BEFORE THE
OIL CONSERVATION COMMISSION
SANTA FE, NEW MEXICO

IN THE MATTER OF:

CASES 1664 and 1665

TRANSCRIPT OF HEARING

MAY 12, 1959

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BEFORE THE
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IN THE MATTER OF:

CASE 1664 Application of Sunray Mid-Continent Oil Company for permission to institute a water injection project in San Juan County, New Mexico, and for the promulgation of special rules and regulations in connection therewith. Applicant, in the above-styled cause, seeks an order authorizing it to institute a water injection project in the Bisti-Lower Gallup Oil Pool to inject water into the Lower Gallup formation through two wells located in Section 6, Township 25 North, Range 12 West, San Juan County, New Mexico. Applicant further proposes that special rules and regulations be promulgated governing the project, including but not limited to, conversion of additional wells to water injection without notice and hearing and the transfer of allowables from injection wells to producing wells.

CASE 1665 Application of Sunray Mid-Continent Oil Company for an order authorizing an LPG-gas injection project in San Juan County, New Mexico, and for the promulgation of special rules and regulations in connection therewith. Applicant, in the above-styled cause, seeks an order authorizing a liquefied petroleum gas-gas injection project in the Bisti-Lower Gallup Oil Pool in San Juan County, New Mexico. Applicant proposes to inject liquefied petroleum gas followed by gas into the Lower Gallup formation through seven wells in Township 25 North, Range 12 West, and to inject gas into the same formation through three wells in Townships 25 and 26 North, Range 12 West, all in San Juan County, New Mexico. Applicant proposes that special rules and regulations be promulgated governing said project, such rules being substantially the same as are set forth in Order R-1315.

BEFORE:

Daniel S. Nutter, Examiner.

TRANSCRIPT OF PROCEEDINGS

MR. NUTTER: The hearing will come to order, please. The first case now will be Case 1664.

MR. PAYNE: Case 1664. Application of Sunray Mid-Continent Oil Company for permission to institute a water injection project in San Juan County, New Mexico, and for the promulgation of special rules and regulations in connection therewith.

MR. WHITE: If the Examiner please, I am Charles White of Gilbert, White and Gilbert, Santa Fe, New Mexico, appearing on behalf of the applicant, Sunray Mid-Continent Oil Company. We have associated with us in this case Mr. Bill Lear of Tulsa, Oklahoma who will be actively in participation. If there is no objection, for the sake of time and orderly presentation, we would like to consolidate Case 1664 and Case 1665.

MR. PAYNE: For the purpose of testimony, Mr. White?

MR. WHITE: Yes.

MR. NUTTER: Will you read the style of Case 1665, Mr. Payne?

MR. PAYNE: Case 1665. Application of Sunray Mid-Continent Oil Company for an order authorizing an LPG-gas injection project in San Juan County, New Mexico, and for the promulgation of special rules and regulations in connection therewith.

MR. NUTTER: Is there objection to the consolidation of Cases 1664 and 1665? If not, they will be consolidated for the purpose of taking the testimony only. Would you proceed, Mr. Lear?

accounts for all the working interest in the area under consideration by the Examiner this morning, which is the identical area to the proposed unit area, with the exception of four tenths of one percent. This is owned by Val R. Reese and Associates in the S/2 of the SW of Section 32, Township 26 North, Range 12 West. We have continuing negotiations with Mr. Reese and his associates, and we anticipate that this will be included. If it is not, we will be able to operate the unit, protect correlative rights with his tract remaining outside. The U.S.G.S., the Indian Agency at Gallup, and the State Land Office have all given their tentative approval to the agreements, and the agreements are now being prepared in the approved form and will be submitted for signature at an early date. We anticipate we will have all signatures in time for this tentative hearing at the end of June.

MR. NUTTER: Mr. Loar, in the application file in Cases 1664 and 1665, you stated that you wanted to inject either water or LPG gas followed by gas into certain wells.

MR. LOAR: Yes, sir.

MR. NUTTER: Now, are all of the wells which you propose to inject these fluids into located on Sunray's Mid-Continent leases?

MR. LOAR: No, sir. They are located on leases belonging to Amerada, Phillips, El Paso, and Sunray Mid-Continent. The other parties have -- excuse me --

MR. NUTTER: Some of these wells, then, are located

on leases which have not been actually committed to the unit agreement?

MR. LOAR: Yes, sir. The unit agreement has not yet been formally signed. However, we have an underwriting agreement which has been signed by all of the parties with the exceptions of those that I mentioned, which contemplates that this unit will be formed. It authorizes a conversion, that is, among the parties it authorizes a conversion of these wells to injection services.

MR. NUTTER: Are all of the wells which you propose to convert to injection located on acreage which is either covered by the unit agreement as committed at the present time, or by underwriting agreement?

MR. LOAR: Yes, sir.

MR. NUTTER: So all injection wells are covered by the underwriting agreement?

MR. LOAR: Yes, sir.

MR. NUTTER: Is it expected that the unit agreement will be submitted to the Commission prior to the time that any of the wells will be authorized as transfer wells?

MR. LOAR: We will develop that by testimony. However, we, in the interest of taking care of any correlative rights problem, we will limit our transfer of allowable pending approval of the unit by the Commission to the lease on which the injection well is located so that there will be no transfer of the lease prior to the formal approval of the unit by all parties including

the Commission.

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

MR. LOAR: We will have two witnesses; if you would like to swear them both at this time.

(Witnesses sworn)

PAT KIMBERLIN,

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

DIRECT EXAMINATION

BY MR. LOAR:

Q Will you please state your name and occupation?

A My name is Pat Kimberlin. I am a staff research geologist for Sunray Mid-Continent Oil Company in Tulsa, Oklahoma.

Q Have you testified before this Commission in that capacity previously?

A No, sir, I have not.

Q Would you briefly state your educational background?

A I am a graduate of the University of Oklahoma. I received a Bachelor of Science degree in geology in 1951; a Master of Science degree in geology in 1953. I worked for Sunray Mid-Continent Oil Company for approximately five years.

Q Have you made a study of the Bisti Field, essentially all the electric logs in the Field, made isopachs, structure maps, conducted other geological studies in this Field?

A Yes, sir, I have.

(Whereupon, Sunray Mid-Continent Oil Company's Exhibits were marked for identification.)

Q Will you please refer to Exhibit No. 1 and discuss it briefly?

A Exhibit No. 1 is an area map of the Central portion of the Bisti Field. It includes portions of Township 26 North, Township 25 North, Range 14 West, Range 13 West, and Range 12 West. The proposed Central Bisti Unit is shown by a hatched line on the area map, and in the line it will include the acreage within the line that will be described as follows: Township 26 North, Range 12 West, Section 31, the S/2, S/2 of the N/2 of Section 31. In Section 32, the S/2 and the S/2 of the N/2. In Section 33, the S/2 of the SW/4. In Township 25 North, Range 12 West, in Section 3, the SW/4, all of Section 4, all of Section 5, all of Section 6, all of Section 7, all of Section 8, all of Section 9, and the NW/4 of Section 10. All of Section 16, and Section 17, the N/2 and the SE/4, and the E/2 of the SW/4, and the NW/4 of the SW/4 of Section 17. In Section 18, the NE/4, and the N/2 of the NW/4, and the N/2 of the SE/4. In Section 20, the NE/4, NE/4 of the NW/4. In Section 21, the N/2, the N/2 of the SE/4, and the NE/4 of the SW/4, all in San Juan County, New Mexico.

Q Mr. Kimberlin, is this the area which is the subject of the two applications before the Examiner this morning, that is, the application for water injection and the application for the

injection of LPG followed by gas?

A Yes, sir.

Q Would you please proceed with your discussion of this Exhibit?

A The area enclosed by dots and dashes is the LPG Pilot project, and the cross section that we have used is labeled in red and labeled B,BB Prime,C,CC Prime,and E,EE Prime,and the proposed LPG and gas injection wells are shown by circles. The proposed injection wells for gas only are shown enclosed by triangles. The proposed water injection wells are shown enclosed by squares.

Q In addition, you have shown thereon the producing wells and dry holes?

A Yes, sir.

Q Now, then, will you refer to Exhibit No. 2?

A Exhibit No. 2 is an electric log portion of the Sunray Mid-Continent Federal 1 "C" in Section 6, Township 25 North, Range 12 West. We have chosen this as the type section for the Lower Gallup formation.

Q All right, sir, would you proceed to discussing Exhibit No. 3?

A Exhibit No. 3 is an electric log cross section. It is labeled B, BB Prime, and it is also indicated the same on the area map. It includes the wells, British American No. 1 Marye in Section 1, Township 25 North, Range 13 West; Sunray Mid-Continent 3 "C" Federal in Section 6, Township 25 North, Range 12 West;

Sunray Mid-Continent's 4 "C" Federal in Section 6, Township 25 North, Range 12 West; Sunray Mid-Continent's 12 "C" Federal in Section 6, Township 25 North, Range 12 West; Sunray Mid-Continent's 15 "C" Federal in Section 8, Township 25 North, Range 12 West; Sunray Mid-Continent's 14 "C" Federal in Section 8, Township 25 North, Range 12 West; the Amerada No. 2 J. White in Section 9, Township 25 North, Range 12 West; Shell 14-10 Government in Section 10, Township 25 North, Range 12 West; Shell 33-15 Government in Section 15, Township 25 North, Range 12 West; Shell 32-14 Carson in Section 14, Township 25 North, Range 12 West.

The producing area of the Lower Gallup formation is illustrated in green on this cross section.

Q Does this cross section reflect that the Lower Gallup formation is continuous and connected in a northwest southeast direction across the area, which is the subject of these two applications?

A Yes, sir, it does.

Q Now then, will you refer to Exhibit No. 4?

A Exhibit No. 4 is generally a northeast southwest electric log cross section, and it is labeled C, CC Prime, and it is shown as such on the area map. Again, we have shown the Lower Gallup producing area in green. It includes the British American No. 2 Marye in Section 12, Township 25 North, Range 13 West; Sunray Mid-Continent's No. 5 "C" Federal in Section 6, Township 25 North, Range 12 West; Sunray Mid-Continent's 6 "C" Federal in

Section 6, Township 25 North, Range 12 West; Sunray Mid-Continent's 4 "C" Federal in Section 6, Township 25 North, Range 12 West; Sunray Mid-Continent's 9 "C" Federal in Section 6, Township 25 North, Range 12 West, and Reese No. 1 Hickman in Section 32, Township 26 North, Range 12 West.

Q Does this cross section also indicate that the Lower Gallup formation is continuous and connected in a northeast southwest direction across the proposed area?

A Yes, sir, it does.

Q Now then, would you refer to your last cross section, which is your Exhibit No. 5?

A Exhibit No. 5 is generally a north south electric log cross section. It is shown as E, EE Prime on the area map. It includes the El Paso Natural Gas No. "8" Kelley State in Section 16, Township 25 North, Range 12 West; El Paso Natural Gas No. 3 Kelley State, Section 16, Township 25 North, Range 12 West; El Paso Natural Gas No. 1 Kelley State, in Section 16, Township 25 North, Range 12 West; Phillips No. 1 I-Tah-Nip in Section 9, Township 25 North, Range 12 West; Shell No. 42-9 Phillips in Section 9, Township 25 North, Range 12 West; Shell No. 41-9 Phillips, in Section 9, Township 25 North, Range 12 West; Pan American No. 2, In-Ni-Da-Pah in Section 4, Township 25 North, Range 12 West.

Again, we have shown the Lower Gallup producing area shaded in green.

Q Mr. Kimberlin, do all three of these cross sections

that you presented, in addition to the other geological work that you have done in this area, lead you to believe that the Lower Gallup formation is continuous and connected throughout the area which is under consideration?

A Yes, sir.

Q From a geological standpoint, is this the type of formation which would be susceptible to the secondary recovery operations which are being proposed here today?

A Yes, sir, from a geological standpoint, it is.

Q Would you refer again to Exhibit No. 1, the area map, and point out the initial water injection wells?

A The initial water injection well is shown enclosed by squares. It is Sunray Mid-Continent No. 3 "C" Federal located in the southwest quarter of the northwest quarter of Section 6, in Township 25 North, Range 12 West, and Sunray Mid-Continent No. 5 "C" Federal in the SW/4 of the SW/4 of Section 6 Township 25 North, Range 12 West.

Q Now then, would you refer to Exhibit No. 6, and state what that is?

A Exhibit No. 6 is a complete electric log of the Sunray Mid-Continent Oil Company's Federal "C" 3 located in Section 6, Township 25 North, Range 12 West.

Q Now then, would you point out where the Gallup formation is on that well, actually the Lower Gallup formation?

A The top of the Lower Gallup formation is approximately

4816 feet, as illustrated by the electric log.

Q And was the well at total depth still in the Lower Gallup formation?

A Yes, sir, it was.

Q Now then, have you investigated the source of water which would be used in the water injection project?

A Yes, sir, I have.

Q Would you indicate where this -- the correlative section to the British American Well on this log?

A The correlative section to the British American Well is shown at approximately 1905 feet to 2475 feet. We have picked the top of the Mesaverde at approximately 1905 feet.

Q And this is the same portion of the Mesaverde group which British American will produce their water?

A Yes, sir, it is a correlative portion.

Q Is this water productive, in your opinion, in this well?

A Yes, sir, it is.

Q Were Exhibits 1 through 6 prepared under your direction and supervision?

A Yes, sir, they were.

MR. LOAR: At this time we move the admittance of Exhibits 1 through 6.

MR. NUTTER: Without objection, they will be received in evidence.

MR. LOAR: That's all we have from this witness. We have an engineering witness.

CROSS EXAMINATION

BY MR. NUTTER:

Q Mr. Kimberlin, why were you pointing the top of the Mesaverde Well on this well at 1905 with the British American Well?

A I compared the two electric logs and the two tops are correlative.

Q Just why are you pointing this out?

A Well, sir, I mentioned Mesaverde because some of the other formations -- various companies have different terminology, and I felt that the Mesaverde would be agreeable with all companies.

Q You are not planning to use this as a water supply well, however, are you?

A I do not know of our future plans now.

Q You have immediate plans to use this as a water supply well?

A I imagine Mr. Brooks, our engineer, would answer that question.

Q I just wondered why you talked about the Mesaverde being correlative with other wells.

Q We are simply trying to show that we have the same section present in our well that is in the British American Well.

Q Do you know the interval that you propose to inject water in, in your Federal "C" 3 and Federal "C" 5?

A No, sir, I do not. I believe Mr. Brooks -- his testimony will cover that.

Q Do you know of any plans that Sunray may have for using a well that is located just a few feet out of the northwest corner of Section 6?

MR. LOAR: Mr. Brooks will discuss our injection wells and our plan of operation, Mr. Nutter.

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

MR. PAYNE: I have one question.

QUESTIONS BY MR. PAYNE:

Q I believe these Exhibits were prepared by Mr. Kimberlin, is that right?

A Yes, sir, under my supervision.

Q Do you not propose to have an injection well in the LPG Pilot area? I believe in the previous case, British American showed an injection well within that Pilot project.

A Sir, I believe Mr. Brooks' testimony will cover that phase.

MR. PAYNE: All right, sir. Thank you.

MR. NUTTER: If there are no further questions of Mr. Kimberlin, he may be excused.

(Witness excused)

R. E. BROOKS,

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

DIRECT EXAMINATION

BY MR. LOAR:

Q Will you please state your name and occupation?

A My name is R. E. Brooks. I am employed by Sunray Mid-Continent Oil Company as senior reservoir engineer in Tulsa.

Q Have you testified before this Commission in this capacity previously?

A Yes, sir.

MR. LOAR: Are his qualifications acceptable, Mr. Nutter?

MR. NUTTER: Yes, sir. Please proceed.

Q Have you made detailed studies of the Bisti Lower Gallup Oil Pool from a reservoir engineering standpoint?

A Yes, sir.

Q Have you examined the data available and made several reservoir studies?

A Yes, sir.

Q This is the application of Sunray Mid-Continent Oil Company for authority to inject LPG followed by gas to inject gas and to inject water into the Bisti Lower Gallup oil formation, and the rules necessary to carry out this project. Are you familiar with these applications?

A Yes, sir.

Q Mr. Brooks, has Sunray Mid-Continent in cooperation with other operators been conducting an LPG Pilot project?

A Yes, sir, we have.

Q Will you please refer to Exhibit No. 7 and discuss that, please?

A Exhibit No. 7 is a graphical illustration of the Bisti LPG Pilot project production data. On this Exhibit, you should note that the scale for each curve is designated at the top of that scale. Curve No. 1 is the cumulative gas injection in MCF.

Q Is the scale for that shown on the left-hand side of the --

A The scale is shown on the left-hand side of the Exhibit. This curve shows that we have injected, to April 1, 1959, five hundred and eighty-eight million, three hundred and eighty-two thousand MCF of gas. Curve No. 4, which is the cumulative LPG injected, is shown with the scale to the right and the slug which we initially injected consisted of 31,015 barrels of LPG. Under curve No. 4 is curve No. 5, entitled "Total Oil Production In Barrels Per Month," with the scale on the right-hand side. Now, from this curve you may note that for approximately the first year of operation we were able to maintain a producing rate of approximately 16,000 barrels per month. Since that time, due to the increase in gas-oil ratios and the manner in which we prorate

the Pilot, we've had a decrease in the production rate. Currently, or as of April 1, 1959, we were producing 10,902 barrels per month.

Q That's your March production. Is that 10,000 barrels?

A That's correct. And curve No. 2, which is the cumulative oil production shown with the scale on the left-hand side, and is a dash curve shows the cumulative production to April 1, 1959 of 282,491 barrels. Gas-oil ratio curve No. 3, with the scale on the left-hand side, is shown by the solid dots. Now, you may note from this that the gas-oil ratios remain fairly constant for the first five months of operation, and since that time we've had a gradual increase in the gas-oil ratios. The most recent gas-oil ratio, or as of -- for the month of March, was an average of 4,414 cubic feet per barrel.

Q Is this a relatively low ratio for a project of this type?

A Yes, sir, it is. We believe that a project of this type could be carried to an economic limit of 20,000 cubic feet per barrel.

Q I note that you pointed out that we had produced in excess of 280,000 barrels of oil from this project, is that correct?

A That's correct.

Q What were the primary estimates for production from these 160 acres?

A Slightly in excess of 80,000 barrels.

Q Then, this would be approximately three times the

primary recovery?

A Yes, sir.

Q I believe you stated that you are still producing in excess of 10,000 barrels of oil per month?

A That is correct.

Q And your GOR's are still in the range of economic and engineering feasibility for the operation of this project?

A That is correct.

Q Mr. Brooks, what is the approximate daily production from these wells, these four producing wells?

A The approximate daily production is on the order of 400 barrels per day, I believe.

Q Then the withdrawal from the -- excuse me -- do you know the allowable in the Bisti Oil Pool or approximately the allowable per well?

A In the Bisti Oil Pool per well?

Q Yes, sir.

A 106 barrels, I believe is the latest.

Q Then, we are withdrawing from the Pilot project either the allowable or less than the allowable of comparable wells, or the top allowable for the Field, is that correct?

A As a whole, we are. Now, some of the Pilot wells are making less and some are making more, but the average of the four is less than the Field allowable.

Q And you restricted these voluntarily?

A We have restricted these voluntarily based on the volumetric withdrawal.

Q Has the project essentially served its purpose?

A The project has essentially served its main purpose. However, we feel that there is still research knowledge to be gained from this operation. At the same time we do agree with British American that we can inject water into the Bisti, G I No. 1, but we have a gas bubble which is within the bounds of the Bisti Pilot, and the gas will be displaced by water and certainly give us additional information.

Q In the foreseeable future, then, it would be agreeable to Sunray Mid-Continent and the other operators, then, to convert this to water injection?

A We feel that it would, yes, sir.

Q And that is a part of the proposed water injection program?

A That's correct.

Q Would you please refer to Exhibit No. 8?

A Exhibit No. 8 is a tabulation of the average reservoir fluid characteristics of the Central Bisti Lower Gallup sand unit. On this Exhibit we have shown that the acres in the participating area are 4,713 acres. The average porosity is 14.4 percent, connate water 26. -- 26 percent. Permeability, 9 millidarcies. The bubble point pressure of the reservoir fluid is 1207 pounds per square inch with a reservoir temperature of 145

degrees Fahrenheit. The fluid has a solution gas-oil ratio of 406 cubic feet per barrel, formation volume factor of 1.261, viscosity at bubble point conditions, .83 centerpoise. The oil has an approximate oil gravity of 39 degrees API, it's a greenish brown in color.

Q Mr. Brooks, we are discussing two applications this morning. What is it that the operators in the Central Bisti Unit propose to do?

A Well, the operators in the Central Bisti Unit propose to institute a pressure maintenance program which will call for injecting gas on the north and the south edges of the Field, with an LPG gas admissable slug type operation down in here, called the fairway portion of the Field. On the eastern and western boundaries we propose to set up water block which in turn will yield additional secondary recovery oil by the injection of water into wells which have been pointed out, in part, here today.

Q What would be the source of your gas that will be injected within the project area?

A The source of the gas that will be injected will, of course, consist of that gas produced from the unit area plus makeup gas required to fill the voidage space from the oil and gas produced, purchased from El Paso.

Q And what will be the source of your LPG?

A The source of the LPG will be from El Paso at their Chaco plant transmitted to the injection location in the unit

area.

Q Now then, would you please identify, first of all, the gas injection wells?

A Referring to Exhibit 1, the area map, the gas injection wells are shown with a triangle. The Sunray Mid-Continent Federal "C" No. 7 is located in the SW/4 of the SE/4 of Section 31, Township 26 North, Range 12 West. The El Paso Benally No. 1 is located in the SW/4 of the NE/4 of Section 5, Township 25 North, Range 12 West. The Amerada Salina White No. 1 is located in the SE/4 of the SW/4 of Section 8, Township 25 North, Range 12 West. Now, on this Exhibit, we have indicated that the Sunray Mid-Continent Federal "C" 16 would be used as an LPG gas injection well. Since preparation of the Exhibits, the engineers have had a reversal of decision and feel that it will be more economical and more operative to include this well as a gas injection well. It is located in the SW/4 of the NW/4 of Section 8, Township 25 North, Range 12 West. Now, in addition, we have currently in operation our Federal "C" 18, which is located in the SW/4 of the NE/4 of Section 7, Township 25 North, Range 12 West. This well was authorized as a gas injection well by the Commission's Order No. R-1315.

Q Mr. Brooks, these, I believe, are your initial gas injection wells, is that correct?

A That's correct.

Q Will there be additional gas injection wells as the project progresses?

A That's correct.

Q What will be the approximate volume of gas and the pressure required for these injection wells?

A Initially we plan to inject a total of three to four million cubic feet of gas per day in these wells. The pressure is anticipated to range between 1600 and 1800 pounds per day.

Q Now then, will you please identify the initial LPG injection wells?

A The initial LPG injection wells will be the Sunray Mid-Continent Federal "C" No. 4, located in the NW/4 of the NE/4 of Section 6, Township 25 North, Range 12 West. Did I make an error? I will read it again. The SW/4 of the NE/4 of Section 6, Township 25 North, Range 12 West.

Q Will you give that well name again to clarify the record, please?

A The Sunray Mid-Continent Federal "C" No. 4.

Q All right, sir.

A The Sunray Mid-Continent Federal "C" 13 is located in the SW/4 of the SW/4 of Section 5, Township 25 North, Range 12 West.

Q Just a minute, Mr. Brooks.

A The Amerada Gle-na-nup-pah No. 1 is located in the SW/4 of the SE/4 of Section 5, Township 25 North, Range 12 West. The Sunray Mid-Continent Federal "C" No. 10, located in the SW/4 of the SE/4 of Section 6, Township 25 North, Range 12 West.

The Sunray Mid-Continent Federal "C" 14 is located in the SW/4 of the NE/4 of Section 8, Township 25 North, Range 12 West.

MR. NUTTER: How about the Phillips Benally Well there on the SW SW of 5 that is circled in on my Exhibit?

A Mr. Nutter, there was a great deal of discussion about using the Benally Well for an injection well. I mean, you asked about 16?

Q (By Mr. Loar) No, he asked about the Phillips Benally No. 1

A Didn't I mention that?

Q No, you did not. Will you please identify that on the map?

A The Phillips Benally No. 1 is located in the SW/4 of the SW/4 of Section 5, Township 25 North, Range 12 West.

Q Mr. Brooks, will these six wells be the initial LPG injection wells?

A Yes, sir.

Q Will there be additional wells as the project progresses?

A Yes,sir.

Q What will be the volume of LPG and the pressure which you propose to inject in this LPG?

A Our plans are to inject a total volume of between 6,000 and 7,000 barrels of LPG per day. The anticipated pressure may range between 1,000 pounds per square inch and 1,800 pounds

per square inch.

Q This is taking care of the individual difference in the wells, is that correct?

A That's right.

Q Then, will you follow this LPG slug with the injection of gas?

A Yes, sir.

Q I hand you what we would like to have marked as Exhibit No. 8 -- No. 9, excuse me. Would you please refer to that and discuss it briefly?

A Exhibit No. 9 is a schematic drawing of the current gas injection well, Federal "C" 18. This well shows that the casing -- surface casing is of 8 5/8 inch OD, is set at 352 feet, and cemented with 225 sacks of cement, which were circulated to the surface. The top of the cement was found at 3650 by temperature survey. This well has a Baker production packer set at 4830. The Lower Gallup reservoir is perforated from 4842 to 4858, 4890 to 4896, 4910 to 4916, 4922 to 4930. The well has 5½ inch casing set at 4989 with 200 sacks of cement.

Q Mr. Brooks, is this typical of the type of completion which Sunray Mid-Continent will use for injection wells in this area?

A That's right.

Q And this is the well which has previously been authorized by the Commission for injection purposes?

A Yes, sir.

Q And is now in operation --

A Yes, sir.

Q -- as a gas injection well?

A Yes, sir.

Q In all wells, whether they be water injection or LPG injection followed by gas or initial gas injection, will we inject down tubing on a packer?

A Yes, sir.

Q Now, would you refer to Exhibit No. 1, the area map, and identify the two initial water injection wells and give their locations?

A The two initial water injection wells will be the Sunray Mid-Continent Federal "C" No. 5, which has 8 5/8 inch casing set at 195 feet with 150 sacks of cement, which were circulated to the surface. It has 5½ inch casing set at 5,000 feet with 200 sacks of cement, with top of the plug at approximately 3900 feet. The location of this well is in the SW/4 of the SW/4 of Section 6. The other well, the Sunray Mid-Continent Federal "C" 3, has 10 3/4 inch casing set at 178 feet with 200 sacks of cement, which was circulated to the surface. It has 5½ inch casing set at 5,026 feet with 250 sacks of cement, with the top found by temperature survey at 3850.

Q Again, Mr. Brooks, you will inject water down tubing set on a packer in these wells?

A That's correct. I didn't give the location of that well.

Q I am sorry.

A The location of the Federal "C" 3 is in the SW/4 of the NW/4 of Section 6, 25 North, 12 West.

Q What will be the volume of water and the pressure which you expect to inject water into the water wells in the Field?

A We anticipate an injection rate of 100 to 700 barrels per day. However, we feel that it may be necessary to go to higher rates in order to balance the injection with our offset operators. British American will furnish the supply water. The injection pressures will be 400 to 600 pounds per square inch.

Q Mr. Brooks, do you feel that the method of completions as proposed will prevent the migration of the water to any other formation in the Bisti-Lower Gallup?

A No, sir.

Q Let me rephrase my question. I am not sure that you understood my question.

A Sounded good to me.

Q Is the method of completion for these water injection wells such that the water will be restrained, yes, restrained to the Lower Gallup formation?

A Yes, sir.

Q What is the purpose of the water barrier which has been discussed in the British American application, and which you

are now proposing?

A The water barrier will serve two purposes. No. 1, of course, is to eliminate migration of fluid across the unit boundary line and/or to other offset operators which we feel will protect correlative rights. The other reason is to maintain the reservoir pressure at a level which we desire in the Bisti Unit.

Q Have you studied the rules now in effect for Sunray Mid-Continent's Federal "C" gas injection project?

A Yes, sir.

Q These are carried under New Mexico Oil Conservation Commission's Order No. R-1315. Are you now asking for permission to convert the two water injection wells which you've previously identified British American additional gas injection wells and the six LPG gas injection wells at this time? Are you asking permission to convert these wells at this time?

A Yes, sir.

Q Now then, this Order No. R-1315 provides for conversion upon administrative approval. Are you asking that this Order be expanded to include the area which is the subject of this application, and in addition, to include water injections and LPG gas injections?

A That's correct.

Q Are you requesting June the 1st, 1959 as the effective date of these rules?

A Yes, sir. We feel that would be a good date.

Q Why?

A It is imperative that we start the injection operations in the proposed unit area as soon as possible, due to the availability of LPG which we now have available in the volumes that we need for a program of this type. At the same time, reservoir pressures are approaching the level where we feel it is also important that we get started as soon as possible.

Q Mr. Brooks, I believe we mentioned a per day injection on this LPG. What approximately will be the total number of barrels necessary to build the reservoir pressure to the point which this project will be feasible?

A 935,000 barrels, which we now plan to inject, and this figure would be, up to 935,000 barrels, will go a long ways toward restoring the pressure to the desirable pressure that we will operate the unit. Of course, in addition, we will have the gas injection on the edges, and the water on the boundary lines.

Q Now then, because of the seasonal demand for LPG, it is anticipated we will run into a winter demand problem if we do not commence this LPG injection at an early date, is that correct?

A Yes, sir.

Q Mr. Brooks, since it's anticipated that the unit cannot be effective until approximately July the 1st, and you are today requesting allowable transfer privileges as provided in Rule R-1315, will you actually transfer any allowables pending approval

of this unit by the Commission except on the lease from which the allowable -- except on the lease from the well which the allowable will be transferred?

A That's right.

Q Why do you feel that this restriction is necessary, pending unitization?

A Well, we feel that as long as we can produce the oil from the lease, from a well which we have converted to an injection well, which is certainly restricting the royalty owner in his pro rata share of the oil, that this will give him the protection that he needs.

Q I would like for you to refer back to the -- one of the initial gas injection wells, which is the El Paso Benally No. 1. Is that the only well on that lease in the NE/4 of Section 5?

A That's right.

Q Pending unitization, will you convert that well?

A That well will not be converted until such time as we have a unit agreement signed and those people can realize their production through unit operations.

Q All other wells which you have requested for immediate approval have wells to which -- have wells on the same lease to which the allowable can be transferred?

A Yes, sir.

Q Is it proposed to operate the unit at a reduced allowable until the pressure is restored in the unit area?

A Yes, sir.

Q Mr. Brooks, is the method of operation, that is, the injection of water along a common boundary of the British American acreage and the Central Bisti Unit, the prospective injection of water along the east side of the unit, the injection of gas in the flanks, and the injection of LPG followed by gas in the fairway the most efficient and economical way in which this project can be operated?

A Yes, sir, we feel that it is.

Q Will it recover additional oil which would otherwise not be recovered?

A Yes, sir.

Q Will this plan of operation prevent waste and protect correlative rights?

A Yes, sir.

Q Were Exhibits 7, 8, and 9 prepared under your direction and supervision?

A Yes, sir.

MR. LOAR: At this time we move the admittance of Exhibits 7, 8, and 9.

MR. NUTTER: Sunray's Exhibits 7, 8, and 9 will be admitted in this case.

(Whereupon, Sunray Mid-Continent's Exhibits 7, 8, and 9 were admitted in evidence.)

MR. NUTTER: We will excuse Mr. Brooks from the stand,

pending recess, and the hearing will reconvene at one-thirty.

(recess)

MR. NUTTER: Let the record show that Mr. Bob Brooks is on the stand as a witness. Does anyone have any questions of Mr. Brooks?

RECROSS EXAMINATION

BY MR. NUTTER:

Q Mr. Brooks, referring to your Exhibit No. 7, most of these curves on this Exhibit are the sum and total of the four wells in the Pilot project area, are they not?

A They all are.

Q Would you give us some statistics on the individual wells in that LPG test area, please?

A The oil production for the individual wells as of April 1, 1959 were as follows: The Sunray Mid-Continent Federal "C" No. 1 produced 3,651 barrels for that month; the "C" 2,770 barrels; the Hospash "A" 1, 2,174 barrels; the Marye No. 1, 4,307 barrels.

Q Do you have cumulative production for those wells, Mr. Brooks through March, 1959? These figures you just gave are the production rates for March, are they not?

A Yes, sir. I don't have them. I have the numbers by

month here, and could add them up rather rapidly. Let me look and see if I can give you some. It is going to take a little bit of time. With certain qualifications, I am not sure exactly whether these numbers check with our official data which I didn't bring. The cumulative production, including that which was produced before the Pilot started on the Sunray Mid-Continent Federal "C" 1 was 101,736 barrels, at the end of January, 1959. The Sunray Mid-Continent Federal "C" No. 2 for the same period was 27,421. I don't have the production of the other two wells with me, Mr. Nutter. I might be able to give something, if you want it.

Q Yes, sir, please.

MR. LOAR: Mr. Nutter, if it will be helpful, I will be glad to give you this at a later time.

MR. NUTTER: I think I have some questions regarding this, Mr. Loar.

A Would numbers for each well as of October help any?

Q If you have comparative figures for the four wells, I think so.

A I am sorry, but this doesn't give it in the order that I thought I had it.

Q Well, let's just take what we have here, Mr. Brooks. We have the Federal "C" 1 producing cumulative production through January of '59 of almost 102,000 barrels, and the "C" No. 2 producing 27,000 barrels. There is quite a variance in the production rates there. Now, is this a function of the sand thickness and

the permeability and porosity of the sand in the vicinity of these two wells?

A I think that it is.

Q Well now, will you have a variation of similar nature in other areas of your proposed injection project now?

A No, we feel that the primary purpose of picking this LPG type operation for the fairway, as we've demonstrated here today, will eliminate that type of thing. We are in the better part of the fairway, as you recall, all of the LPG injection wells and more or less an even type of distribution. Now, there may be some variation, but not nearly so much as we've had in this Pilot which covers a pretty good range, as you can see by looking at your isopacheous map.

Q In other words, what you are attempting to do is confine your injection of the LPG slug to areas of similar reservoir characteristics and thickness?

A That's correct, where we feel that they will be successful.

Q What about the cumulative production of the wells in this fairway area? What has the production history of these wells been to date?

A The production history on these fairway wells, just taking from the cuff, has been good. All the wells have held up and have been able to, for the most part, sustain their normal production rate, or top allowable.

Q And approximately what have most of these wells produced to date?

A Could you read me off some there, and I'll try and look them up for you.

Q Sunray Mid-Continent Federal "C" 4 would be one.

A For this same period of January, 1959, the "C" 4 produced 3,230 barrels for that month.

Q What about —

A Had a cumulative production of 39,091 barrels.

Q How about the "C" 10, Mr. Brooks?

A Monthly production 3,266 barrels, with a cumulative of 35,405 barrerls.

Q What about the Sunray Federal "C" 13?

A The "C" 13 made 3,035 barrels, with a cumulative of 49,125 barrels.

Q How about Phillips Benally 1?

A The Benally 1 is shown to have produced 3,461 barrels with a cumulative of 40,184.

Q In other words, Mr. Brooks, selecting these four wells, which will be used as LPG injection wells, they've had a cumulative production in the range from 35,000 to almost 50,000 barrels?

A That's what it appears, yes, sir.

Q What percent depleted are these wells at the present time, in your estimation?

A Originally, these wells were producing by mechanism of oil compression, and at the end of that phase of operation, the reservoir was still 100 percent saturated. Since that time, they have probably produced in the order of 4 percent of the oil in place at bubble point conditions. And that's strictly a guess, sir.

Q What would the total recovery be were it not for an injection program being initiated in the area?

A We are estimating an overall recovery of 16 percent; --

Q Now, is that --

A -- includes both expansion and solution drive.

Q Does that also include fairway areas as well as side areas?

A That's the field average. I think in the fairway you would have something greater than that.

Q How much greater?

A Possibly as high as 3 percent greater.

Q You might have 19 percent recovery in this fairway area?

A Might have. That would be very hard to answer without going into a detailed study of it.

Q In this LPG Pilot area, you stated that you were presently producing in the range of 10,000 barrels per day, I think?

A Yes, sir.

Q What percent depleted do you think that that area is at the present time, assuming, now, first of all, you assume you could operate this to a limiting GOR of approximately 20,000 to 1?

A The gas-oil ratio will rise very rapidly. I would say that we are in the final stages of depletion in this Pilot project. We could possibly produce another 30,000 to 40,000 barrels from these four wells.

Q What is the main purpose, Mr. Brooks, of using your gas injection system only on the northeast and southwest flanks of this reservoir?

A This is the tight edge area which is not receptive to the LPG, and at the same time we feel that permeability is a control of the recovery factor, and these areas are of lower permeability, naturally, than those down the fairway. The purpose, I believe, as you want, would be to help us maintain the pressure and to eliminate any possible drop of pressure in these areas.

Q Does one of the influences that the LPG slug has on the oil, is one of those influences to reduce the viscosity of the oil?

A To a certain extent you would expect some reduction of viscosity. However, it is not really apparent; it isn't a big factor.

Q So LPG injection into the tighter areas wouldn't reduce the viscosity to a point where that oil could be produced through those tight formation areas?

A No, sir, we don't think that it would be beneficial in those particular edge areas.

Q Now, what injection interval do you propose for the wells which you will use gas and LPG both?

A What intervals?

Q Yes, sir.

A All of the intervals.

Q The entire perforated interval?

A The entire Gallup reservoir.

Q How about the wells that you will inject gas only?

A All of the Lower Gallup reservoir.

Q What about the wells that you propose to inject water only?

A Only the Lower Gallup reservoir.

Q Aren't you concerned that you might be injecting water into those lower intervals in there in those water injection wells and possibly drive some oil across your lease line? Were you present at the hearing of Case 1663?

A Yes, sir.

Q Did you hear the British American witness testify that they propose to inject water into the upper set of perforations only?

A Yes, sir.

Q You wouldn't have any counterbalancing water injection, then, opposite your lease if you inject into the lower for-

mation and they inject into the upper formation?

A We hope that we can work that out.

MR. ERREBO: Mr. Examiner, Burns Errebo, Modrall, Seymour, Sperling, Roehl & Harris, Albuquerque, New Mexico, appearing on behalf of British American Oil Producing Company. Since this morning, the testimony which you now refer was given, the British American has further considered that, and would be willing and certainly find acceptable an order which would provide for the injection of water in the British American Wells through all three members of the lower formation, and it is their plan now to not use in those wells, to seal off the lower formation. Now, they adopted this position mainly since they found out and fully realized what Sunray intends to do across the line, and if that change would help the overall plan of establishing a barrier, certainly we want to go along on it.

MR. NUTTER: Mr. Errebo, could you file with the Commission a statement of British American's intention so it can be placed in the case file of Case 1663?

MR. ERREBO: Yes, sir, we will submit one later.

QUESTIONS BY MR. PAYNE:

Q Mr. Brooks, is this -- does Sunray contemplate a water injection project in its Bisti Unit?

A The project which Sunray Mid-Continent proposes consists of three different types of operations.

Q Yes. I am just limiting it to the water right now.

A The water is only for the purpose of creating a barrier, and, of course, at the same time will yield additional recoveries. We feel that water will do a better job of sealing off that lease line on each side than any of the other medias that we could inject.

Q Well, do you contemplate drilling any additional water injection wells?

A At this time, I can't answer that on the east side. On the west side, we do not.

Q Well, I was wondering why your application asked for an administrative procedure for the conversion of additional producing wells to water injection wells?

A You'd better run that by again, please, sir.

Q Your application requests that an administrative procedure be established whereby producing wells can be converted to water injection wells. Now, if you don't contemplate drilling any more water injection wells, that would seem a rather useless provision in the order.

A We have the Bisti GI No. 1 which is the injection well in the Pilot area, which we contemplate in the future converting from a gas injection well or change of status to a water injection well.

Q I see. Do you believe that this barrier system will trap any significant amount of oil, Mr. Brooks?

A No, sir.

Q Then, it will be your testimony that a well drilled in the extreme NE/4 of the SE/4 of Section 1, Township 26 North, Range 13 West, would probably not prove to be a commercial well at the time that this water flood project is near the end of its life, right in there? In other words, in the middle of the four injection wells, two of Sunray's and two of British American's?

A I don't think that a well there would produce any appreciable, if any, amount of oil. After this project is carried to its completion.

Q Do you believe that when this project is carried to its completion, that any oil that is trapped in there could be recovered by stopping the water injection on one side or the other of that Township line and forcing out of a producing well?

A I don't believe that would be necessary, in the first place.

Q How are you going to get it -- how are you going to recover it?

A I don't believe that there will be any left. I think that we will sweep that area. We have essentially the same thing as a staggered line drive there, as you can see, which is one of the most effective sweep efficiency mechanisms that you can create.

Q Are you going to sweep it either directly north or directly south?

A The oil -- as I see it, the water will be going in

in a cylindrical fashion, and will continue to sweep these areas with the injection and the oil is going to move the offsetting wells.

Q And yet your barrier will still be effective?

A The barrier will still be effective.

MR. NUTTER: Which offsetting well is going to be producing the oil that is in the SE/4 of Section 1?

A I don't know what British American plans to do there.

Q (By Mr. Payne) Now, your water supply is going to be furnished by British American, is that right?

A Yes, sir.

Q And Mr. Brooks, do you have any objection to the inclusion of Rule 3 in Order No. R-1315, in an Order that would be entered in each of these cases? That's the Rule that provides for transfer giving notice to offset operators.

A I have no objection at all to that Rule, sir.

MR. PAYNE: Thank you.

RECROSS EXAMINATION

BY MR. NUTTER:

Q Mr. Brooks, you stated that the average producing rate for the LPG Pilor area is approximately 400 barrels a day at the present time?

A I believe it is probably slightly less than that, Mr. Nutter, but my slide rule gives 350 barrels for four wells.

Q Some of the wells are producing in excess of the

allowable for the Bisti Pool, however, are they not?

A Yes, sir.

Q Do you feel that this Pilot has advanced to the state where enough knowledge is known about the feasibility of using LPG as a producing mechanism in the Bisti Lower-Gallup Oil Pool, that these wells could be operated under the established normal unit allowable for the Bisti Lower-Gallup Pool?

A Well, I'll answer that question in this manner. We still feel that we have considerable knowledge to gain even with the injection of water, due to the fact that the gas which is in contact with the oil in the reservoir will be moving in the same fashion as it is today. However, if it is working a hardship, I believe that Sunray Mid-Continent would certainly go along with eliminating this monthly allowable recommendation that we have made in the past.

Q This was for the purpose of elevation of the Pilot, is that right?

A Yes, sir, that's correct.

Q When do you actually expect to convert the "GI" 1 to water injection?

A We anticipate doing that as soon as the unit agreement is signed, which should be sometime before July the 1st.

Q Do you expect to place your two proposed water injection wells, being the "C" 3 and the "C" 5, on injection at approximately the same time that British American places their

Marye 2 and 5 on injection?

A Yes, sir

Q Now,how many days do you expect that it will take to inject the LPG slug into the various LPG wells?

A The injection of the LPG slug requires a great deal of scheduling to get the volume needed into the ground at the proper time. The first days of the operation will last from June the 1st to July the 23rd, and then the next phase of the operation will extend from July 23rd to September the 23rd; the next phase from July the 23rd to September the 23rd. Now, these two are two separate phases due to the type of LPG that we are injecting, and the last phase will extend from September the 23rd to October the 18th, and we anticipate having all of our slugs in the ground some time near October the 18th.

Q Now, will the slug be the same size slug in all of the wells?

A No, sir.

Q What is the reason for the variation?

A The slug is based upon the hydrocarbon per volume in each of the five spots. That's one thing that we haven't brought out, that this is a five spot pattern, which you can see if you will look at the base map.

Q You testified earlier, Mr. Brooks, that this is an area of equal pay thickness and porosity?

A By equal, we didn't mean to infer that it was exactly

equal throughout. The volume of the slug size will range from 53,000 barrels for the poorest five spot to 128,000 barrels for the better five spot.

Q Would you give us the barrels expected into each of the six weels, please?

A These barrels which I will quote are the maximum volumes that we will inject. The Sunray Mid-Continent Federal "C" No. 4, 128,000 barrels. The Sunray Mid-Contient Federal "C" No. 10, 83,000 barrels. The Sunray Mid-Continent Federal "C" 13, 75,000 barrels. The Phillips Benally No. 1, 39,000 barrels. The Amerada Gle-na-nup-pah No. 1, 109,000 barrels. The Sunray Mid-Continent Federal "C" 14, 76,000 barrels. Now, the low number that I gave you will be for those wells which we plan to convert in the future.

Q Oh, I see. And this in each case will be calculated on the per volume in the vicinity of the injection well that you calculate must be filled?

A That's correct and will be essentially on the same basis that we use for the Pilot, Mr. Nutter, which you are familiar with.

Q Mr. Brooks, when you have this entire system that you are requesting immediate approval for --

A Yes, sir.

Q This -- I believe you've got five injection wells here proposed?

A Including the "C" 18.

Q Including the "C" 18?

A That's right.

Q Will this system be capable of handling all of the produced gas on these leases in the unit area?

A Yes, sir, I believe they will.

Q When do you expect the date will be when you will be able to use all of the produced gas?

A The gas gathering system is now on the board, and the people are out on the field getting ready to put it in, and in answer to that I would say just as soon as we can possibly get it done.

Q That's the gas gathering system for the entire unit area?

A I believe that's true, yes, sir.

MR. LOAR: We have Mr. Strubble, who is project engineer, who can tell you the details if you would like to.

A It is true that it will be for the whole area.

Q And what is the date that you expect the five injection wells to all be in operation as injection wells?

A I would put a date of June the 15th on that.

MR. NUTTER: Does anyone else have any questions of Mr. Brooks? Mr. Errebo?

MR. ERREBO: Mr. Examiner, on behalf of British American, for the record, I would like to state that they presently

plan to recomplete Well No. 8 in the SE/4 of Section 1 on their Marye lease as a producer in the Lower-Gallup.

MR. NUTTER: This will take care of that SE/4, then?

MR. ERREBO: Yes, sir.

MR. NUTTER: Thank you, Mr. Errebo. If there are no further questions of Mr. Brooks, he may be excused.

(Witness excused)

MR. NUTTER: Does anyone else have anything further they wish to offer in Case 1664 and Case 1665?

MR. ERREBO: British American would like to go on record in this case, for the record, as being in accord with Sunray's proposed system as an integral part of the system in which we will participate.

MR. PAYNE: Mr. Examiner, we received the following communication from Phillips Petroleum Company, submitted by their attorney, Mr. Charles Spann, which states that Phillips approves the application for and on behalf of their company, and urges that the Commission grant this application.

MR. NUTTER: Thank you. Any further statements in these consolidated cases?

MR. KELLAHIN: If the Commission please, Jason Kellahin of Kellahin & Fox, Santa Fe, New Mexico. Amerada is the owner of approximately 18 percent of the proposed unit, and is in favor of this application, and we feel that the evidence has shown it is in the interest of conservation and the greatest ulti-

mate recovery of oil in this particular reservoir.

MR. NUTTER: Thank you. If there are no further statements, we will take Cases 1664 and 1665 under advisement, and recess the hearing until four o'clock.

STATE OF NEW MEXICO)
) ss
COUNTY OF BERNALILLO)

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

WITNESS my Hand and Seal this, the 18th day of May, 1959, in the City of Albuquerque, County of Bernalillo, State of New Mexico.

Joseph A. Trujillo
NOTARY PUBLIC

My Commission Expires:

October 5, 1960

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 1664-1665, heard by me on 5-12, 1959.

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