BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
July 27, 1960.

IN THE MATTER OF:

APPLICATION OF UNION OIL COMPANY of CALIFORNIA for an order authorizing it to institute a waterflood project in the Caprock-Queen Pool on its proposed South Caprock Queen Unit by the injection of water into the Queen formation through ten wells located in Township 15 South, Range 31 East, Chaves County, New Mexico, and for authority to drill a water injection well at an unorthodox location, being 330 feet West of the East line and 1320 feet South of the North line of Section 18, Township 15 South, Range 31 East.

CASE NO. 2032

BEFORE:

Hon. Daniel S. Nutter, Examiner.

TRANSCRIPT OF PROCEEDINGS

MR. NUTTER: Hearing will come to order. Next case will be Case 2032.

MR. PAYNE: Case 2032. Application of Union Oil Company of California for an order authorizing it to institute a waterflood project in the Caprock-Queen Pool.

MR. CAMPBELL: Jack M. Campbell, of Campbell and Russell, Roswell, New Mexico, appearing on behalf of the Applicant, Union Oil Company of California. I have two witnesses to be sworn.

(Witnesses sworn.)

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E D W A R D M A T C H E S, a witness, called by the Applicant, having been first duly sworn, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. CAMPBELL:

Q Will you state your name, please?

A Edward Matches.

Q By whom are you employed, and where do you reside?

A Union Oil Company; Midland, Texas.

Q What is your position with that company?

A I am a geologist.

Q Would you give the Examiner a brief resume of your education and experience as a geologist?

A I was educated at Princeton University, Princeton, New Jersey; I graduated with a bachelors' degree of Geology in 1948. For the past 11 years, I have been employed as a geologist by the Union Oil Company of California; the past three years I have been working in the reserve engineers as a geologist. I have done quite a bit of work for Union in the Permian Basin area during the past nine years.

Q Have you made any particular studies insofar as the Caprock-Queen area of New Mexico is concerned?

A Yes, sir, from the initial extension of the field in November of 1954, I followed the development of the field to date.

Q What type of studies have you had occasion to make in that area?

A I have basically been concerned with the geology. I have watched a number of wells cored; I have personally examined and described in detail 51 of the producing wells that were cored and analyzed.

Q You are talking now about the general area that is included in the proposed South Caprock-Queen area, are you not?

A Yes, sir.

Q When did that area development first start?

A The development was first initiated with the completion of the O'Neill Number 1 Midland "A", which is located in the SW of the NW in Section 8, Township 13 South, Range 31 East.

Q Has there been a considerable amount of information available as a result of the drilling and testing and production from the wells in this southern area of the Pool?

A Yes, sir. We have a total of 167 producing wells that fall within our proposed unit outline. There have been 114 wells that have been cored, and those cores have been analyzed. Of these, 95 were producing wells. Of these wells, I have personally seen 51 cores.

Q Do you feel that with that kind of information from this field, that you are able to make a pretty thorough geological analysis of the area?

A The amount of information available in the south portion of the Caprock-Queen Field is extra good. The number which we have cored far exceeds the number that were not cored. The area

that joins to the north, our information is very good. The amount of information available, allows me to make a detailed study of the variable changes in the mythology throughout, and a portion of the northern Caprock Field.

(Whereupon, Applicant's Exhibit 1 marked for identification.)

Q Mr. Matches, I refer you now to what has been identified as Applicant's Exhibit Number 1 in this case, and which is on the board there. I wonder if you would step over to the board and point out to the Examiner what that exhibit is, and what the symbols reflect, please?

A Exhibit Number 1 demonstrates the outline of the Unit in red. The colored acreage here is designated by green. State acreage: orange Federal acreage; blue fee acreage. The Unit outline of the Drickey Queen Unit adjoins our Unit; that is also shown here in green outline. Also shown on this map are the locations of the water wells from which we will obtain water for the flooding of this field.

Q How are those shown?

Q They are shown in blue, with the water well number outlined in blue, and the permit number underneath the water well number.

Q What about the proposed projection wells, are they shown on this particular map?

A Our proposed injection wells are shown in red along the

west side of our Unit. There are ten proposed injection wells.

Q Let's talk for a moment about the water wells, and the water by which you intend to use for the development of this secondary recovery project, Mr. Matches. Will you advise the Examiner -- I believe you said you had permits from the State Engineer, and permit numbers are indicated at the point where the wells are situated, would you state what is the amount of your water permits from the State Engineer?

A Yes, sir. We have been allocated a total of 1126 acre feet water permits; in Township 14 South, Range 31 East, we have 136 acre feet; in Township 15 South, Range 31 East, we have 990 acre feet.

Q How do you -- From what formation is that water obtained?

A This water is obtained from the Ogallala formation, which overlies the red beds; the water is commonly encountered at depths ranging from 275 feet to 325 feet.

Q To your knowledge, is this the same source of water that is being encountered in other areas of the Caprock-Queen Pool which are now under flood projection?

A Yes, sir, it is.

Q Is there any other source of water available, economically feasible to obtain, which you could use in lieu of water from fresh water from these wells?

A No, sir, there is not.

Q How do you intend to get your water from the water well

locations to the area of your project?

A We have water wells located in Sections 26 and 22 of 15 South, 31 East. This water will be taken to the vicinity of Section 17 by pipeline. Our proposed plant will be in Section 17 of Township 15 South, Range 31 East.

Q Mr. Matches, do you consider that the amount of water you have available under your existing water permits, will be sufficient to cover all of your needs for water in connection with the entire unit project?

A Yes, sir.

Q Now, Mr. Matches, on the Exhibit 1 there, it is apparent that your northern boundary of the proposed South Caprock-Queen Unit joins the southern boundary of the Cities Service Unit, the north only at its northeast corner and the southeast corner of the Cities Service Unit; in between on your, immediately to the north of your northern boundary it appears there are some wells apparently not producing from the same general formation, is that correct?

A Yes, sir.

Q Have you made -- Did you prior to the time the northern boundary of this proposed unit was established, make a geological study to attempt to set a reasonable boundary line on the north of this unit?

A Yes, sir, the north line of our unit was not on an arbitrarily drawn line, it is based on geologic factors which separate the two areas.

(Whereupon, Applicant's Exhibit 2 marked for identification.)

Q I hand you what has been identified as Applicant's Exhibit Number 2 in this case, and ask you to state first what that is?

A Exhibit 2 is a structure map of the Caprock-Queen Field dropped to the top of the Queen sand. This exhibit shows the position of the gas cap in the north portion of the Caprock-Queen Field developed at datum of plus 1405. A difference in the gas cap is demonstrated here. The gas cap in the south portion, or the proposed South Caprock-Queen Unit, is developed at plus 1355. There is also a syncline which is developed in the NE/4 of Section 28, and the NW/4 of Section 27, Township 14 South, Range 31 East, which is well controlled. This syncline separates the two areas, and in addition to this, a third point which separates the two areas is the production obtained from red sands to the north of this syncline.

There is an area in Sections 21, 20, 17, 16, and 9, of Township 14 South, Range 31 East, that has been productive from red sand. This similar development is confined to this basic area that I have mentioned, and also a small area to the extreme south of the South Caprock-Queen Unit in the southeast portion of Section 30. The remainder of the production from the Caprock-Queen Field is obtained from the gray sand.

Q Mr. Matches, based on the differences in the gas cap, and based upon the syncline there, and the production from the red

sand that you spoke of, is it your opinion that insofar as the northwest portion of that area on Exhibit 2 is concerned, lying just north of your unit, that is separated from it geologically, from the unit area?

A Yes, sir, it is. The similarity of this area to the area to the northeast is very small, or rather, is great, it is similar to the area to the northeast. It is dissimilar from the south portion of our unit.

Q On that, can you say whether you believe that geologically speaking, there is a sound basis for the northern boundary of the proposed unit?

A Yes, sir, this is drawn from geological evidence.

Q Now, Mr. Matches, have you made some studies in the Caprock-Queen area with regard to the stage of completion?

A Yes, sir, I have.

(Whereupon, Applicant's Exhibits 3 and 4 marked for identification.)

Q Mr. Matches, I refer you to what has been identified as Applicant's Exhibits 3 and 4, and ask you to state to the Examiner what those exhibits reflect.

A Exhibits 3 and 4 represent oil production for the month of November, 1959, and April of 1960. This map is contoured on barrels of oil per month, taken from the New Mexico Engineering Committee's reports. The color scheme shows a breakdown in units of 10, of barrels of oil produced per day. The red represents

0 to 10 barrels of oil per day; yellow, 10 barrels of oil per day to 20 barrels of oil per day; the green represents 20 to 30 barrels of oil per day; the blue represents 30 plus barrels of oil per day.

Q Have you shown on each well the amount of production reflected on the Engineering Committee's reports for that month?

A Yes, sir, these are 30-day months, and the figures on each well represent the monthly production for that well.

Q Does the large amount of blue area in the northern portion and in the central portion, reflect the development of secondary recovery projects in those areas?

A Yes, sir, it does. The red dots, or wells circled in red, are wells that are currently injection wells.

Q There is a period there between Exhibit 3 and Exhibit 4 of five months, is there not?

A Yes, sir.

Q Directing your attention particularly to the proposed unit area in the south portion of the Caprock-Queen, it is apparent that in the month of November, 1959, as shown on Exhibit 3, there was some blue area both in the extreme northern portion and the extreme southern portion of the proposed unit area, is that not correct?

A Yes, sir, exhibit 3 and 4 show the production on a daily rate of barrels per day within our proposed unit area, which is outlined in red. It is very noticeable that the daily productive

rate is dropping rapidly. The greater portion of the central area in the South Caprock-Queen unit is now in the stripper stage, the production is in the range of 0 to 10 barrels of oil per day. There are two areas that exceed 10 barrels of oil per day, and they are located on the extreme north and south portion of the South Caprock-Queen unit. These areas also exhibit a rapid decline. The period represented by these two maps is five months, yet it is possible to see by this graphic form here that the blue area, and also the green, which represents production in excess of 20 barrels of oil per day, is getting smaller, the amount of blue and green is diminishing, that the greater number of the wells now fall in the 0 to 10 barrels of oil per day range, and the two higher areas to the north and south are now coming to the 10 to 20 barrels of oil per day.

Q What is the history of this Pool, generally, Mr. Matches, with regard to the rate of production, once a decline of production rate sets in?

A The decline after the decline has set in is very rapid. Once the wells start to decline, the decline is very noticeable.

Q Based upon your studies of production history in this Pool, and it is generally of all Caprock-Queen Pools, do you believe by the time this waterflood project develops to the extent that it will affect the areas shown on Exhibit 4 in blue and yellow, that those will in effect be stripper areas?

A Yes, sir, they will. They should take not more than a

year or so to be down into the 0 to 10, or 10 to 20 barrel range.

Q Do you believe, if there were a decline until the area were in the stripper stage, it might result in the lower ultimate, lower secondary production?

A Yes, sir.

Q What, with regard to these two exhibits, referring to the northern area, the Caprock-Queen will encompass the North Caprock Unit and Ambassador Unit, what does that show with regard to the present status of the production in that northern area?

A The map itself shows that the flooded area has now reached its peak, and is now beyond its peak in some areas. There are some windows showing, that is, this window in the pilot area of the Graridge Flood, has now passed its peak, the production is on the downfall. In other words, the amount of water produced there is great, but the barrels of oil is below normal allowable.

Q So that as your project in the southern portion of this Pool develops, you would expect the production in the northern portion of the Pool to decline, as a result of the waterflood project there having peaked out, would you not?

A Yes, sir. That is, now, being as I would say, the fact the northerly area has this hole in the middle, where production has passed its peak.

MR. CAMPBELL: That is all the questions I have of this witness.

MR. NUTTER: Does anyone have any further questions of

Mr. Matches?

MR. PAYNE: No questions.

CROSS-EXAMINATION

BY MR. IRBY:

Q In your discussion of your source of water, I note that in your application you mention only Sections 26, 15, 31, and in your testimony you referred to other locations for your source of supply?

A Yes, sir, I mentioned that -- I mentioned Section 26, a line that will be used to bring the water to the central part of the Unit would originate in Section 26. On Exhibit Number 1, I have shown the location of our water wells; we have one well, number 1 in Section 25 of 14-31; water well number 2 is in Section 22 of 15-31; and three additional wells are located in Section 26 of 15-31. Our wells are concentrated in Section 26, so that our initial line will be laid from the center of Section 26 to Section 17.

Q Then am I to understand from your testimony that you propose to use water from all of your permits in this pressure maintenance or waterflood?

A Yes, sir.

Q Is the water from these wells to be used in other floods?

A By other floods, do you mean to the north?

Q Other than that designated here, wherever it might be.

A There is the question of the possibility of Continental

developing a lease, or a unit to the northeast portion of our unit, and we would be glad to cooperate with them. This would not be used in any other unit outside this area. In other words, it would be restricted to the area of our unit.

MR. IRBY: Thank you.

QUESTIONS BY MR. NUTTER:

Q Have you made calculations as to the total amount of water that will be required, or have the Engineering Committee testified to that?

A I can give you a rough figure that will fall under the engineering testimony.

Q I see. I note that one of the injection wells that is indicated by red on your Exhibit Number 1, is that a dry hole on the unleased tract. What would you do if you cannot get the lease there, start another location for injection?

A For that, we will attempt to get that lease.

Q What is the significance, Mr. Matches, of the gas-oil contact being higher in the north part of the field than it is in the south part of the field?

A There is a distinct break from the gas cap in the south portion at plus 1355, to the north portion where it is at 1405, that break occurs to the northwest of this syncline. The gas cap has been traced to this point in the approximate center of Section 29, 14 South, 31 East, and due to the fact there have been few dry holes drilled along here that have encountered tight sand; develop-

ment has not progressed westward to tie down the gas cap. To pick up the gas cap again, you have to go to Section 17 of 14-31, and the gas cap has development at plus 1405 in the W/2 of the W/2.

Q Is it your opinion these are two separate gas caps, or that it would be continuous across Section 20, if there were development in there?

A The reason -- I will have to give you some speculation as to why it's not there. I will state my reasons as to why it's not there. In the vicinity of Section 29 and Section 20 of 14-31, there is a permeable barrier developed, and this barrier consists of dolomitic sand which is not common to the productive portion of the gap through it. Though dolomitic sand has been developed in several wells, and I believe that it acts as the permeable barrier which separates these two fields, separates the gas cap of these two fields. By saying two fields, the south portion of the Caprock-Queen Field is in communication with the north portion.

Q Is there communication between the oil wells from Section 21 down into Section 28, and from Section 20 into Section 29?

A Yes, sir. The red sand that I spoke of earlier is developed in the Northeast of Section 29, and the Northwest of Section 28, and continues northward into this shown area, and into the Cities Service Unit.

Q What do you find if you drill into this synclinical structure, do you find red sand, or dolomite, the Queen sand, or gray sand?

A In the vicinity, the red sand developed; it is quarrying, it is wet, there is no oil in this immediate area.

Q Is water present in this syncline?

A Yes, sir.

Q Mr. Matches, the southernmost injection well, which is in the NW/4 of the NE/4 of Section 29, is relatively close to the area that is productive of more oil than would be normally attributed to stripper wells, do you agree with that?

A Yes, sir, it is, in the sense that it is near a higher productive area in barrels of oil per day; by the time expansion of our proposed program reaches the south area, that area should be in the stage of possibly 10 barrels or 20 barrels a day.

Q Now, it is Union Oil Company's proposal to put these ten injection wells on simultaneously?

A Yes, sir, to develop a bank in the gas cap. The water, the injection of the ten wells, as shown, is to develop a water bank in the gas cap.

Q How long do you estimate it is going to take to develop a water bank in the gas cap at the southern end of your initial conversion project?

A That is a question that is difficult to state from a given period of time, because of the variation in the amount of permeable sand developed in the gas cap. The net permeable sand varies from an estimated 5 feet to approximately 15 feet, and the time that it will take to fill or to develop a bank across 15 feet

of sand, or across 5 feet of sand will vary.

Q What is the thickness of the sand in this well here in Section 19, this injection well?

A In Section 19?

Q The injection well is Magnolia Number 1 State -- rather, it's the Mobile Number --

A That has 11 feet of sand. Due north, the collar has 14 feet; there is a difference of 3 feet in one location. Our program pictures the expansion into that area, taking approximately two years, and by that time the extreme south portion of the field should be very near the stripper stage, or at the stripper stage.

Q I appreciate that the expansion of it into the blue area would probably not find it blue at the time, but what I am speaking of is, presently this is offsetting acreage that is yellow, which is producing from 300 to 600 barrels of oil per month. The well directly east of this injection well produced 414 barrels of oil in April. This is not strictly stripper production.

A On the extreme south portion of the field, the state of depletion has not reached the stripper stage, but the decline has started and it is very rapid. Within two years the decline should be very noticeable, and that area will probably be at or near the stripper stage.

Q Well, that well directly east of that injection well, it produced 406, and 414 in April?

A The well we are looking -- 414 in April is a well that

is affected by the expanding gas cap. It will eventually wind up in the stripper stage, if we don't stop the expansion of the gas cap. The case -- I might point out that also if we will look in Section 5-15-31 in the NW NW, or NW SW of Section 5, we have the Monsanto Number 4. I remember when this well as initially completed had a fairly high G.O.R., the south offset and the east offset were initially completed with low G.O.R., and the gas cap has expanded and caught these wells, it has expanded to them and in turn they are penalized. And our proposal for these ten wells is to develop a water bank in the gas cap to stop this expansion.

Q Are the wells down structure producing appreciable amounts of gas?

A In this case only some, by the base of the expansion of the gas cap.

Q How do you have gas-oil contact, this situation producing enough gas to have a penalized ratio?

A For the west flank of the field you might; the gas cap is mostly in one location, that has to be modified as to the structural position of the wells. Some of the wells that have not been affected, they will be if the trend continues.

Q Are there any high ratio wells as much as two locations away from the gas-oil contact, the line of the gas-oil contact, I should say?

A There are wells -- there are essentially two locations in the vicinity of this Lyon lease that I have mentioned earlier,

in the SW of Section 5, the locations that were affected are, one location, and I believe the one Number 1 which shows to be producing 465 barrels of oil per month has had an increase in ratio. I have not mapped the exact -- I haven't mapped the ratios as such to present here as an exhibit, however, I have mapped in the past, the expansion of the gas cap, and in general it is one location. And now, and this is one of the few cases where I think it might be coming into two locations.

Q What is the target date that Union has set for starting water into the ground in these ten wells?

A October 1st, 1960.

Q October 1st, 1960.

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

(No response.)

MR. NUTTER: You may be excused.

(Witness excused.)

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W I L L I A M D. O W E N S, a witness, called by the Applicant, having been first duly sworn, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. CAMPBELL:

Q Will you state your name, please?

A William D. Owens.

Q By whom are you employed, and where do you reside?

A Union Oil Company; in Midland.

Q What is your position?

A Division engineer.

Q Have you previously testified before the New Mexico Oil Conservation Commission, or one of its Examiners in your professional capacity?

A Yes, sir.

Q Mr. Owens, have you been before the Engineering Committee for the study of the proposed South Caprock-Queen Unit Agreement for waterflood?

A From the beginning.

Q How long have you been engaged in the engineering study in connection with this?

A Three years.

Q And are you acquainted with the proposed plan of operation for secondary recovery in this unit area?

A Yes, sir.

Q I would like to have you place on the board there Exhibit 5.

(Whereupon Applicant's Exhibit 5 marked for identification.)

Q Referring to what has been identified as Exhibit 5, Applicant's Exhibit Number 5, would you state what that is, please?

A This is a map showing the plan of operation for the entire life of our unit, and the initial ten injection wells. They are located on the western side of the most depleted areas, which

Mr. Matches has testified, and we colored the project area green. And then assuming ideal expansion, and assuming that every well is stimulated at the same time, we colored the various segments in the expansion phases, and the little table down in the corner indicates the number of wells -- Well, the nunber of injection wells, the number of new wells required.

Q It is apparent you are starting this project on the west flank with the ten injection wells involved in this application. Would you state to the Examiner why you have chosen to start your project in this fashion?

A Well, sir, the big problem in this part of the field is the gas cap, and the gas cap is dry and has never been wet in oil, and if it is wet with oil, we calculate we would lose about two and a third barrels. That will not be cored for that reason, and our first move will be to build up a barrier to prevent the migration of oil. That is why we chose the ten wells.

There is an imperfect embayment near the top of our proposed initial phase. That is a natural starting place. We have gone down through the depleted area.

Q What do you anticipate will be your rate of injection in the early stages of the development of this project?

A We are set up for somewhere between 500 and a thousand barrels a day, and as Mr. Matches pointed out, we do not really know how much water will go into the gas cap. We will inject into the well, and then we will build up our water bank, and then we

will cut back.

Q Do you contemplate you will be able to operate this project within the limits of the prescribed allowables for waterflood projects?

A Yes, sir. As soon as we do have the barrier built up, we will cut back to maintain the barrier, and expand normally into a pattern type flood.

Q A question has been raised here as to the amount of water that you think may be required for this project. Are you able to make any estimates of that at this time?

A You want the ultimate water required?

Q What is the amount of fresh water, I think would be the question that the State Engineers are interested in, would be required say on the maximum basis?

A Oh, of course during all the four years of the project, we are going to be on fresh water, and the maximum after about four years will be about 16,000 barrels a day. From that point on, the use will decline and we will use recirculated water.

MR. CAMPBELL: Does that satisfy your question, or is there something else you would like to have brought out?

MR. IRBY: I am interested in the recirculating and what it does to the quality of the water; and I am sure you will bring that our later, the construction of the water.

Q (By Mr. Campbell) Do you have any information with regard to the effect of the recirculating of the water, insofar as

its quality is concerned?

A Well, sir, there is -- There is a lot of free salt in the formation; of course, it is going to come out salty when we put the fresh water in.

MR. CAMPBELL: Was that your question?

MR. IRBY: I am requesting of the Company, when are you going to start recirculating, the date you are going to start recirculating?

A We anticipate no trouble. We will use sodium chloride, it is pretty well solidified.

Q (By Mr. Campbell) You anticipate no problem of corrosion with the use of your water that you are recirculating?

A No, sir. Of course, we are prepared for it, with plastic injected into the stream.

Q When do you anticipate to where you will begin to get to the point where you actually will start recirculating water?

A The big point will occur in about four years.

Q How much additional oil do you believe you will be able to recover by virtue of the installation and operation of this secondary recovery project from this unit area?

A We estimated 11.12 million barrels, which we feel is probably conservative, based upon information on the units to the north.

Q What is your multiple that you are using in your calculations there?

A It is slightly less than one and a half times primary.

Q How many of the proposed injection, ten injection wells are to be new wells drilled by you?

A We must drill three new wells, and re-enter two dry holes.

Q Is one of those new wells an unorthodox location?

A Yes, sir.

Q Would you identify that well, since it is included in this application?

A It is identified as injection well Number 7, and located in the E/2 of the NE/4 of Section 18.

Q And there are seven existing wells that you intend to use as water injection wells, is that correct?

A Yes, sir.

Q Do you have a fairly good data on the casing, cement program, that was used in the drilling and completions of these wells?

A They are all adequately cased into the Queen, or through it, and the amount of cement was adequate.

(Whereupon, Applicant's Exhibit 6 marked for identification.)

Q I hand you what has been marked as Exhibit 6, and will ask you what that is, please?

A This is a list of projections, showing the location of the wells, the elevation, the depth, the amount of surface casing, the amount of production casing, the top of the Queen sand, and for the three new wells we have underlined in this data, because the depth of course is estimated. This is the casing program we

intend to use on the new wells.

Q Do you consider that the present casing program on the seven existing wells is sufficient to adequately protect any potential oil or water producing formations as you inject water, either fresh water or recirculated water?

A Yes, sir, the surface is set into the red beds at a depth adequate to protect the well.

Q It has previously been brought out that all of the development in this particular area of the Caprock-Queen Unit has taken place during approximately the last six years, is that right?

A Since 1954.

Q These wells have all been completed using entirely new and modern completion practices, have they not?

A Yes, sir.

Q In connection with these injection wells, do you have any logs that cover any of the existing wells?

A We have logs for three of the wells.

(Whereupon, Applicant's Exhibits 7, 8 and 9, marked for identification.)

Q Referring to what has been identified as Applicant's Exhibits 7, 8, and 9, I believe you stated those were the three logs on the three wells on which you have logs?

A Yes, sir.

Q And do those reflect anything that is not reflected on the previous exhibits with regard to these wells?

A They do reflect the pay interval in the previous exhibits, on the top of the logs, of the surface casing, and the production casing is indicated.

Q Mr. Owens, do you believe that the establishment of this secondary recovery project at the early stages is essential to the greatest ultimate recovery of oil?

A Yes, sir, I do.

Q Why do you say that?

A Well, we are at the point now where the viscosity characteristics and the shrinkage of the crude are becoming critical. If you waited, before the pressure got much lower, we would lose oil.

Q Do you believe that if this program is instituted at an early date, on the basis that you have testified to, that you will be able to obtain a greater ultimate recovery of oil than if the secondary recovery were not undertaken?

A Yes, sir.

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

MR. NUTTER: Anyone have any questions of Mr. Owens?

CROSS-EXAMINATION

BY MR. PAYNE:

Q Do you propose to inject through tubing?

A Yes, sir. In the field to the north, the injection is sometimes through casing, and of course that is a lot more economical, and we are watching that pretty closely. However, the

initial ten wells, we will use tubing, yes, sir.

Q Would you consider this to be line dry flood?

A No. We are going to expand to normal pattern flood.

Q You just prefer to start on this side because of your gas cap?

A That is the only reason, yes, sir.

MR. PAYNE: Thank you.

QUESTIONS BY MR. NUTTER:

Q In this well, will you eventually go to the uniform 5-spot pattern flood?

A You will notice some strips we have mythology. Many of the wells just won't make very good powers, but will make a good injectors. Normally, we will follow a 5-spot flood.

MR. PAYNE: A thorough and efficient sweep of the oil, in any event?

A Yes, sir.

Q (By Mr. Nutter) Mr. Owens, what do you think your initial rate of injection will be during the initial fill-up in the gas cap barrier?

A We expect to have 500 and 1,000 barrels per day per well.

Q Then you will reduce that rate of injection after you get full-up?

A After we fill up, we will reduce just enough to maintain it. We actually don't know how far the gas cap is, we think it is extended about a mile. We are in the dark a little bit, we really

don't know what the injection rate will be. That is a fair guess.

Q Not knowing the limits of the gas cap, you do not know how long it will take then to achieve fill-up in that area?

A No, sir; we estimated about eight months, that is an estimate.

Q At those rates of injection?

A Yes, sir.

Q What do you think you will finally settle for as an average injection rate throughout your project?

A We worked it out there, the various phases, and of course on the first phase that is an estimate, 100 barrels per day, or a more flexible increase, or average injection rate, so I cannot give you an exact number. Probably, oh, three to five hundred barrels per day.

Q What is your estimate of the total amount of water that will have to be injected during the life of this project?

A Sixty-three million barrels.

Q Which of course includes recirculated water?

A The bulk is recirculated water.

Q What is your estimate of the total amounts of fresh water that will be required?

A Thirty million.

Q What is the primary recovery estimated for this area?

A Percentage?

Q Percentage, and also barrels?

A It is 7,592,197 barrels, as Mr. Snyder testified, plus the recovery from the seven new wells that were drilled after July 1st, 1959. That is the recovery from old wells, that has been established by the Engineering Committee; and there are seven new wells, they are going to recover possibly in the neighborhood of 50,000 barrels.

Q For each of the seven?

A No, total; a very small amount of the seven new wells.

Q This is the amount of oil that had been recovered up to July 1st, it is not--this seven million barrels or so, is this the total amount of oil that has already been recovered, plus what is expected to be recovered?

A This is total primary.

Q And what percent of the original oil in place does this represent?

A 15 percent.

Q And you expect you are going to recover by secondary recovery, one and a half times the primary?

A A little less than 22 percent. The total will be 36.6, I believe.

Q Upon completion of the waterflood, you expect to recover 36.6 percent of the original oil in place?

A As I said before, I think that is a very conservative estimate, based on the information on the other floods.

Q Now, in barrels, what is the estimate, secondary plus

time?

A Eleven million one hundred thousand plus, plus primary, which is 18,692,000.

Q According to your calculations, Mr. Owens, what will be the allowable for the initial stage of the project?

A Well, we calculated there will be 29 waterfloods allowable, phase one.

Q That is taking into consideration the 40-acres that have injection wells on them, plus the 40-acres that are directly, or diagonally offset these section tracts which have wells on them?

A Yes, sir, I might point out we intend one new producing well in the project area.

Q Where will that well be?

A Located in the SE of the NW/4 of Section 5.

Q That is the well labelled on the map as location "6"?

A Yes, sir. 29 times 42 is 1218 barrels per day.

MR. NUTTER: I believe that is all. Does anyone else have a question?

QUESTIONS BY MR. IRBY:

Q Going into your Exhibit 6, Mr. Owens --

A Yes, sir.

Q -- these three line proposals, proposed ones, those depths are all estimated, I believe you said?

A Yes, sir.

Q In each case, I note you propose to drill, to set your

surface casing at 300 feet?

A Yes, sir.

Q You have reason to believe, I assume, that you are into the red bed?

A That is well into it.

Q If it is not --

A If it is not, we will drill deeper till we get into it.

Q It is your estimate that the sacks of cement indicated here will circulate to the surface?

A Yes, sir. If this doesn't circulate, we will use the amount required to circulate.

Q One more question. In the case of the seven wells which are already drilled, did -- this cement on the surface string did circulate?

A I am not able to answer that. I presume that it did.

Q I note that there is a rather wide variance in the amount of cement used there, and even on wells that are nearly the same depth?

A Yes, sir; of course, there is a difference in the size of the hole that was used. Some of them used an 8 5/8 hole, and a smaller amount of cement than those with 10 3/4 inch holes that used 200 sacks of cement, so possibly this variance was the amount required to get circulation.

Q But in accordance with your previous testimony, you consider there is adequate cement there to prevent fresh water --

A Yes, sir.

Q These figures of one million barrels, and seven and a half million barrels, primarily include the acreage which is there in the unit, is that correct?

A They include everything within our unit outline.

Q And I think either you or Mr. Matches stated that the expanded secondary recovery estimate was a conservative estimate in comparison with some of the success encountered to the north?

A I understand that some of the wells have recovered almost twice the primary. Of course, I think our estimates is a good one, I do feel is conservative.

MR. IRBY: That is all.

MR. CAMPBELL: I would like to offer Applicant's Exhibits 1 through 9 .

MR. NUTTER: Applicant's Exhibits 1 through 9 will be admitted into evidence.

Anyone else have a question?

(No response.)

MR. NUTTER: The case will be taken under advisement, and we will recess till 9:00 o'clock tomorrow morning.

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

I, LLEWELYN NELSON, 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, 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 4th day of August, 1960, in the City of Albuquerque, County of Bernalillo, State of New Mexico.

Llewelyn J. Nelson
NOTARY PUBLIC.

My Commission Expires:

June 14, 1964.

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 2052, heard by me on 9/27 1960.

Examiner
New Mexico Oil Conservation Commission

I N D E X