BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
November 2, 1960
Examiner Hearing
Case No. 2111

IN THE MATTER OF:

Application of Gulf Oil Corporation for a waterflood project. Applicant, in the above-styled cause, seeks permission to institute a waterflood project in the Eumont and South Eunice Pools by the injection of water into the Queen formation through six wells located in Sections 27 and 34, Township 21 South, Range 36 East, Lea County, New Mexico

BEFORE:

Elvis A. Utz, Examiner

TRANSCRIPT OF HEARING

MR. UTZ: The hearing will come to order. The first case on the docket will be 2111.

MR. PAYNE: Application of Gulf Oil Corporation for a waterflood project.

MR. KASTLER: If the Examiner please, I am Bill Kastler from Roswell, representing Gulf Oil Corporation, and our two witnesses this morning will be Mr. F. W. Moran and Mr. G. J. Savage.

(Witnesses sworn.)

MR. UTZ: Any other appearances in this case? There are not. You may proceed.

FRANK W. MORAN, JR.

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

DIRECT EXAMINATION

BY MR. KASTLER:

Q Will you please state your occupation, or position, and what company you are employed with and--

MR. UTZ: Just a moment, Mr. Kastler. Is this to be one Exhibit?

MR. KASTLER: Actually, it could be considered as such; however, I have referred inside to Exhibits 1, 2, 3, 4, 5, 6, 7, and 8.

MR. UTZ: I was just wondering how we are going to mark it here. Are they marked inside?

THE WITNESS: Yes, sir.

MR. UTZ: Go ahead, I will mark them.

THE WITNESS: My name is Frank W. Moran, Jr.; I am employed by Gulf Oil Corporation in Roswell as a Petroleum Engineer

Q (By Mr. Kastler) Are you qualified as a Petroleum Engineer, and have you given testimony before the New Mexico Oil Conservation Commission?

A I have.

Q Are you familiar with Gulf's proposal in Case 2111 in connection with the leases, and so forth?

A Yes.

MR. KASTLER: Is the witness qualified to your satisfaction?

MR. UTZ: Yes, sir.

Q (By Mr. Kastler) Would you briefly outline what Gulf Oil Corporation seeks in its application in Case No. 2111?

A Gulf seeks a waterflood permit to inject water into certain designated wells in the Eumont and South Eunice Oil Pools, and, also, to recover secondary oil underlying a portion of this lease.

Q Initially, this is the pilot waterflood project, is that correct?

A Yes, sir, it is.

Q Have you prepared for introduction into evidence in this case an entire brochure containing numerous Exhibits referring to various and sundry matters?

A Yes, sir, we have.

Q I now call your attention to Exhibit No. 1 within the waterflood brochure and wish you would state what that is.

A This is an area plat outlining in red the proposed project area in which there are 28 wells, six of which will be used as water injection wells and two will be used as center producers in the project area. The injection wells are outlined in green on this plat and we have, also, shown an area outlined in yellow, which is the ultimate expanded waterflood area and is encompassed by all property operated by Gulf Oil Corporation in the Eumont and

South Eunice Oil Pools.

Q In the area outlined in yellow, then, I take it, Gulf Oil Corporation is the sole working-interest owner, is that correct?

A Yes, sir, they are.

Q And in the project area which you have designated by bounding it with red lines, that is the site where this pilot waterflood is to be conducted if allowed?

A Yes, sir.

Q Now, all of the wells shown within the pilot area, are they wells all having the same reservoir in common?

A Yes, sir, they are.

Q All of the wells within the yellow outlined area, are they wells having the same reservoir in common?

A Yes, sir, they are.

Q I wish to ask if your outline bounded in red, or the project area, which is what I will try to refer to hereinafter, is the project area entirely within one or two leases owned by Gulf?

A Yes, sir.

Q And in these leases, is there any diversity of royalty ownership?

A No, sir, not under the William A. Ramsay and Arnott Ramsay leases there are not; however, there is a diversity or, rather, a fee interest involved to the Felton lease, which is the southeast quarter of Section 28, Township 24 South, Range 36 East.

Q What is the condition of that well, S. E. Felton No. 1 as shown on Exhibit No. 1?

A At the present time, that well is producing from the Eumont Gas Pool but, originally, it produced from the Eumont Oil Pool, but has since been recompleted as a gas well in the Eumont Gas Pool.

Q Did it reach an economic limit in the oil pool?

A Yes, sir, it did.

Q Before being plugged back?

A Yes, sir.

Q And the location of that well is somewhere in the southeast-southeast of Section 28, Township 21 South, Range 36 East, is that correct?

A Yes, sir.

Q In regard to your pilot project area, if you were allowed producing allowables on account of this well, it might present an inequity, therefore, would Gulf be willing to have the boundary of the project area amended so as to strike a straight line between William A. Ramsay Well No. 2 and Arnott Ramsay Well D-2?

A Yes, sir.

MR. KASTLER: Mr. Examiner, does the Commission understand what I am trying to get at and propose as an amendment to our application for this purpose of allowables and production tests on the pilot waterflood?

MR. UTZ: Yes, sir, I believe so.

MR. PAYNE: You have one less well, right?

MR. KASTLER: We have one less well.

Q (By Mr. Kastler) Mr. Moran, does Gulf have any present plan to recomplete this well in the Eumont Oil Pool?

A No, sir, not at the present time.

Q If the pilot area should prove successful, would Gulf then propose a communitization agreement to bring in an agreement with this one royalty owner so that this could be included?

A Yes, sir.

Q What are the reservoir and fluid characteristics of the entire pool, with particular reference to the reservoir name, composition of producing formation, geological structure, type of drive during depletion and the original reservoir pressure?

A The reservoir involved, of course, is the Eumont Oil and South Eunice Oil Pools, and we plan to inject water in the formation of these Pools. The composition is a gray, fine-grained, shaly sandstone interbedded with tan and gray fine to medium crystalline dolomite and anhydrite. The structure here is generally west-dipping sand beds with minor local anticlines. The type of drive during primary depletion has been solution gas-drive and it has been estimated that the original reservoir pressure was 1450 lbs. per square inch gauge.

Q In regard to the proposed project area, please give the number of productive acres in the initial area to be flooded and

the reservoir characteristics of this area.

A Excluding Well No. 1, the S. E. Felton No. 1, there would be 640 acres in the initial pilot project area. The average depth to the top of pay of these wells is approximately thirty-seven hundred feet, and the estimated average gross thickness has been determined to be one hundred fifty feet.

The estimated average thickness is thirteen feet--net pay, that is--and average porosity of the pilot project area has been determined to be 14.1%. The average porosity is 5 Mds. and it ranges from five to fifty-eight.

The water content has been determined to be 35% and the gravity of the oil is 35.6° API.

Q In regard to the primary production history in the project area, do you have any Exhibit and tabulated data, and what do they show?

A Yes, sir. That would be Exhibit No. 2, which is in the brochure, and this tabulation shows the monthly oil and water production for the pilot project since the initial discovery in 1937 up through September, 1960. In that regard, the first well completed in this project was October 30, 1937, and we have determined that this project area is in the late stage of depletion. Excluding that S. E. Felton No. 1, there are 27 wells in this project area, six of which we plan to convert for water injection purposes. The average daily oil production per well is 13.5 barrels. This pilot project area has produced approximately

1,248,081 barrels since the first well was completed in October, 1937.

Q Now, for the purpose of the cumulative production in here, the S. E. Felton 1 was included, is that not correct?

A Yes, sir. Now, that well has produced approximately one hundred seventy-five thousand barrels of oil so, excluding--or subtracting that figure from the one I just gave you as to the cumulative oil production, it would be the amount of oil produced by the area, which amounts to slightly over one million barrels.

Q In other words, you feel that well, during its productive life in the Eumont Oil Field, was draining this area, this project area, and contributing to its present state of depletion?

A That is correct.

Q Will you please give the date the first well was completed in the project area, the stage of depletion, the number of producing wells, the current daily average oil production per well, and the amount of oil that area has produced?

A I believe I have already given that; however, that information is tabulated under Item No. 2 in the brochure.

Q With regard to the injection data for this project area, please give the source of injected water, the type of water to be used, the treatment of injected water, pattern and spacing to be used, injection pressure to be used, amount of water to be injected initially into each well, and whether any additional wells will be drilled.

A We plan to obtain the water to be injected into this project area from Gulf wells produced from the Arrowhead, Eumont, Eunice and South Eunice Oil Pools. This water is being handled by commingled automatic battery which is located approximately in the center of the project area and from a battery located on our H. T. Mattern "E" lease in the southwest quarter of Section 1, Township 22 South, Range 36 East, which is about one mile southeast of the project area.

Approximately 4340 barrels of water per day will be available from these two batteries, which we feel likely is more than enough for this project area. This water is brackish and we have analyzed the representative sample of this water and have found it compatible and, therefore, no treatment will be necessary.

We plan to use two 80-acre 5 spot patterns and, although we don't know at the present time what the initial injection pressure will be, we anticipate it will be in the neighborhood of three hundred pounds, and we have no plan to exceed an injection pressure of one thousand pounds.

We plan to inject approximately five hundred barrels of water per day into each of the injection wells. And we do not plan to drill any additional injection or producing wells in this area.

Q What result do you expect from this project?

A We expect that this pilot project will provide us with sufficient data to evaluate the floodability of the Queen formation

underlying our William A. Ramsay lease in the Eumont and South Eunice Oil Pools.

Q What are your recommendations and reasons for this project, and do you have Exhibits in this connection?

A Yes, sir. I would like to present Exhibit No. 3 in the brochure, which shows the primary production history of the pilot area, since initial completion in 1937 up until the present time. This curve shows the monthly oil and water production of the wells in the project area. It also shows, for a certain period there, the producing gas-oil ratio of these wells, and, also, indicates the top-level rate of these wells in the pilot project area. It is very obvious, I believe, that this curve indicates that the pilot project wells are definitely on decline, and have been on a production decline for some three years.

In addition, it shows the magnitude of difference between the current top level rate, if these wells were able to make them, and existing rate.

Q Mr. Moran, is this Exhibit No. 3 actually a graphic description of the same information that is contained in Table 1, which is Exhibit No. 2?

A Yes, sir, it is. With this Exhibit in mind, I would like to point out this: That our information, and I am sure the information that anyone else is able to obtain on these oil pools, indicate that these two pools are producing by solution gas-drive mechanism and, as a result, there will be a considerable quantity

of oil remaining at the end of the primary depletion unless some type of fluid injection project is initiated. I would like to refer you to Exhibit No. 1, which, as I pointed out previously, shows a yellow area which is the ultimate expanded area. Now, with reference to that area, that portion covers a major part of Gulf's properties in these two pools and we ultimately hope to have this area under expansion, and in that regard, we would like to point out Exhibit No. 4, which is a production decline curve of the ultimate project area. Now, this curve shows the monthly oil and water production for the ultimate expanded area in addition to the number of wells that have been completed over the years; and, also, definitely shows that this expanded area, which consists of over three thousand acres, is on a definite production decline and has been for the last two and a half years.

Now, in that regard, that ultimate area at the present time is producing on a per well basis 14 barrels of oil per day, and at that existing rate of decline, these properties will have but a few years remaining under primary operating conditions before they are depleted and abandoned. Therefore, we feel in order to prolong their producing life, these wells should be stimulated by some secondary recovery method in order to increase the ultimate oil recovery.

The available data indicates that the Queen formation underlying this lease would be susceptible to water injection and would subsequently increase oil recovery.

Again with reference to Exhibit 1, the area plat, as indicated previously, the proposed project area includes 27 wells, 21 of which are producing from the Queen formation of the Eumont Oil Pool and three wells are producing from the Queen formation of the South Eunice Oil Pool. Of the remaining four wells, one is, as we pointed out previously, on our S. E. Felton lease, and that is Well No. 1, and it formerly has produced in the Eumont Oil Pool. And we have three wells temporarily in the Eumont Oil Pool.

Since this brochure was typed and put together, we have found out there is one additional well in the area which has been abandoned, which is economically unable to produce, and that is W. A. Ramsay "A" No. 47 in Section 27 and is the northwest well of the southwest quarter of Section 27. As shown on the project production curve, all of these wells are on a definite production decline, and in September of 1960, the average production from these wells was 13½ barrels per day. We feel like, based on this data we have on hand, that at the existing rate of decline, which, incidentally, is very high--ranges from thirty to forty percent per year--these wells have approximately four years future life remaining under primary conditions. This well is approximately eighty percent depleted and we feel we ought to orient this method of fluid injection, project should be initiated now before it reaches any further state of depletion. We feel like approximately one year would elapse before we gain any appreciable knowledge as

to the response that these wells would obtain from this type of injection and, further, an additional period of time will be necessary before we can decide or determine if this project area should be expanded on a much larger basis than outlined here.

Q Have you made any extrapolations, taking from the present eighty percent depleted rate of this reservoir going forward into two years which, conceivably, might be the time before you receive any results on the ultimate project area?

A Yes, sir. By extrapolating this production performance curve of this pilot area, it can be readily determined that in approximately a year and a half to two years' time the average daily oil production will be down to something like eight barrels per day, and that is approaching the economic limit of the wells in this field.

Q You arrived at that calculation, or that estimate, by extending these present decline curves and considering no further wells are going to be abandoned, but just extending it as though all were going to continue to produce?

A Yes, sir, I have.

Q Do you have an Exhibit showing the casing program of the injection wells?

A Yes, sir, I do. That would be Exhibit No. 6.

Q Have you covered Exhibit No. 5 yet?

A No, sir, I don't believe I have. I believe that is the production curve of the entire Eumont Oil Pool. I would like to

comment on that briefly, if I may.

Q All right, please do, referring to Exhibit No. 5.

A That curve shows the monthly oil and water production of all wells in the Eumont Oil Pool and this curve definitely shows that the Eumont Oil Pool itself is on a production decline, has been for the last three or three and a half years. This curve also shows the producing gas-oil ratio, which has indicated on the curve, the ratios have gone up over the years, as you would expect for a reservoir of this kind--at the present time it is approximately, although not shown on this curve, the average producing ratio is fourteen thousand cubic feet per barrel, approximately. This curve also shows the number of wells that have been completed over the years and, also, shows the most recent bottom-hole pressure of the reservoir with previous years also indicated.

This curve, although not shown on the curve--I think the last production month was in June, I have since plotted two additional points on this curve, but it does not appreciably change the existing line. The average production of oil is 9.2 barrels of oil per day per well.

Q Now, do you have any Exhibits showing the casing program of the injection wells, and what are your conclusions in this regard, calling your attention to Exhibit No. 6?

A This Exhibit shows how the parent, or the existing injection wells, or proposed injection wells, are cased, and my conclusions from this Exhibit are that all the wells are cased and

cemented and completed such that the proposed injected water can enter no other zone than that the wells are producing from.

Q In your opinion, are each of the injection wells then so cased and completed that the injected water can enter only the zone that you plan to flood?

A Yes, sir, they are.

Q Mr. Moran, has Gulf had previous experience in water-flood in reservoirs of this nature?

A Yes, sir, we have. We have a project--in fact, several projects--going over across the State line in Texas in which we are flooding the Queen formation and that formation over there is very similar to what we propose to flood here, and we have had very good results from that project and we feel, on that basis, that we certainly have an excellent chance of increasing the ultimate oil production from the Eumont and South Eunice Oil Pools.

Q The flooding there, I take it, was conducted under a 5 spot program similar to this?

A Yes, sir, it was.

Q And you say the results are successful to date?

A Yes, sir, they are.

Q How long has it been continued and carried forward, what stage is it in?

A Well, the particular project I have in mind is our Oakclap lease in Kermit Field. We have had that under project since '53 or '54 and the project has peaked and now is more or less

in a settled state or, rather, it is on a slight decline, indicating, of course, that we have reached the peak production rate from those wells and there is no question in our mind that we have had a very successful waterflood there and we feel like, at least we hope to have similar response in the project under consideration here.

Q Were Exhibits 1 through 6 prepared by you or at your direction and under your supervision?

A Yes, sir, they were.

MR. KASTLER: This concludes my questions of this witness on direct testimony and I would like at this time to move that Exhibits 1, 2, 3, 4, 5, and 6 be entered into evidence.

MR. UTZ: Without objection, Exhibits 1 through 6 will be entered into the record.

CROSS-EXAMINATION

BY MR. PAYNE:

Q Mr. Moran, could you give me that latest production figures on the pilot wells in the project area?

A Yes, sir, I could. Starting with our--our W. A. Ramsay No. 2--I beg your pardon, No. 14, if you please--the figures I am giving you now are for the month of September. That well made six barrels of oil and three barrels of water. Would you like the gas-oil ratio?

Q No, just the production.

A Oil Well 17 made six on it, twenty-eight water; No. 19

made twenty-one oil, four water; No. 20 made twenty oil, ten water; No. 21 made thirteen oil and five water; No. 22 made twelve oil, no water; No. 23 made nineteen oil and six water; No. 24 made thirteen water and thirteen oil; No. 25 made thirteen oil and four water; No. 26 made thirteen oil, twenty-two water; No. 27 made six oil and one water; No. 28 made eight oil, four water; No. 29 made fifteen oil, eight water; No. 30 made ten oil, seven water; No. 31 made eleven oil and eleven water; and No. 32 made twelve oil and twelve water; No. 33 is closed in, it has been uneconomical to produce; No. 35 made eleven oil and three water; and No. 45 made twenty-nine oil and nine water; and No. 47, which was in September, made five oil and forty-three water--as I pointed out previously, that well has since been abandoned due to it being uneconomical to produce; No. 48 made eleven oil and five water.

And in the South Eunice Oil Pool, No. 34 made nine oil and forty-five water; and No. 36 made eighteen oil and thirty-four water; and No. 38 made nine oil and twenty-three water. The William A. Ramsay No. 2, that producing oil formation, that has been squeezed off and that well is not producing.

Ramsay No. 2, that well has closed in and is not producing from any zone.

And Arnott Ramsay D No. 14 has produced three barrels of oil and no water.

Q Are these production figures somewhat lower than are those in the area as depicted in yellow?

A No, sir--well, yes, sir, on a well average basis they are, that is correct.

Q That is why you proposed to start your pilot in this area?

A Well, yes, sir. Of course, another reason--in fact, two reasons for starting in this area is that all the injection and center producing wells are on the same lease and nowhere do we encroach on lease lines or anyone else's lease lines, and we feel like this is the best place to start and, although there are four areas in this area outlined in yellow, this is probably a little better than some of the area, but not as good as all of it, but it should give us a real good indication of what to expect in this particular pool.

Q Now, once you start expanding your pilot flood to take in some of the area shown in yellow, do you propose to execute line agreements with offset operators?

A Yes, sir, we do. We certainly plan to work with them every way we can in order to get them to cooperate with us, and I am sure they will. We don't anticipate any problem in that regard.

Q Now, as I understand your casing program, you don't plan to inject a tube?

A Yes, it is planned to set above the perforation and into pack tubing.

Q Will this be non-corrosive tubing?

A Yes.

Q Now, are there producing zones above the claim in this area?

A Yes, sir. It is the Yates and 7-Rivers productive gas, and it would be in the Eumont Gas Pool. The zone that we plan to inject into is strictly the Eumont and Eunice Gas Pool, which is the Queen and Penrose only.

Q Is this area within the confines of the Lea County underground water basin?

A Yes, sir.

Q Do you feel your casing program is adequate, however, to protect such fresh water?

A Yes, sir, we do.

Q Do you anticipate your project here could have any harmful effect on the gas wells in the Eumont Gas Pool?

A No, sir, we don't.

MR. PAYNE: Thank you.

Q (By Mr. Utz) I believe you said that all the wells in this pilot were in the same reservoir; however, they are in two pools, are they not?

A Yes.

Q You feel that both pools are in the same reservoir?

A No, sir, I don't. This gas zone, of course, is in the Yates and 7-Rivers and my examination of that with respect to the wells producing all from the Eumont indicates to me that there is

definitely no effect at all, or no communication between the two zones. In other words, the Eumont is producing based on the internal solution gas-drive, the oil pool portion--whereas the gas, of course, is producing as the result of its own gas.

Q Do you have an estimate of your primary production for this pilot area?

A Yes, sir, I do.

Q I believe you said that it was now eighty percent. What would a hundred percent be?

A My calculations indicate that we could, under primary operations, recover approximately one-half million barrels of oil from this pilot project area.

Q And how much more do you think you can recover by secondary recovery?

A Well, based on our experience in floods similar to this, in the same formation in other areas, we feel like that we could count on about--approximately seventy-five percent of primary. We, of course, hope to do better than that, but we feel like that is a realistic figure.

Q I don't believe I understood where you were going to get your water.

A We plan to get the water from an automatic commingled battery which is located approximately in the center of this project area and, also, from a battery on our H. T. Mattern "E" lease, approximately one mile southwest--excuse me, southeast of

this area, and that water is coming from, or would come from our wells producing--which are producing into these batteries from the Arrowhead, Eumont and South Eunice Pools and we would have available from those two batteries four thousand three hundred forty barrels per day which, of course, will be more than enough required at the planned injection rate.

Q What is the location of your battery on the Mattern?

A I would say just south of Well No. 1 in Section--H. T. Mattern "E" lease in Section 1. That is where that battery is located.

MR. UTZ: Are there any other questions?

MR. KASTLER: I would like to ask two more questions.

RE-DIRECT EXAMINATION

BY MR. KASTLER:

Q Mr. Moran, you have testified that Arnott Ramsay is now producing 33 barrels. Is that a recently completed well?

A Yes, sir, that well was completed in--well, it was completed in the early part of this year.

Q In January, or so, of 1960?

A Yes, sir, that is correct.

Q Is this the same lease area in which Gulf recently proposed and obtained Commission approval for a complicated commingling with satellites, batteries, and so forth?

A Yes, sir.

Q And that is substantially your source of water--waste

water?

A Yes, from that battery, in addition to that one located on H. T. Mattern "E" lease.

MR. KASTLER: I don't have any other questions.

RE-CROSS-EXAMINATION

BY MR. PAYNE:

Q Mr. Moran, is there any possibility that the producing gas-oil ratios of these wells might increase so that one would subsequently be classified as a gas well, one or more?

A Yes, sir, it is possible. In fact, we have a well now--I believe it is No. 47 which I indicated earlier--we have abandoned. The gas ratio was 68,000 and I am not sure whether the limit has gone beyond that, but it is possible that some wells could be classified as gas wells.

Q Then you would be water flooding a gas well rather than an oil well?

A Well, true--I mean, it is strictly--you see, of course, we hadn't pointed this out earlier, but this is kind of a complicated reservoir. We have got--of course, our geological witness will bring this out--but there are six zones producing throughout this hundred fifty-foot gross interval and in this--in these six zones we have water problems and gas problems. In other words, you can't say there is a gas-oil contact or a water-oil contact, although it is generally considered that you could probably put a figure on the gas-oil contact. Essentially, each

of these little zones produce on their own, have their own gas and own water. Certainly some of these wells could go to gas, but it would be more of a secondary gas problem more than a Eumont Pool problem. It is possible some of them could go to gas, and it would appear we are flooding a gas zone, but really that is not the case. We would be flooding a zone that is somewhat deeper than the wells that are producing from the Eumont Gas Pool.

Q Now, supposing--you have assumed in your computation of allowables, project allowables--that you would get credit for the high gas-oil ratio wells by your water injection so that your oil well allowables wouldn't be penalized, is that right?--in other words, you have assumed 42 barrels for each producing well?

A Yes, sir, we did. Of course, we don't anticipate that we will need that allowable for some time on down the road; in fact, we may not ever need it, but certainly when we do get response, and we certainly hope to get and expect to get response, well, the initial kick may not be significant and, of course, it will extend on, but we will have six wells that will be closed in, which are injection wells and under the Commission order will have the unit allowables, as we understand it, and we could produce the wells--some may be making more, some making less than the actual pool allowable.

Q But what you asked for is credit for net injected which you could apply against your oil producing wells?

A Yes, sir.

MR. PAYNE: Thank you. We haven't had this problem before.

MR. UTZ: Any other questions?

MR. KASTLER: One more.

Q (By Mr. Kastler) What is the pipeline carrier for the oil that is to be produced out of this project area?

A Shell Oil Company.

Q Has Shell been given notice of our application here?

A Yes, sir, they have.

MR. KASTLER: That is all.

MR. UTZ: Any other questions? The witness may be excused.

MR. KASTLER: Mr. Savage, will you take the stand?

GERALD J. SAVAGE

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

DIRECT EXAMINATION

BY MR. KASTLER:

Q State your name, position, employer and place of residence, please.

A I am Gerald Savage, employed by the Gulf Oil Corporation as Geologist in Roswell, New Mexico.

Q Are you familiar with Gulf Ramsay's block leases and this proposed waterflood area?

A Yes.

Q Have you previously appeared before the New Mexico Oil Conservation Commission and appeared as an expert witness?

A Yes, sir, I have.

Q Do you have a structure plat of the subject area?

A Yes, sir. I have the structure plat which has been labeled Exhibit No. 7 in the brochure in this case, and this structure plat is contoured on top of the Queen Formation with contour intervals of fifty feet. The proposed injection wells are circled and colored green, and the project area has been outlined in red.

This structure plat also shows a line A-A' of a cross-section to be shown as a later Exhibit.

This structure is the general west-dipping flange of an exceedingly large anticline, it would be in the central basin trap. The west beds of the Queen are interrupted by minor anticlines and folds which aid in providing the trap.

Q What is the composition of the Queen in the subject area in which you have just testified?

A The Queen is made up of gray, fine-grained, shaly sandstone interbedded with tan and gray fine to medium crystalline dolomite and anhydrite.

Q Do you have copies of the A-A' cross-section mentioned earlier which is shown on Exhibit No. 7 and further defined in Exhibit No. 8?

A Yes, sir. This cross-section, A-A', traverses the area

between Gulf's No. 5 Arnott Ramsay (NCT-D) in Section 33 of 21 South, 36 East to Gulf's W. A. Ramsay (NCT-A) No. 16 in Section 35 of 21 South, 36 East, going from west to east.

Q What does this cross-section show?

A This cross-section attempts to show the west-dipping nature of the beds in the Queen formation. The heavy line connects the tops of the Queen and the tops of the Penrose member of the Queen between wells.

The logs chosen for this cross-section show the inter-bedded nature of the individual sandstones, dolomites, and anhydrites that make up the Queen; shown are the perforations through which the wells are producing and, also, shown are the sub-sea datums of the minus one hundred fifty and minus three hundred feet.

Q Have you been able to establish any gas-oil or oil-water contacts for this area?

A No, sir, not as the terms are generally used to indicate a gas cap, or a water table. The minus one hundred fifty-foot sub-sea datum has been considered to be an approximate gas-oil contact for the area, and the minus three hundred-foot datum has been considered to be the water-oil contact. However, there have been high GOR problems to be considered on an individual well below a minus one hundred fifty feet.

Q Has water been encountered in all of your wells?

A Well, sir, not always on the initial. We generally find

our problems to begin near the depth of three hundred feet, but there are exceptions to that rule. Our W. A. Ramsay (NCT-A) Well No. 47 in Section 27, 1980 feet from the south line and 660 feet from the west line--

Q Incidentally, that well is not shown on the cross-section?

A No. However, it is on the edge of the project area and by the way, it is the well that our engineering witness testified has been shut in since September as being uneconomical to produce. That well will indicate both the high GOR problems and the water problems that we have encountered in this field. It was open through only two feet of perforations at a sub-sea depth of minus one hundred ninety four to minus one hundred ninety-six feet, that being fifty-four feet below what has been considered to be the gas-oil contact, and some one hundred feet above the minus three hundred-foot datum.

On potential, in February of this year, the well flowed 49 barrels of oil and 190 barrels of water, with a gas-oil ratio of 15,370. It was a penalized oil well up to September of this year, and this well, also, had perforations below that two hundred-foot producing interval which had--which were squeeze-cemented prior to placing the well on production, and I feel this is ample evidence that the water production is from the zone now open rather than from below. This well also indicates the depleted nature of the reservoir.

Q Do you find other similar anomalies in the entire reservoir making this, in other words, is this capable of saying it is a homogeneous reservoir, or not?

A Well, the producing sands, or the make-up of the reservoir, being a number of producing sands separated by dense dolomites and anhydrites makes it a heterogeneous reservoir and with very little vertical permeability.

Q Is there any other statement you want to make in connection with this reservoir?

A Well, I believe that this reason in itself, that this heterogeneous nature of the reservoir shows the complicated nature of the reservoir and that, in itself, is a reason for the initiation of a pilot waterflood to evaluate the floodability of the reservoir.

Q You mean, that is why you initiate a pilot project rather than an all-out, full-scale flooding of the area?

A Yes, sir, that is correct.

Q Were Exhibits No. 7 and 8 produced by you or at and under your direction?

A Yes, sir, they were.

MR. KASTLER: I would like to move the Exhibits be admitted into evidence at this time.

MR. UTZ: Without objection, they will be admitted into evidence.

MR. KASTLER: I have no further questions on direct.

MR. UTZ: Any questions of the witness?

MR. PAYNE: Yes, sir.

CROSS-EXAMINATION

BY MR. PAYNE:

Q Mr. Savage, I have a question which more properly should have been directed to Mr. Moran, but perhaps you can answer it. Are the low production figures of the proposed producing wells in the pilot area due to the inability of the wells to make their allowables, or is it due, in any case, to the fact that the well was penalized because of a producing high gas-oil ratio?

A I would be of the opinion that it would be--could be a combination of both, that some of them would be unable to make their allowables and some of them are penalized due to a high gas-oil ratio.

Q Now, would you call an oil well which was penalized due to a high gas-oil ratio a stripper oil well?

A I believe I would have to call it a stripper oil well because the high GOR is a result of the depleted nature of the reservoir.

MR. PAYNE: Thank you.

MR. UTZ: Any other questions?

MR. PORTER: I wonder if you would be able to answer this: What are the nature of the gas-oil ratios, the range of gas-oil ratios in this particular area?

THE WITNESS: I am not prepared with that information.

May I refer that question to our engineering witness?

MR. PORTER: Surely.

MR. MORAN: The gas-oil ratio range in this project area is from two thousand four hundred forty-four cubic feet per barrel up to sixty-eight thousand two hundred fifty cubic feet per barrel. The existing average, I believe, is on the production decline curve; however, we will try to find that for you. It is approximately eighty-six hundred cubic feet per barrel.

MR. KESTLER: You are referring to Exhibit No. 3?

MR. MORAN: Yes, sir. Now, that averages somewhat below the Eumont Pool average which is around fourteen thousand cubic feet per barrel.

MR. PORTER: Do you have some high ratios in the South Eunice, too, don't you?

THE WITNESS: Yes. I would like to make one other statement, if I may. In this project area we have eight wells that are considered high ratio wells. That means they are beyond the ten thousand cubic feet per barrel pool limit.

MR. PORTER: That is all the questions I have.

MR. UTZ: Any other questions? The witness may be excused.

Are there statements to be made in this case? If not, the case will be taken under advisement.

STATE OF NEW MEXICO)
) ss
COUNTY OF BERNALILLO)

I, LAWRENCE HOLMES, JR., Certified Shorthand 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 this 22nd day of November, 1960.

Lawrence Holmes Jr.
CERTIFIED SHORTHAND REPORTER

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 2111, heard by me on Nov. 2, 1960.

Thomas A. Dick, Examiner
New Mexico Oil Conservation Commission

I N D E X

E X H I B I T S