN THE MATTER OF:

Application of Sunray Mid-Continent Oil Company for an order authorizing a pilot secondary recovery project in the Bisti-Lower Gallup Oil Pool in exception to Rule 701 of the Commission Rules and Regulations. Applicant, in the above-styled cause, seeks an order authorizing it to drill and operate a well at a point five feet southeast of the northwest corner of Section 6, Township 25 North, Range 12 West, San Juan County, New Mexico, for the injection of liquified petroleum gases and dry gas into the Lower Gallup formation of the Bisti-Lower Gallup Oil Pool for the purpose of secondary recovery of oil from said pool.

Case No. 1280

BEFORE:

Honorable Edwin L. Mechem
Mr. A. L. Porter
Mr. Murray Morgan

TRANSCRIPT OF HEARING

MR. COOLEY: Application of Sunray Mid-Continent Oil Company for an order authorizing a pilot secondary recovery project in the Bisti-Lower Gallup Oil Pool in exception to Rule 701 of the Commission Rules and Regulations.

MR. L. C. WHITE: If the Commission please, may the record show Mr. Burns Errebo, attorney of Tulsa Oklahoma, and L. C. White of Santa Fe, New Mexico, appears on behalf of the applicant,

and Mr. Burns Errebo will put on the testimony.

MR. PORTER: You may proceed, Mr. Errebo. Would you like to call your witnesses at this time?

MR. ERREBO: I want to make one brief introductory statement. If it please the Commission, this is the application of Sunray Mid-Continent Oil Company for permission to have a pilot secondary recovery project in the Lower Bisti Pool of San Juan County. Sunray, Phillips Petroleum Company, British American Oil Producing Company, El Paso Natural Gas Company, Shell Oil Company and Amerada Petroleum Corporation have been making a study of this pool and have agreed upon a program for the injection of a quantity of liquified petroleum gases to be followed by an injection of dry gas into the Lower Gallup formation.

These studies indicate that the expected recovery from this pool, of oil, can be more than doubled if this program is carried out. The purpose of this pilot project, which will cover only 160 acres, is to enable the operators to obtain data so they can determine whether or not liquified petroleum gas and dry gas injection should be carried out on a fieldwide basis. The injection of liquified petroleum gas followed by gas is new and never been done before in the State of New Mexico. However, a similar program has been carried out in other states, or they are being planned. I think one program has been carried out to a certain extent, and there has been considerable research done in the matter.

This Commission is given specific power to authorize this project under Chapter 65 of the New Mexico Statutes, Article 3, Section 11, Subsection 14, which grants this Commission the authority to permit the injection of natural gas, or any other substance, into any pool in this State for the purpose of repressuring, circulating, pressure maintenance, or secondary recovery operations. At this time, if it please the Commission, we will have two witnesses, and if you desire, have them sworn now.

MR. PORTER: All right, have the witnesses come forward and be sworn at the same time.

(Witnesses sworn.)

MR. ERREBO: I would like to call as our first witness, Mr. L. J. Finfrock.

L. J. FINFROCK

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

DIRECT EXAMINATION

By MR. ERREBO:

Q Your name is L. J. Finfrock? A Lawrence J. Finfrock.

Q Lawrence J. Finfrock. And by whom are you employed?

A Sunray Mid-Continent Oil Company, Tulsa, Oklahoma.

Q In what capacity? A Staff Geologist.

Q Have you previously testified before this Commission?

A No, I have not.

Q Will you then give the Commission a background of your experience and education?

A Graduated from University of Illinois in 1940 with a Bachelor of Science Degree in geology; in 1948 I received my Master of Science Degree in geology from the University of Illinois. I was employed for a period of seven years by the Carter Oil Company, and the past six and a half years in the employ of Sunray Mid-Continent Oil Company.

Q Are you familiar with the geology of this Bisti-Lower Gallup Oil Pool? A I am.

MR. ERREBO: Are his qualifications acceptable?

MR. PORTER: They are.

Q Mr. Finfrock, will you please go to the board and refer to the exhibit which has been marked for identification as Exhibit No. 1 and identify and explain it?

A Exhibit No. 1 is an area map of the Bisti-Lower Gallup Oil Pool located in Townships 25 and 26 North, Ranges 12 and 13 West of San Juan County, New Mexico. This portion of the pool lies approximately twenty miles south and slightly east of the town of Farmington, New Mexico.

We have shown here on this map the approximately eighty oil wells that are productive from the Lower Gallup Oil Pool in the Bisti Field. Shown by the green border are the estimated limits of the Lower Gallup producing sands in this area. Shown here by the red

rectangle, is our proposed pilot area for liquified petroleum gas and dry gas injection. This area composed of the Southwest of the Southwest of Section 31, Township 26 North, Range 12 West; Southeast of the Southeast of Section 36, Township 26 North, 13 West; the Northeast of the Northeast of Section 1, Township 25 North, Range 13 West, and the Northwest of the Northwest of Section 6, Township 25 North, Range 12 West, all in San Juan County, New Mexico.

The two wells to the east are on a Sunray lease which is a Federal lease. The British American well in the Northeast of Section 1 is on a Federal lease. The Phillips well in the Southeast of Southeast of Section 36 is on a State lease. These comprise the portions of these leases into the pilot area, shown by thin red lines, A, A_1 and BB_1, are the traces of our two cross sections which will be entered as Exhibits 4 and Exhibit 5 in this hearing.

The red arrow points to the discovery well for the Bisti Field which is the El Paso State Kelly No. 1 which was completed October 7, 1955, after fract for 180 barrels of oil per day. This constitutes our Exhibit No. 1.

Q Mr. Finfrock, what are the names of the Federal and State leases involved?

A This Phillips State lease is the Hospah lease; the British American Federal lease is the Marye lease, and the Sunray Mid-Continent lease refer to it as #078056.

Q That's the Federal C lease?

A That's the Federal C lease, yes, sir.

Q Now, Mr. Finfrock, what is the nature of the geologic trap holding the oil in this pool?

A I feel that the nature of this trap is stratographic trap. I mean it has nothing to do with the structure of the bed. It is controlled by lateral gradation of the portion of Grime sands of the Lower Gallup by shale and silt stone phases.

Q Are all of the wells shown on Exhibit 1 within the green outlined area completed in the Lower Gallup?

A Yes, sir.

Q Are any other formations productive of oil or gas in this immediate area? A Not in this area.

Q Will you please refer then to Exhibit No. 2 and identify it and explain it?

A Exhibit No. 2 is a reproduction of the lower portion of the Schlumberger electrical log. Shown hereon, we have labeled the Lower Gallup which we encountered here at a depth of 4829 feet, and we have this to the bottom of the log at 5,001 feet. We defined that as the Lower Gallup formation. This can be seen here we have a heavier sand body more porous and permeable overlaying by thinner bedded, less permeable sands and silt as a base.

Q Then would you say that you will find a higher permeability at the top of the formation, and the permeability would grade downward

as you go deeper into the formation?

A That is correct, on the average.

Q Excuse me.

A That is correct, on the average.

Q I see. Do you know of any vertical barriers to communication within this reservoir? A I do not.

Q Will you please refer to Exhibit No. 3 and identify and explain it?

A Before I move to Exhibit 3, I believe that it's best to give a short description of the type sands we have encountered in this log. The upper portion, which we refer to as a bar or off shore barrier beach type of deposit is composed of fine to medium grade sands which are fairly well sorted, rather clean, and more permeable and porous than in the basal portion which is composed of finer grain, siltier and shalier sands.

Exhibit No. 3 is a structure map contoured on the top of the Lower Gallup sand at this equivalent point on Exhibit 2. This represents --

Q (Interrupting) Excuse me, Mr. Finfrock. You refer to the top of the producing interval on Exhibit No. 2?

A That's correct.

Q Is that right?

A At 4829 feet. This structure map was contoured with an interval of 25 feet, and it shows a gentle Northeastward dip with

minor noses across this area. And this can be seen from here with the outline of our estimated Lower Gallup producing sands. The structure has no control over the entrapment of oil in this field. Also shown on this map is the outline of our pilot area with the proposed injection well five feet out of the Northwest corner of Township 25. This injection well is also shown on Exhibit 1 in the same location, proposed injection well.

Q Do you have any other comments with regard to that Exhibit, Mr. Finfrock? A I do not.

Q Will you then refer to Exhibit No. 4 and identify and explain it?

A Exhibit No. 4 is a North-South cross section labeled A to A1. This is the same cross section as referred to here in Exhibit 1, extending out of the pilot area in a southeasterly direction. This section is composed of the following wells: From North to South, the Sunray Mid-Continent Federal C2 which would be the Northeast well in our proposed pilot area. The Sunray Mid-Continent Federal C1 which would be the Southeast well within our proposed pilot area. Moving in a southeasterly direction, we have the Sunray Mid-Continent Federal C10 in Section 6, the Sunray Federal C17 in Section 7, and the Amerada Salina White in Section 8. And the last well on this section is the Sunray Mid-Continent Federal B in Section 17, all lying in Townships 25 and 26 North, Range 12 West.

This cross section was constructed to show that the Lower Gallup sand is present and continuous in these wells within the pilot area as well as in a southeasterly direction, showing that we do have continuity of deposit.

Q Will you please refer to Exhibit No. 5 and identify and discuss it?

A Exhibit No. 5 B to B_1 is the one shown here on our pilot area in an East-West direction. This well, I mean this cross section, is composed of the following wells: The Sunray Mid-Continent Federal C19 in Section 7, the Amerada Salina White No. 2, which is the same well that was encountered in Section 1, which is in cross section 1, which is Exhibit 4, which lies in Section 8. The Amerada Notispak No. 1, located in Section 8; the Amerada Joanne White located in Section 9, and the Phillips Eton is also located in Section 9. This cross section was constructed to show also that the Lower Gallup formation is present not only in a local area surrounding the proposed pilot area, but along strike of this producing field, showing that this sand is not a local phase but is a general larger nature and is occurring throughout a great portion of the area. And seen here also, the Lower Gallup producing sand is present and continuous in each of these wells.

Q Mr. Finfrock, do you know of any faults in this pool, or any other barrier to communication? A I do not.

Q Horizontally? A I do not.

Q Now, based on the evidence which you have, including electric logs and cross sections and the studies which you have made, is it your opinion that the Lower Gallup is a common reservoir?

A It is.

Q Then, is it your opinion that the wells in the pilot area are in communication with each other?

A Yes, I would say they would be in communication with each other.

Q Now, are you familiar with the program of liquified petroleum gas and gas injection which Sunray Mid-Continent will propose here today? A I am.

Q And do you know of anything from a geological point of view which would prevent this program from being a success?

A I do not.

Q Were Exhibits 1 through 5 inclusive prepared by you or under your supervision? A Yes, they were.

MR. ERREDO: We would like to offer these exhibits in evidence at this time.

MR. PORTER: Without objection they will be admitted.

MR. ERREDO: That's all we have from this witness.

MR. PORTER: Does anyone have a question of this witness?

MR. MANKIN: Warren Mankin, Oil Conservation Commission.

CROSS EXAMINATION

By MR. MANKIN:

Q Mr. Frinfrock -- A Yes, sir.

Q Did I say that right? A Finfrock.

Q Finfrock. Are you able to testify as to what kind of reservoir this is? I realize you are a geologist, but will someone else testify to the type of reservoir this is?

A You mean the type of drive we have here or --

Q (Interrupting) Yes, yes.

A Now, I believe that is outlined in engineering testimony, but I would be glad to --

Q That would be carried later? A Yes.

Q You indicated this was a rather continuous reservoir, and the structure did not play any part in, but is it not true certain areas, there has been water found coming from some particular direction?

A Yes, sir. In the western portion of the field waters have been encountered which we feel are meteoric waters and not due to water encroachment in the normal sense you would feel in a field. They are meteoric waters that have percolated downward.

Q Also in this pilot flood area, you think the Lower Gallup pay is continuous enough that it should get fairly good flood pattern to each of the four wells you propose to inject?

A Yes, I believe so.

Q Is it not true that in the discovery well in this pool that actually production found in that well was not actually Lower Gallup?

A We have checked into that well and find that, I don't have the definite figures with me, but a great interval was opened and quite a section was perforated, and it's our opinion that the oil that was produced at that time from that test actually came from the Lower Gallup section and not from the Hospah.

Q The discovery well was actually Lower Gallup?

A That is our opinion, yes.

Q But since then recompleted in another portion of the Lower Gallup?

A I think they squeezed off some perforations and recompleted, yes, sir.

Q So it will be Lower Gallup all the time?

A We believe so.

MR. MANKIN: That's all.

MR. PORTER: Does anyone else have a question? The witness may be excused.

(Witness excused.)

MR. PORTER: Mr. Errebo, you may proceed.

MR. ERREBO: If it please the Commission, at this time we would like to call Mr. R. E. Brooks.

R. E. BROOKS

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

DIRECT EXAMINATION

By MR. ERREBO:

Q You are Mr. R. E. Brooks? A Yes, I am.

Q And, Mr. Brooks, by whom are you employed?

A Sunray Mid-Continent Oil Company.

Q And in what capacity?

A Senior Reservoir Engineer.

Q Have you previously testified before this Commission?

A No, I haven't.

Q Will you please give a brief background of your education and experience?

A I graduated from the University of Oklahoma in January of 1949, as a Petroleum Engineer. After graduation I worked three years in the field, and since that time have been a Reservoir Engineer.

Q Have you made a reservoir study of the Bisti-Lower Gallup Oil Pool? A Yes.

MR. ERREBO: Are his qualifications acceptable?

MR. PORTER: Yes, sir.

Q Mr. Brooks, have you made a study of a program of liquified petroleum gas and gas injection in this pool?

A Yes. I am Chairman of the Bisti Engineering Committee, composed of representatives of British American, Phillips, Amerada, El Paso, Shell and Sunray. The committee made a study of liquified petroleum gas and gas injection and has unanimously agreed upon the

injection program which Sunray will propose today.

Q Mr. Brooks, will you please refer to Exhibit No. 6 and identify and discuss it?

A Exhibit No. 6 is a core analysis prepared by Core Laboratories of Sunray Mid-Continent Oil Company's Federal C-1. This well is located in the Northwest, Northwest of Section 6, Township 25 North, Range 25 West. It's also in the Southeast quarter of the pilot and will be one of the producing wells. There are 39 feet pore interval which extends from 4820 to 4859.

The average properties in this interval, there are 25 feet of net productive sand, which has an average permeability of 31 millidarcys and 16% porosity, and 24% water saturation.

Q Mr. Brooks, I believe the location of that well is in Section 6, 25 North, 12 West, is that correct?

A That's correct.

Q I believe you said 25 West. Does this core analysis represent the properties encountered in the Lower Gallup reservoir then?

A Yes.

Q Have you studied all of the available cores from the Lower Gallup in this pool?

A Yes, I have.

Q Then do you agree with the first witness, Mr. Finfrock, that the sand development is usually better in the upper portion of this reservoir?

A Yes. And I also agree with him that it's a common source

of supply.

Q Please refer now to Exhibit No. 7 and identify and explain it.

A Exhibit No. 7 is a summary of the average reservoir and fluid characteristics of the Bisti-Lower Gallup Oil Pool. Some of the pertinent information on this exhibit is that twenty wells have been cored, and we have shown the average rock properties, the bubble point pressure of fluid analysis was 1207 pounds per square inch, and the bottom-hole pressure in April 1957 was 1319 pounds. We have shown that there are 607, 670 barrels per acre foot of original oil in place.

Q Then, on the basis of this exhibit, Mr. Brooks, would you say that at the present time the reservoir is approximately 100 pounds per square inch above the bubble point pressure?

A Yes, I would.

Q And the bubble point pressure is that pressure at which gas will start to come out of solution, is that right?

A That's correct.

Q Will you please refer to Exhibit No. 8 and identify and explain it?

A Exhibit No. 8 is a tabulation of bottom-hole pressure data since discovery of the Bisti-Lower Gallup Pool. Below the tabulations we have shown graphically a plot of the pressures versus cumulative oil production from the field, and this is demonstrated by a

red line.

We have also shown the bubble point pressure of 1207 pounds with a green line. This is a performance of the field today since we are still above the bubble point.

Q I believe, Mr. Brooks, the next exhibit is No. 9. Will you identify and explain it?

A Exhibit No. 9 is a tabulation of field production data; pertinent information there is that as of the end of May, 72 oil wells were producing, and they had a cumulative production of 783,502 barrels. The gas-oil ratio in this field has been exceptionally low, with an average of about 575 cubic feet per barrel.

Q How much cumulative gas has been produced as of that time, Mr. Brooks?

A 451,453 M.C.F.

Q What is the present daily production per well in this field?

A 1,591 barrels.

Q The daily production, I believe, is 14 barrels per day, isn't it, per well, on a per well basis?

A That's correct. I didn't understand that question.

Q And who is the purchaser? A El Paso.

Q Now, Mr. Brooks, will you refer to Exhibit No. 10 and identify and explain it?

A This shows a plot of the predicted reservoir pressure and gas-oil ratio versus the recovery percent of the original stock

tank oil in place. The curves were obtained by a material balance calibration based on present methods of operation. They demonstrate under present competitive operations, only 21% of the original oil in place will be recovered at an abandonment pressure of 100 pounds per square inch. This compares to an expected recovery of 50% under the proposed program.

Q Then you mean, Mr. Brooks, that if this program of liquified petroleum gas and gas injection is successful, that more than twice the amount of oil than we presently expected to recovery by ordinary methods will be recovered, is that correct?

A Yes, sir, that's correct.

Q Will you please refer to Exhibit No. 11 and identify and explain it?

A Exhibit No. 11 is a plat which shows the 160 acre pilot area. The proposed injection well is shown in red and is located three and a half feet from the West line and three and a half feet from the North line of Section 6, 25 North, 12 West. The producing wells, as shown on the plat, are the Phillips Hospah No. 1, the British American Mayre No. 1, and the Sunray Mid-Continent Federal C's No.1 and 2.

Q Now, you stated that you propose that the injection well will be located in Section 6? A That's correct.

Q Now, would you recommend a ten foot radio tolerance from the intersection of the township lines at the Northwest corner of

Section 6? A Yes, sir.

Q Actually the purpose of that radio tolerance would enable Sunray to locate a rig for the drilling of this well at, perhaps in such a way that would not interfere with any bench marker of the United States Geological Survey, which might be located at that intersection, is that correct? A Yes, sir.

Q Now, Mr. Brooks, will you please describe what the operators plan to do under this injection program?

A We, our plans are to inject up to 33,000 barrels of liquified petroleum gas at a rate of 600 to 1,000 barrels per day. We do not anticipate the surface pressures to exceed a thousand pounds per square inch. A minimum of 334 barrels of oil will be produced from the four wells in the pilot area.

Q What will be the next phase of the program after the liquified petroleum gas has been injected into the reservoir?

A Sufficient volume of dry gas will be injected to maintain the reservoir pressure at 1400 pounds per square inch. The volume will be injected at a rate of between 500,000 and a million cubic feet per day, depending upon the oil rate. Since the program is experimental, the duration will depend upon the results of the pilot and the rate of the oil production.

Q Mr. Brooks, will you please step to the wall and identify and explain Exhibit No. 12, which is shown thereon?

A This is Exhibit No. 12, which is a diagrammatic illustration

of displacement by liquified petroleum gas flooding. On this diagram we have shown three phases of operations that we will be going through in this project. On the left-hand side of the exhibit we have shown the injection wells, and on the right-hand side we have shown the producing wells. Now, in the initial operating phase we will first inject our liquified petroleum gas, which will displace the — which is shown in green — and will displace the reservoir oil shown in brown, through the reservoir and out the producing well.

In the intermediate phase of operation we have shown the liquified petroleum gas followed by dry gas, which is colored in red. The dry gas will force the liquified petroleum gas through the reservoir in a piston-like fashion, and cause the oil to be pushed through the sand and out the producing well.

Now, you may note that we have shown some gradiation of coloring between the oil liquified petroleum gas and gas. These are the mixing zones between the fluids which are against each other. And this is sometimes referred to as zones of admissibility by the engineers.

In the final operating phase, we have displaced all the reservoir oil and are now ready to produce the liquified petroleum gas which we have injected. Under this project, the area that will be swept will recover approximately a hundred percent of the original oil in place. However, we know from water flooding and past secondary

recovery operations, that we will not be able to sweep all the reservoir, and that is the reason we have a figure of fifty percent for the recovery factor.

Q Mr. Brooks, what is the proposed completion program for the injection well?

A We will set eight and five inch surface pipe at approximately fifty feet and circulate cement to the surface wall, then wait twenty-four hours and test with 1500 pounds per square inch for thirty minutes. We will then run five and a half inch casing with scintilliners and scratchers, through the Lower Gallup sand reservoir, sufficient cement will be used to displace the top 500 feet of cement, the top of the cement 500 feet above the top of the producing sand.

Q Mr. Brooks, in your opinion will this completion program prevent the escape of any fluids from this reservoir into any surrounding formations?

A May I finish this, I didn't get some of it in. Then I will answer that. Will permit the cement to set for 48 hours, and test the casing with 2,000 pounds for thirty minutes. Tubing will be run and set in a packer; all injection will be down the tubing.

Q Mr. Brooks, then in order to repeat that question, is it your opinion that this proposed completion program will prevent the escape of any fluids from this formation into any surrounding formation? A Yes, they will.

Q To the best of your knowledge, has liquified petroleum gas and gas injection ever been tried before?

A Yes, in one instance it was tried in Oklahoma and was proven successful from a research viewpoint. Also four other projects that I know of are being planned by major operators in other states. These projects are in the Celexon Field operated by Humble, the Parks Field operated by Magnolia. Both of these are in the State of Texas. The Short Junction Field operated by Continental in Oklahoma, the Sunray Mid-Continent has a project North of Los Angeles. The Texas Railroad Commission has approved the project for the Parks Field in Midland County, Texas. The project we propose is, will be the first to be initiated in the State of New Mexico.

Q Mr. Brooks, you have previously stated that an Engineering Committee of six operators in this field have approved the program which we are proposing here today. Are these operators now entering into a cooperative agreement for the operation of this project?

A Yes, they are.

Q Then the operation will be a cooperative production and not a unitization of the leases involved, is that correct?

A That's correct.

Q In your opinion will the approval of this application by this Commission prevent waste and protect correlative rights of all concerned?

A Yes, sir.

MR. ERREBO: At this time, if it please the Commission, we would like to offer in evidence Exhibits 6 through 12; before we do that, were these Exhibits 6 through 12 prepared by you or under your supervision? A Yes, sir.

MR. PORTER: Without objection the exhibits will be admitted. Are you through with your direct examination?

MR. ERREBO: Yes, sir, I am. I have one additional statement to make. We can wait until after that.

MR. PORTER: Mr. Mankin, you have a question?

MR. MANKIN: Yes.

CROSS EXAMINATION

By MR. MANKIN:

Q Mr. Brooks, on your Exhibit 7 you indicated certain reservoir and fluid characteristics. Do you have available something, on the permeability range; it was noted it was about nine millidarcys for the average for the reservoir. Do you have somewhat of a range in this area on these twenty wells that were cored?

A Yes, sir. It's a terrific range. It will range from point one to as high as two hundred millidarcys. I don't remember the exact top number.

Q And then on the porosity, is that a fairly narrow range or is it a very wide range?

A The porosity range is a narrow range. The variation isn't too great.

Q Does it vary just a few percent from this 14.4%?

A Yes, sir.

Q You were relating the casing program a moment ago, as to this injection well. Did I understand that the injection casing, or what was commonly called production casing, be set at approximately the top of the Lower Gallup or --

A (Interrupting) Through the Lower Gallup.

Q Through the Lower Gallup and perforated?

A Yes, sir.

Q Also in Exhibit 7 you pointed out that the bubble point was 1207 pounds and the present bottomhole pressure, the last report was 1319 pounds, which is approximately still about 112 pounds above the bubble point, is that correct?

A Yes, sir.

Q Is it not quite important that this particular project be started very soon because of this approaching the bubble point at this time?

A Yes, it is very important.

Q To maintain reservoir pressure?

A Yes. Inasmuch as we have, this is only a pilot and we certainly want to know the results of the pilot before we reach equilibrium gas saturation.

Q It was also mentioned that there would be liquified petroleum gas injection of approximately 33,000 barrels during the life

of this project. Might not that be either more or less than 33,000 barrels? A That's correct.

Q And also the length of time that this pilot project would be in effect might vary anywhere from one month to six months, would you say?

A It will depend upon the time that will take to -- in other words, the producing rates of the wells, the faster we can produce the four wells which is not rate sensitive, the sooner we can get the results.

Q That was my next question. In other words, it's your feeling that this particular project with liquified petroleum gas injection is not particularly rate sensitive?

A No, sir.

Q That's your present feeling. It was also mentioned that there was, you mentioned the cumulative oil production, cumulative gas production. Is it not true that this oil and gas production has been considerably limited by the market that was available for these wells in the field? A Yes.

Q In other words, the wells haven't been, continually been properly tested or valuated due to a limited market for the oil?

A Yes.

Q But that particular thing will possibly be helped in the future by pipeline into the area? A I believe it will.

Q On Exhibit 12 it was titled "Diagramatic Illustration

Displacement by Liquified Petroleum Gas Flooding". Actually it's LPG flooding you are proposing there, is it not?

A That's a technicality, and that's a good way to call it if you like that. It really never has been designated. You may hear anything from one group of engineers to another.

Q "Missable" flooding?

A I think "missable" LPG flooding is the best name I know of.

Q I asked a question awhile ago and it was referred to you, in the type of drive this reservoir has. Would you relate the type of drive you feel this reservoir has?

A Yes, sir. It's my opinion that the Bisti Field at the present time is operating by a drive of fluid expansion. However, in the future, after we have passed bubble point pressure, it is my opinion that we will be producing by a solution drive mechanism.

Q Also in Exhibit 9 you indicated there was approximately 72 wells, which I believe is primarily what is shown on Exhibit 1 of the wells in the area, is that correct?

A Yes. However, you will notice that in that column it says the number of wells produced, and we did that to show that all of the wells are produced.

Q So in this Exhibit 1 there was more than this 72 wells?

A Yes, sir.

Q And is it not also true that this area, that the areas present on Exhibit 1 is essentially now what is known as the Bisti-Lower Gallup Oil Pool?

A There is also an extension to the Southeast which is called the Lower Gallup. Bisti Pool or Lower-Bisti Gallup Pool.

Q In addition to the wells shown on Exhibit 1, is there not another group, an extension of Gallup production both Southeast, North and Northwest that is known, which wasn't considered in these production figures?

A No, sir. To the best of my knowledge those to the North which you speak of, such as Nelson, were not included.

Q So there is a considerable group of wells that was not here considered, but might further make the project even more lucrative for even larger projection in the future?

A I would say this, it might make the area more lucrative.

MR. MANKIN: That's all.

MR. PORTER: Anyone else have a question? Mr. Utz.

By MR. UTZ:

Q Mr. Brooks, referring to Exhibit No. 6 which is your core lab analysis, I note that in the upper zone we have the permeability variation of, in about five feet from 69 millidarcys to as high as 124 millidarcys. Is this phenomena prevalent over the large area of this field where you have —

A (Interrupting) Would you repeat the last two or three

words, I couldn't understand?

Q I say, is this prevalent over quite an area in this field?

A It is predominent in the pilot area. And you may see this down the middle of the field more than you will on the edges. There is a gradiation down through the edges of the section which you are talking about in permeability, but in the area that we are speaking of, this is a common thing.

Q Will this have any effect on your vertical sweep efficiency on the project?

A We don't believe that it will.

Q You don't anticipate then that this liquified petroleum gas current will comb, so to speak, through this lower, higher permeability area?

A Not with the pressures that we intend to use, no, sir.

Q If it should, is there any way you can control it by rate of production?

A Yes. You would have control on the coning and fingering, if you please, by a rate that you produced the wells and by the pressures that you maintained within the reservoir.

Q If you didn't control it, is there a possibility of leaving a substantial amount of oil in the permeable zones?

A If it occurred it would be possible. However, it would still be better than what we anticipate under primary.

Q Yes, sir. That's all I have.

MR. PORTER: Mr. Nutter.

By MR. NUTTER:

Q Mr. Brooks, I think you stated you would set your pipe through the sand and perforate. Would you get the interval perforations?

A We haven't drilled it yet, Mr. Nutter, but it would be approximately the same interval. Well, we don't know until we get down and see what we have.

Q I was wondering if you would probably perforate the entire sand or just the upper sands or lower sands or in the middle or what?

A We may perforate only the upper section. These things have to be worked out in the Engineering Committee, and the final decision has not been made on that. Sunray has no, does not have a complete control over it.

Q Did you state in your testimony the amount of leaway that you would have to have if the location of the well —

A The amount?

Q I know you said that on account of the necessity of the rig being clear of a bench mark or any other feature there in the corner you might have to have a little leaway in the location of the well. Would you specifically say how much?

A Ten feet distance of radio tolerance.

Q From the point three point five or what?

A From the corner would be satisfactory.

MR. ERREBO: Mr. Nutter, in our application we set out 3.5 feet out of the corner. That would be 3.5 feet from the North line and 3.5 feet from the West line of Section 6. And then a point for further consideration, we thought if there was a bench mark there, perhaps covered up, or we discovered one, a radio tolerance within Section 6 of ten feet would enable us to clear that bench mark say from the pits or from the cellar.

MR. NUTTER: That would give you plenty of room to work then?

MR. ERREBO: We think it will.

MR. COOLEY: Ten feet from the, 3.5 feet from the North line and 3.5 feet from the West line, or from the corner?

MR. ERREBO: Ten feet radially in Section 6 from the Northwest corner of Section 6.

MR. PORTER: Would be confined to Section 6?

MR. COOLEY: It would be an arc then?

MR. ERREBO: Yes, sir.

Q Mr. Brooks, in your testimony you also stated the average production per well was 14 barrels per day, I believe. Did you make that statement? A Yes.

Q And you also stated that the four wells included in this pilot area would be produced at a maximum rate or minimum rate of three hundred and some odd barrels per day?

A A minimum rate.

Q A minimum rate of how many was that?

A Three hundred thirty-four.

Q A minimum rate of 334, and yet the average producing rate for the wells in the area is 14 barrels per day. I wonder if you would explain how you plan to accomplish that.

A Well, that is something that we are still working on. We will have to transfer the allowable from wells on leases to the producing wells, and all of the wells that would be required to give a producing well its production.

Q Well, now, each well would be produced with a minimum of 334 barrels per day?

A No, sir. All four wells.

Q Oh, the four wells would? A Yes, sir.

Q Oh, I see. So how many wells' allowables will have to be transferred to these four wells in order to accomplish that 334 barrels?

A Well, we would have to divide the--I don't believe I can answer that question right now.

MR. ERREBO: Mr. Nutter, I might be able to help out on that. I am inclined to think, as I hear this testimony, that the 334 barrels per day might have been based upon a higher per well take than is presently in existence for the month of July.

MR. NUTTER: So it wouldn't --

MR. ERREBO: (Interrupting) It might have to be reduced, the total --

A A little bit.

MR. ERREBO: -- take from these four wells.

Q Mr. Brooks, in reply to Mr. Mankin's questioning, you said that this project would not be rate sensitive. I wonder if you would explain in a little more detail what you mean by that?

A By that I mean that we could produce the wells as fast as they would produce without harming or leaving any of the reservoir oil behind the gas front. We intend to. This is a solvent action, and the laboratory experiments that have been performed to date have actually all led to the same conclusion that this type of drive is not rate sensitive.

Q Now, you say you can produce these wells as hard as they can produce, or fast as they can produce, without leaving any of the oil? A That's right.

Q Can you produce them at a rate less than they can produce and still get the same efficiency? A Would be zero.

Q No, I meant say at half the, for instance, at half of the possible producing rate.

A It wouldn't make any difference. Just, now my own personal opinion is I wouldn't want to shut them in after we get started. But, from the research that has been done, it is doubtful that that would harm the reservoir. But I don't want to do it.

Q But they could be slowed down without abandoning.

A Yes.

Q Thank you.

MR. PORTER: Mr. Cooley.

By MR. COOLEY:

Q Mr. Brooks, Mr. Nutter's questions and your answers, you referred to allowables for the wells in the area. These wells are not being prorated by the Oil Conservation Commission, are they?

A No, sir.

Q They are being given a prorata share of the purchases by the common purchasers in the area? A That's correct.

Q And that in transferring the prorata shares of several wells to the particular producing well, is prorata project, the prorata share indicated to an entire lease, would not be exceeded, would it?

A No. Unless some provision can be made that we can withhold the allowables for future operations in order to expedite this experimental flood that we propose.

Q What wells other than Sunray Mid-Continent wells will be affected by this injection project?

A The Phillips Hospah No. 1 and the British American --

Q Would you locate those wells --

A (Continuing) -- Mayre No. 1. The Phillips Hospah No. 1 is located in the Southeast Southeast of Section 36, 13 West, 26 North.

Q And the British --

A The British American Mayre No. 1 is located Northeast, Northeast of Section 1, 12 West. 13 West, correction, 25 North.

MR. ERREBO: I believe he made an inadvertant error, in the location, township and range on the first well. Are you copying that down?

MR. COOLEY: No, I wasn't.

MR. ERREBO: Will you repeat the location of the first well you described?

A It's in the Southeast, Southeast of Section 36, Range 13 West, Township 26 North.

Q That's correct.

MR. ERREBO: That was right.

Q These are the only wells other than Mid-Continent's wells that will be affected by the injection of liquified petroleum gas in the reservoir and the pilot flood?

A There may be some effects felt on a few of the walls nearer the pilot. However, the Bisti Field Engineering Committee has set up thirteen wells in this area which we will test in order to analyze the success of this project.

Q Have the owners of all the wells that could possibly be affected by this project agreed to, and are participating in, the same?

A To the best of my knowledge they have been, yes, sir.

Q What source will you obtain your liquified petroleum gas from?

A We are negotiating to obtain liquified petroleum gas from either the Wingate Plant or the, I can't remember the name of it. What's the close one?

MR. MANKIN: Ignacio Plant. A Ignacio.

Q It will be procured as closely —

A (Interrupting) As closely as we can get it to save transportation charges.

Q And what source will you obtain the dry gas for the injection, behind the opening?

A We are negotiating there with El Paso, which has a line running within six hundred feet of the proposed injection well. The agreements, the contracts, haven't been signed, but we are verbally negotiating with them and feel sure we can do it.

Q Is the gas being carried in that line being produced from the Lower Gallup? Is it part of the casing-head gas in the area?

A No.

Q Dry gas?

A Dry gas from other areas and — that's correct.

Q You testified that on pilot flood you expect efficiency of fifty percent sweeping efficiency. If the project is extended to a pool line basis, would there be probabilities of a greater efficiency?

A Yes. There is certainly a good possibility that the sweep efficiency could be bettered on a fieldwise basis.

Q Well, the reason I said efficiency of fifty percent, you said the area that was swept would be one hundred percent swept.

A That's correct. Approximately one hundred percent.

Q So if you are getting fifty percent, you must be sweeping fifty percent? A That's right.

MR. PORTER: Does anyone else have a question?

A That is very common in water flooding and is something that we have seen ever since the beginning of water flooding, is sweep efficiency and, on a five spot, it's, usually approximately, fifty-three percent is a good round number.

MR. PORTER: Mr. Utz, you have a question?

MR. UTZ: Yes, sir.

By MR. UTZ:

Q Mr. Brooks, will this pipeline gas that you intend to purchase from El Paso be recoverable?

A Let me correct that statement. We did not say that we would purchase the gas from El Paso. We may not have that right. It will have to be done upon an exchange basis. In other words, we will have to furnish them gas from the Bisti Field or some other location, in, probably in the State of New Mexico.

Q Well, at any rate, it will be dry pipeline gas that would inject in this project?

A That's correct. Yes, sir.

Q Will this gas be recoverable?

A Yes, just like a gas reservoir.

Q To what extent?

A Our guess is 85%.

MR. UTZ: That's all.

MR. PORTER: Does anyone else have a question of this witness? You may be excused.

(Witness excused.)

MR. PORTER: Does anyone have a statement to make? Mr. Currans

MR. Currans May it please the Commission, I am representing Pan American Petroleum Corporation. Pan American is the operator of one well in this pool. We are presently drilling another, and in fact it's almost completed and possibly we will drill more in the future. Based on the data presented here today it appears that this pilot program will serve a conservation function in that it will provide a means and a method of evaluating one method of increasing ultimate recovery. Therefore Pan American recommends that it be approved.

MR. PORTER: Anyone else? Mr. Woodward.

MR. WOODWARD: If it please the Commission, John Woodward, appearing for El Paso Natural Gas Products Company in support of this application by Sunray. We feel that this pilot project will

afford the Commission and the industry with the unique opportunity of determining if a tremendous amount of underground waste of oil can be avoided through a timely institution of such a pressure maintenance program, and therefore, urge the Commission to approve this application.

MR. BUSHNELL: H. D. Bushnell, attorney with Amerada. Amerada concurs in the application.

MR. PORTER: Are there any statements from any other operators? Any other comments, Mr. Errebo?

MR. ERREBO: If it please the Commission, I would like to state at this time that inasmuch as the State of New Mexico and the United States Geological Survey, the Federal Government, are interested in leases in this area, in the pilot area, the State Land Office and the United States Geological Survey office at Roswell have both been contacted and our plan that we presented here today has been outlined to them.

The United States Geological Survey office in Roswell has authorized us to state that they have at this time no objection to the plan as presented here today.

Also I have here a copy of two telegrams which were received in Tulsa, in Sunray's Tulsa office, which I would like to read for the record. "Although agreement for Bisti Pilot Project not yet formally executed, we wish to advise that Shell Oil Company is in agreement and approves project in principle. This information

transmitted to you for use if needed in hearing before New Mexico Oil Conservation Commission." Signed E. P. Eastin, Shell Oil Company, Los Angeles, California.

The second wire reads as follows: "This is to advise you that the British American Oil Producing Company will be unable to have a representative present at the hearing scheduled for July 17th for purposes of obtaining the New Mexico Oil and Gas Conservation Commission approval for an LPG Pilot Injection Project in the Bisti-Gallup Field. We heartily endorse this plan for secondary recovery and you have our permission to use this message, if necessary, to convince the Oil and Gas Commission of our support in this proposed plan of secondary recovery." Signed Thomas M. Hogan, District Superintendent, British American Oil Producing Company, Denver Colorado. And that's all we have.

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

MR. COOLEY: I have a telegram here from Phillips Petroleum Company addressed to the New Mexico Oil Conservation Commission, Santa Fe, New Mexico. "Phillips Petroleum Company has participated in the engineering study and will participate in the Pilot Program to test the LPG and gas injection secondary recovery project for which your approval will be requested on July 17, at the hearing requested by Sunray Mid-Continent Oil Company. Phillips Petroleum Company is in favor of this project and urges your favorable action

on this application." Signed L. G. Fitzjarrald, Phillips Petroleum Company.

MR. PORTER: Anything else in the case? We will take the case under advisement.

C E R T I F I C A T E

STATE OF NEW MEXICO)
: SS
COUNTY OF BERNALILLO)

I, MARIANNA MEIER, 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 29th day of July, 1957.

Marianna Meier
Notary Public-Court Reporter

My commission expires: