EXAMINER HEARING
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
May 6, 1958

IN THE MATTER OF: Case No. 1433

TRANSCRIPT OF PROCEEDINGS

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EXAMINER HEARING
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IN THE MATTER OF:

Application of Graridge Corporation to expand a pilot water flood project in the Caprock Queen Pool, Lea County, New Mexico. Applicant, in the above-styled cause, seeks an order permitting the expansion of the pilot water flood project authorized by Order No. R-972 in the North Caprock Queen Unit in the Caprock-Queen Pool, Lea County, New Mexico, to include eight additional water injection wells in Sections 30, 31, and 32 of Township 12 South, Range 32 East, Lea County, New Mexico.

Case 1433

BEFORE: Daniel S. Nutter, Examiner

TRANSCRIPT OF PROCEEDINGS

AFTERNOON SESSION

MR. NUTTER: The hearing will come to order, please. The first case on the docket this afternoon will be Case 1433.

MR. PAYNE: Application of Graridge Corporation to expand a pilot water flood project in the Caprock Queen Pool, Lea County, New Mexico.

MR. ELLIOTT: Mr. Examiner, R. A. Elliott, attorney for Graridge Corporation. At this time I would like to move to amend the application in one small respect. On page 2 under the paragraph in the middle of the page having to do with the second four wells, I would like to delete, beginning on the second line: "one

at a time, at intervals of approximately every two months for the remainder of the year 1958..." and insert in lieu thereof: "in accordance with the dictates of periodic performance data at operator's discretion..."

MR. NUTTER: "In accordance with the dictates of periodic performance data --

MR. ELLIOTT: " -- at operator's discretion."

MR. NUTTER: " -- at operator's discretion." Is that "operator parenthesis s"?

MR. ELLIOTT: Apostrophe s.

MR. NUTTER: I mean apostrophe s.

MR. ELLIOTT: Further down, strike the word "however", and "that each of" -- strike "each of", and put in lieu thereof "the conversion"; and then come on down to "Commission" and put a colon (:) after "Commission" and strike "prior to each conversion".

Then that should read like this: "It is further respectfully requested that this Commission authorize the orderly conversion, in accordance with the dictates of periodic performance data at operator's discretion" .. in Lea County, which I indicated in green on Exhibit "A" attached hereto .. "it being understood that the conversion of these four injection wells shall be approved upon written request without a hearing by the Commission."

MR. PAYNE: Do you have any witnesses to be sworn?

MR. ELLIOTT: Yes, sir. I would like to swear Mr. Bob Vick.

(Witness sworn.)

MR. ELLIOTT: Could we have a ruling on that?

MR. NUTTER: Yes, sir. Is there any objection to the amendment of the application as proposed by Mr. Elliott? If not, the amendment will be accepted and entered in the application.

MR. ELLIOTT: If it please the Examiner, I would like to point out, according to the application, that the properties which we are discussing for expansion were originally approved on April 5th of last year by this Commission for a pilot flood, setting up the six wells shown on the exhibits in red as injection wells. Then in November of last year, a capacity production allowable was given for certain wells in this area under your Order R-1073-A. Then on March the 1st of this year, after the properties in that area were unitized, the unit agreement was approved by this Commission. We are now proposing to expand this flood, in order to prevent waste.

ROBERT H. VICK

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

DIRECT EXAMINATION

By MR. ELLIOTT:

Q Mr. Vick, will you state your name, address, company you work for, and position you hold with that company?

A Robert H. Vick, water flood engineer for the Graridge Corporation.

Q Where do you live?

A Breckenridge, Texas.

Q You have testified before this Commission previously, I believe?

A Yes, sir.

MR. ELLIOTT: Mr. Examiner, would you accept Mr. Vick as an expert?

MR. NUTTER: Mr. Vick's qualifications have been accepted, and he may proceed.

(Graridge's Exhibits Nos. 1, 2, & 3 marked for identification.)

Q Mr. Vick, I ask you to state whether or not you prepared these three exhibits marked Exhibits 1, 2, and 3?

A Yes, sir, I did.

MR. ELLIOTT: I would like to enter as Exhibits 1, 2, and 3, they are all three there together, he's going to be discussing them altogether, so we just left them altogether.

Before Mr. Vick starts explaining these, I would like to show that on this Exhibit 1, that the six wells in red represent injection wells which have been approved by this Commission. The four wells in yellow represent the four wells that we're asking for immediate permission to convert into injection wells, and then the four wells in green are the other four that we asked for permission at intervals to put into injection wells.

Q (By Mr. Elliott) Mr. Vick, you prepared these three exhibits which we have entered in evidence here. I ask that you

explain to the Examiner exactly the reasons for these exhibits, and just what they show relative to the problem at hand.

A Well, the Sheet No. 1, or the first page, or Exhibit No. 1, designates the present unit boundary, some 2800 plus acres, and the projected water flood pattern over the whole present unit, and as you stated, the six present water injection wells, the four injection wells that we're applying for immediate conversion, and the four injection wells for which we are seeking approval to be placed on injection at the operator's discretion.

It shows also all the present producing wells and our projected injection system over the entire unit area, with the injection plants and the water supply wells and all the other pertinent data.

The Exhibit No. 2 is a projection of our theoretical calculations and also some of the actual performance data that has transpired to date on the project. The green circles around the present six injection wells indicate the relative radius of the water front, theoretical relative radius of the water front, computed from strictly a volumetric calculation, taking into consideration the amount of water injected into the specific well and the thicknesses of the sand and the porosity and oil and water saturations and so on and so forth. The area shaded in red is an indication of the theoretical pilot flood area which should be affected by our present water injection system, and which as indicated is in varying degrees so affected. The area designated in yellow to

the northeast of the pilot flood area is the area that is also being affected by our present water injection system, due to an unbalanced condition of our pilot flood with subsequent loss of water injection up to this area, creating increasing oil production on the wells shown there. Under each of the producing wells in the pilot area, we have designated or indicated the present oil and water production figures in red there right underneath each producing well. As can be seen, the wells in the shaded yellow portion are up from an average of, oh, a barrel and a half to two barrels per day, up to their present indicated 15, 14, 12, 31, and 35 barrels per day with no water production.

The third exhibit is simply a tabulation of the cumulative production volume of oil that has been produced from each of the respective wells in the overall unit area. We would like to point out at this time that along the southwest border of the pilot flood area, which is outlined in pencil there, that the primary histories indicated by the low cumulative production figures there are the result of what we feel is a permeability barrier along this southwest side of the pilot flood, and it will be restricting any outward flow of water from the pilot flood area in this direction, which we don't have,on the northeast side, and therefore of our subsequent water encroachment into an outside area from our pilot flood.

Q Mr. Vick, to sort of bring the Commission up to date on the development of this pilot flood since the time that permission

was given to enter into this pilot flood, would you sort of give a short history of the injection volumes and producing rates, and just a general history of how the pilot flood has been put into operation and what has resulted since that time?

A Referring back to Exhibit 2, you can obtain a relative idea of the variations in the amount of water injected into each of the six water injection wells by the difference in the radius of the, or radii of the green circled areas there which indicate that some of the wells we have had trouble with and hadn't been able to get a comparative water volume in them that we did into the others, but that is what we feel was a combination of mechanical troubles and also the point mentioned earlier of variations in permeability and porosities throughout the reservoir. The cumulative water injection into the pilot flood area to April 1st, 1958, has totalled 862,325; the cumulative production has totalled 5,245 barrels; the net cumulative water injection therefore being 857,000 barrels, approximately. The cumulative oil production from the pilot flood area prior to start of injection was 490,325 barrels of stock tank oil. The calculated cumulative voidage, or any cumulative voidage of the pilot flood area to the time of the start of water injection was 539,500 barrels, reservoir barrels. The cumulative oil production since the start of the flood has totalled 124,293 barrels of stock tank oil.

MR. NUTTER: That's since injection was commenced?

A Yes, sir. That leaves a net water injection into the pilot

area of an excess of 187,000 barrels of water above our calculated voidage in the pilot flood area.

Q Mr. Vick, has this development or the injection of water under this pilot flood arrangement resulted in any unbalanced condition or a migration of oil in any certain direction or any conditions of that sort?

A Yes, sir. In my opinion it has, as indicated by the added area to the northeast of the pilot flood being affected and with increased oil production, and we had calculated that 100 percent fill-up voidage of the pilot area oil production should have been peaked at 65 or 75 percent of our daily water injection volume, which has been averaging around 2400 barrels per day. This would have given a peak oil production of 1450 barrels to some 1800 barrels, somewhere in between there. We have also calculated that we have injected at present approximately 187,000 barrels of water in excess of 100 percent fill-up, and from study of the present production performance and primary production histories of the various producing wells, this excess 187,000 barrels of water has entered an area indicated to the north of the pilot flood area.

I might explain a little bit more there. When we initiated the pilot flood, it was on a cooperative basis and with no previous histories in the field as far as having any kind of idea as to performance of the pilot flood or the ability of the injection wells that we selected to take equal volumes of water; but under the cooperative effort we had to establish some type of a rate, and

on a round-about volumetric calculation came up with our 500 barrels of water per well per day injection rate; and since it was on a cooperative basis, we had to recommend that for each well, and attempted to put that volume into each well; and as pointed out a minute ago, you can see by the different radii of the green circles that we haven't been able to maintain that equal volume due to various reasons, and that also from the production increases to the northeast of the pilot area that we are definitely having a loss of water to that area and therefore a very unbalanced condition of the pilot flood.

Q Well, do I understand from your opinion there that there is a possibility or a probability of a loss of efficiency of the flood because of being held to this six wells, or just what is the result of this unbalanced condition, what does it mean in waste or loss?

A To me it means a loss of ultimate recoverable oil, mainly from the economic standpoint of not being able or of having a higher economic limit on the rate of production or -- that you could produce those wells in an unbalanced condition such as this, the present injection wells, water breakthrough from them would occur, definitely at an earlier date than the wells that are put on injection later. Therefore you would have to carry the increased water production in your outside producing wells there, or your present outside producing wells, throughout the performance of that individual five-spot and as a result of that increased water production

that you would have to carry your economic limit would be, as far as oil in barrels per day, would be much higher than under a normally perfectly balanced pattern flood.

Q What in your opinion needs to be done to balance up this operation and get it back?

A Well, to place the overall project back in some degree of balance, we feel that the four wells requested for immediate conversion be approved, and that the additional four wells shown be approved by the Commission at this time, these last four wells, the last four injection wells to be put in operation at the discretion of the operator and his selection of the exact time to be governed by his periodic evaluation of actual performance data.

Q Do you want to enlarge a little bit on the performance data, just exactly what it will show and how you will get it?

A Well, I might start off by saying that we would like to state concerning any projected development rate, time rate of putting these injection wells on, that in our opinion pilot flood operations cannot always be exactly ratioed to a total given area such as the North Caprock Queen Pool here. Where sufficient reservoir data is available before installation of a pilot flood or in previous or in proven water flood areas, fairly close performance predictions can be drawn. However, if this data is not available, it sometimes is about as cheap for an operator to install a pilot flood as it would be for him to obtain the necessary data by drilling new producing wells and coring, such things as

that, for such a prediction. In such cases, the main purpose of the pilot flood is to ascertain if the new area is susceptible to water flooding at economical cost; therefore, any detailed or specific projections of cumulative recovery or productive rate must be formulated along with the actual performance data from the pilot flood.

Other points that might enter into the above reasoning are such things that the operator might choose the best indicated portion of his lease to install the pilot flood on, or he might, conversely, he might pick a much poorer section of his lease in order to obtain cooperation from offset operators and such things as that.

In closing, we would like to mention that point which has been brought out many times in the past, that the recovery of oil by water displacement is not a fixed quantity but depends on the skill and the judgment of the operator in his application of developed principles to operation and control of the project.

Q Then it is your opinion that any sort of limitation on the rate of development can very seriously hinder the efficiency of your flood?

A Yes, sir, we don't believe that we can establish a definite development rate in a new area such as this where performance data is not available and where even an adjoining field, data from that, as far as water flooding, is not available; until such time as that data is available, that the operator should be free to put on additional injection wells at his discretion, as indicated by

these past points that we have discussed.

Q From this discussion then, I assume it's your opinion that the four wells shown in yellow on Exhibit 1,that you need approval for them immediately?

A Yes, sir.

Q And then on the four wells in green, there is not such an immediate need for them, that when you do get these other four wells in,that additional data may show you that the others, or one or more of the others, should be put in immediately to keep your flood in a balanced condition?

A That is true, yes, sir. As you will note on the third exhibit, the actual cumulative production figures from those outside edge producers, the very outside of the reservoir, have a slightly smaller average production than the overall field average, which would bring in that point there,that we put the four requested, presently requested wells on, it might be some time before we have indications to guide us in putting on our -- the time of our four additional wells.

Q Is it your opinion, then, that if the four wells now are not immediately granted and the other four left to where you can't work them in to keep your flood in a balanced condition, that waste will result and loss of ultimate recovery will be caused?

A That's right.

Q Do you have any other comments to make?

A No, sir.

MR. ELLIOTT: That's all.

MR. NUTTER: Are there any questions of this witness?

CROSS EXAMINATION

By MR. NUTTER:

Q Mr. Vick, I believe you stated that there would be an ultimate loss of recovery if a water flood were to get out of balance, as evidently this one may have. Would you elaborate on that, please?

A I think it would be easiest to explain, Mr. Nutter, if we took just one five-spot pattern with four injection wells and a producing well in the center. If two of the wells, two of the injection wells on one side were placed upon injection, the water started into them at such and such a date, and at a certain rate; and then two or three months later, the two opposite injection wells in the five-spot were placed on injection, your water fronts from those would progress radially outward from your injection wells and the water would break through to the center producing well on a ratio, as far as time, with the cumulative volume of water that had been injected into each well. The two first wells put on would naturally have water breakthrough into the center producer at a much earlier date than the two later wells. As a result, in an effort to try to obtain all the oil that you could out of the five-spot operation, you would have to produce the center producing well there with a high water cut as a result of water breakthrough from the first two wells. The economic limit of your producing well there would be governed by your water-oil

ratio. Say normally your economic limit would have been, with no water, four barrels of oil per day; if you had one hundred barrels of water or two hundred barrels of water, coming into that well, you couldn't naturally afford to, from an economic standpoint, produce it down to four barrels of oil per day. It would have to be stopped somewhere up the line on the decline curve with loss of that oil that would be remaining there.

Q If the oil were not recovered from the well which experienced the water breakthrough, it would be recovered from another well?

A Would you state that --

Q If the oil were not recovered from the well which experienced the water breakthrough prematurely, would the oil be recovered from another well?

A It could in some cases and very likely couldn't in others. We have found from past experience that on pilot flood operations like this, that where the back-up is brought in too late and your water front from your injection wells is driving your oil like it is here to the second and third row of producing wells, that even though you come in and place these back-up wells on injection, it's very hard to reverse the flow of your -- actually reverse the flow of the fluid in your formation,or your drive. Sometimes it happens and sometimes it doesn't.

Q Mr. Vick, you have had considerable experience with water floods, have you not?

A Yes, sir, to a degree.

Q Have you ever seen a water flood such as this in which a pilot area has been selected and is surrounded by producing wells which are not subject to water injection, which was perfectly in balance?

A To varying degrees, I believe, Mr. Nutter. I think we have one example in the M. R. Y. pilot that we have presently in the Artesia Pool. The producing wells, all of the inside and outside producing wells, are kicking about at the same time as far as increased oil production, and it appears to be very balanced, so we don't expect nearly as much trouble there as we are encountering right here.

Q So if you were to draw a comparable plat of that water flood, you wouldn't have an area which would be colored in yellow as you have here?

A No, sir. The area colored in yellow there is actual performance data, the wells are being affected with increased oil production and we definitely do not have that in the Artesia pilot with the second and third row of producing wells being affected at present.

Q This is one time when increased oil production is not desirable?

A Not from an engineering standpoint, no, sir.

Q Has this Well No. 32-5 in the Southwest of the Northwest of 32 been affected by the water flood?

A 32-5?

Q Yes, sir.

A Yes, sir, the production there is up to the indicated ten barrels of oil and no water, and that's just been in the last two weeks, it was on the last series of well tests.

Q Is that ten barrels or twelve barrels? My exhibit says twelve.

A It's twelve years.

Q What water injection wells, in your opinion, would be affecting that No. 32-5 well?

A Well, the 31-10 and the 31-16 and possibly some help from the 5-4.

Q If you were to put the No. 31-8 and the 32-12 on injection immediately, wouldn't the effect that the water injection in No. 31-10 and 31-16 has had just be multiplied or increased by the injection of additional water, through 31-8 and 32-12?

A Yes, sir, we would have a faster response there, I'm sure.

Q If this is a permeable area up to the northeast which is susceptible to an inbalanced condition, wouldn't that also require that 32-4 and 32-6 go on injection almost immediately?

A It might possibly, yes, sir. That is our reasoning, part of our reasoning behind our present application.

Q Mr. Vick, I think it was Mr. Elliott in his introductory statement mentioned in November of 1957, the Commission authorized capacity allowables by Order No. 1073-A for this area. Were you present at the hearing which was the cause of that Order 1073-A

being issued?

A Yes, sir, I was here on approximately the first two-thirds of the hearing.

Q Do you recall that at that hearing there was some testimony that the only way that water flood allowables should be curtailed would be by the control of the number of projects and the expansion of the project?

A Yes, sir.

Q If a condition like this exists, how are you going to control the expansion of water flood projects?

A Well, Mr. Nutter, it isn't our intention in applying for such a measure as this to come in and request all of our outlined injection wells in the overall area, we definitely intend to stay with that general idea of not exceeding or of trying to maintain some stabilized development rate, or keeping that at a minimum actually governed by this evaluation of performance data and such. We definitely realize the problems concerning the overall situation, but this we don't feel would let anything get out of hand as far as our company's development rate on the overall unit area.

Q How many wells have been affected by the injection of water into these six injection wells in the pilot project?

A Well, all twelve of the wells, producing wells in the pilot area proper, and the 32-14, 32-12 -- 31-8 actually isn't producing. We went in and cleaned it out and ran a liner in it, but it did have an oil show in it, that possibly would have had some oil increase.

Q Which well is that?

A 31-8.

Q That would be approximately seventeen wells?

A Plus 32-5 and 32-11.

Q Would that be approximately seventeen wells?

A It would be sixteen, wouldn't it?

Q How many of those sixteen wells have reached their peak rate of production and either stabilized or declined?

A Well, at present, with the present injection pattern and system, the No. 6-1 well, we feel, has peaked out and is on a decline; also the outside, presently outside producing well, No. 31-9, and the No. 32-13.

Q Let's see, the 31-9 --

A Well, from its present drive, there is 115 barrels and 42 of water. Were we to put on the outside injection wells, well, naturally it would get an additional peak above that.

Q Would the amount of water that is being produced decline?

A No, sir.

Q That water is there to stay?

A Yes.

Q If the rate of injection in 31-10 and 31-16 were decreased, and the rate of injection in 31-8 and 32-12 were -- well, you would have to establish a rate of injection, you don't have any, but you started injecting in 31-8 and 32-12 at the maximum rate -- would not the water production in 31-9 go down?

A No, sir, I don't believe so. In my opinion it wouldn't. As I stated a minute ago, in a lot of cases it is very hard to reverse your direction of flow of fluid in the reservoir and maintain any type of sweep efficiencies on the water flooding program.

Q Have the green circles on this Exhibit No. 2 been drawn taking into consideration variations in porosity or pay thickness?

A No, sir. They were, as I stated, on a theoretical basis. Our actual reservoir data at the beginning of this project was very limited as far as porosity and permeability and the regular information you get from core analysis was very limited, and we had to use average figures on our volumetric calculations and all our work on the overall area.

Q Are any of the wells located within the pilot project itself still increasing in their productive capacity?

A Yes, sir, the No. 31-11 and 31-13 are presently increasing slightly. The slight increase that we have there indicated had just been in the last several weeks, they had come up. The increase or the indicated increase on 6-3, 6-7, and 6-9 have all remained about constant for quite some time. Also the increase in 5-5, the 134 barrels of oil per day has remained constant for quite some time.

Q How about 5-3, what is it doing?

A 34 barrels of oil and no water.

Q Is that stable, going up, or coming down, or what?

A It has been in that range for approximately the last month.

Q How about 32-13, is it coming up, going down, or stable?

A It's stable at 150 barrels.

Q You anticipate it will remain stable until water is injected in 32-12 and 32-14?

A Yes, sir, except that actually the water production will continue to increase and the oil production will go down.

Q Then you already stated that 31-9, the oil production was declining slightly?

A Yes, sir.

Q How about 31-7?

A That is the new producing well that we drilled to replace the old air injection well which we couldn't recomplete. That well potentialed for approximately one hundred, I believe, seven barrels of oil per day, and made that for approximately two weeks, and then the water cut started increasing, and it's presently at its indicated rate there, 31 oil and 102 water.

Q That is a newly drilled well, then?

A Yes, sir.

MR. NUTTER: Are there any other questions of the witness?

MR. COOLEY: Yes, please.

MR. NUTTER: Mr. Cooley.

By MR. COOLEY:

Q Mr. Vick, can you tell me what you anticipate the inclusion or addition of the eight more injection wells in the northern portion of the North Caprock Unit will do to the production in that area?

To what extent do you believe that will increase the production, and to what amounts, if you can make a rough estimate?

A Well, offhand, Mr. Cooley, we feel like it will bring it up to somewhere over a period of, within a period of the next three months; if all eight injection wells were put on immediately, that within three months that we would be approaching approximately 2500 barrels. There again is a, that's just a prediction.

Q How many developed 40-acre tracts are in the North Caprock Unit, Mr. Vick?

A Seventy-two, I believe.

Q My calculations are correct, 33 barrel allowable, 72 units, you would have 2,376 barrel unit allowable, if the North Caprock Unit were to be assigned a unit allowable?

A Yes, sir, that would be correct, 2316, yes, sir.

Q 2376?

A Yes, sir, that's right.

Q Do you feel that the addition of the proposed eight injection wells in the North Caprock Unit could be operated at a total unit allowable with 2,373 barrels of oil per day?

A I couldn't state definitely, Mr. Cooley. Offhand, I believe that it possibly could. There again, the evaluation or periodic evaluation of the overall project would have to, I feel, have to enter into the picture concerning this or future expansion on the south and west sides of the present pilot area. If we, or when that time comes, our development rate there is naturally going to

be much slower, due to the tightness of the formation and the restrictive, or the restriction caused by this permeability variation there, and also another point, these high wells or high capacity wells in the present pilot are going to be decreasing and evaluation of their performance would tie in with that overall allowable that you are speaking of.

Q Mr. Vick, you stated that you cannot say positively that you can operate it within 2376 barrel allowable on the proposed plan. Let's assume for the moment that in no event would the North Caprock Unit be permitted to produce in excess of 2,376 barrels of oil per day, that that is the absolute top on it. How would you then proceed with the development of the present flood?

A It would be my recommendation to proceed just as we have outlined in our discussion here, Mr. Cooley, as far as placing on additional injection wells when we feel that they are warranted, but the moment that production increases are noticed in the outside producing wells, I feel like that the next row of injection wells should be put on at that time, to prevent this ultimate loss of oil.

Q You would recommend proceeding as you now propose, even though it might, I believe as you stated, result in the necessity of curtailing production, still assuming the maximum limit on production from the unit?

A Yes, sir, it would be my recommendation to go ahead, based on those concepts, and with the thought in mind that possibly

something might happen down the line that our decline might be faster in the original pilot area, or something else might transpire to alleviate the end point situation and -- but that would definitely be my recommendation to proceed, as it's indicated to me.

Q Do you concur in the extensive testimony offered in what is commonly referred to as the "Graridge case", which resulted in Order 1073-A, wherein it was stated repeatedly that, in the opinion of many of the witnesses, that to curtail the production from water flood producers would cause waste?

A Yes, sir, I do.

Q You would proceed with the expansion of this flood, even though it might be necessary to curtail them to stay within a unit allowable?

A Yes, sir, I would recommend going ahead as though you weren't looking at any ceiling or anything like that. As I stated a minute ago, it wasn't our intention to try to put the whole project under at any given time or immediately; that would be, my recommendation would be directed by the overall performance of the project, my evaluation of it.

Q Mr. Vick, you have testified several times in this hearing today that in your opinion it's dangerous to try to reverse the liquid flows in the reservoir once you have established a trend of flow in a water project?

A Yes, sir.

Q Go ahead and explain your answer.

A I was going to state that I have seen cases whereby when the next row of injection wells were put on in an unbalanced condition like this, that instead of having something similar, your water flood front similar to the circles here, it would actually elongate out and just continue to be exaggerated in the direction that it was going, as far as your water traveling in that direction. I mean by that that, say we were to put on 32-12 there on injection right now, and we came along and within a month's time 32-6, which is the next outside producer there, which hasn't been affected right now, might possibly kick up and with a very big increase, which would indicate that the major portion of your drive from 32-12 were going still in the same direction, instead of radiating out, radially.

Q Once this trend has been established, and assuming that you do move north and easterly with your conversion of producing wells to injection wells, isn't it more likely that the result will be something in the order of what is referred to as a "line drive", rather than a five-spot type of flood that you started with?

A Well, if the unbalanced condition were maintained, it definitely would develop into that, just as I pointed out, you would be increasing, going that way, and the minute you put your injection on the biggest portion of your drive would be in one direction, or linear, and that was one of the points behind our reasoning in stating that we feel like that as the operator, we

should be able to put these outside injection wells at our discretion, if we come in and put the four present wells on and, say 32-6 were to kick up immediately in oil production, we would come in and recommend at that time that it definitely be put on injection.

Q Is there any performance data that you now have showing any necessity for conversion immediately, or even in the near future, of the 31-2 in the Northwest of the Northeast of 31, and the 30-16 in the Southeast Southeast of 30? It is the two northwesterly wells. Are those wells required immediately to balance this flood?

A No, sir, not immediately. We would be --

Q (Interrupting) But 31-2 is one that you propose for immediate conversion, isn't it?

A Well, that's our reasoning behind that, Mr. Cooley, was the fact that if you connect up this abandoned location or abandoned producing well just outside of the unit area in 31-10 and 37-8 and 31-2, and formulate this five-spot pattern with those four wells.

Q Will you repeat those a little slower? I didn't find them.

A 31-2.

Q I don't find it.

A It is the injection well you questioned. 31-8, 31-10, and then going northwesterly to that location outside the unit which actually had sand, and we're in the process of recompleting the well so that it can be completed in the unit as soon as we can

get it in, but to be included into the unit.

MR. NUTTER: What is the location of that well, Mr. Vick?

A Well, it would be the Southeast of the Northwest Quarter of Section 31.

MR. NUTTER: This is proposed to be an injection well, eventually?

A Yes, sir, as soon as we can make arrangements for it. Getting back to the overall five-spot pattern that that would formulate, you can see the location of the old No. 2 Well, the abandoned producer in the center, and then the new well that was drilled, the No. 31-7, the relatively off-balanced location, relative to the five-spot.

Q (By Mr. Cooley) Yes.

A It is our opinion that unless we can get 31-2 on injection immediately and get considerable volume of water into it, that we're going to leave a lot of oil in the northern half, say, of that subject five-spot; that since we do have water breakthrough already on No. 31-7, that it's going to be a condition as we described a minute ago as far as the economic limit on it, so we feel that 31-2 should be definitely put on injection at this time.

MR. NUTTER: In other words, the water has to travel further?

A Yes.

MR. NUTTER: So it ought to be put in sooner?

A Yes, sir.

Q (By Mr. Cooley) You anticipate producing this well for

the northern part of the five-spot?

A Yes.

MR. NUTTER: Why was that well drilled so close to the water injection there, the Northeast of the Southeast of 31?

A There had been some water injection into the old No. 2 Well during the air injection program back in '51, '52. We didn't have any exact volumes on that, and we felt like that it possibly had decreased the saturation some in that area, the air injection sweeping through and the water injection that was put into No. 2. That is the reason that No. 31-7 was pulled down off location, off the center of the five-spot.

Q (By Mr. Cooley) You do not feel that injection rates in 31-10 could be reduced and alleviate the situation somewhat?

A No, sir.

Q You feel that once water breakthrough has occurred, it can never be remedied?

A That's right, unless you had enough zone that you felt like, or enough permeability variation that you felt it was a breakthrough actually in one streak and you could go in with selective plugging material or something on that order and isolate your water transfer zone.

Q Can you take a copy of Exhibit 2 -- do you have an extra copy there, Exhibit 2?

A Yes, sir.

Q As prepared here?

A Well, it's a little bit different.

Q Take one of these like the ones that you have presented in evidence. Draw, if you can, what you believe is the actual water front there, rather than this theoretical display that you show by the green circles around the injection wells. What type of water flood would you have to have to get the results that you have in the yellow area?

A Well, it would simply be an elongation toward your high producing rates, Mr. Cooley, as far as actually, and with the green surface broken into the wells that are actually producing water and a subsequent decrease of the radius of the green zone on the other side of the well, just more or less in an elongated situation.

MR. NUTTER: Are there any further questions of the witness? Mr. Utz.

By MR. UTZ:

Q Mr. Vick, I don't believe you mentioned whether or not the 6-1 was increasing or not.

A At present it is making 480 barrels of oil and 10 barrels of water. The water production is just recent, within the last week or week and a half. It doesn't appear to be increasing too fast, the water cut on it, but we feel like that under the present conditions, it definitely has peaked and will be declining.

Q Mr. Vick, how long after you started injecting water in the six wells did you get response on the 6-1?

A Approximately five and a half months.

Q Five and a half months. How much longer was it before you reached the peak?

A I don't have any individual curves on the respective producer in the -- well, it was approximately either in November or December that the well peaked out in oil production.

Q Is that November or December?

A Yes, sir.

Q What was it producing per day?

A Approximately 480 to 500 barrels.

Q It's producing 480 now?

A Yes, sir.

Q When did you start injecting?

A April the 15th, 1957.

Q About nine or nine and a half months?

A Yes. The cumulative water flood production from that well has been approximately 55,000 some odd barrels.

Q What is your anticipation as to how these wells will hold up, particularly the 6-1, do you think it will level off a while or fall off rapidly?

A It will just have to be indicated, as far as I'm concerned, just have to be indicated from future evaluation, I mean future performance, that we actually have no way of knowing whether the well, the respective injection wells around the well were receiving enough injection water to create a natural peak and then a sharp

decline, or whether they were at a lesser rate and that your peak production would be actually flattened out a little bit on top. I would say that it's our future planning in recommendations for the overall project to definitely, to come in with variations in injection volumes as regulated by partially a pressure balance method of ascertaining your injection volumes, and also a volumetric balance indicated by both of them, giving weight in the overall operation of the project, and taking in your performance data as you get it along, and also what we know about the cumulative primary production histories of the wells, whether they indicated they were tight wells or prolific wells or average wells.

Q Mr. Vick, it is my understanding that the way you are going to determine how to expand this unit is on the basis of when you get an effect or response from an offset producing well?

A Well, that would be one factor that would enter into it. Actually it would be a combination of everything that we would have at hand to look at and evaluate as far as calculated voidage in that area and the character of the primary history of the well, and just everything at our disposal.

Q Do you give any consideration as to whether the well had peaked or not, or whether it was on a decline?

A Yes, sir, I would definitely say that as far as water breakthrough into the well --

Q Yes.

A -- that putting on back-up wells, we feel like that we will

be able to time our expansion to such a degree that actually our water breakthrough, we will have our injection wells on before water breakthrough occurs, because that is what we are trying to alleviate.

Q It wouldn't make any difference to you in your analysis as to how much oil the well was producing, it wouldn't matter whether or not it had peaked?

A No, sir, if the well -- are you referring to possibility of a water breakthrough into a well without any increase in oil production?

Q I could be referring to that, or oil production either. In other words, the volume of fluids that it is producing, are you going to use that in your determination of when to increase your water flood?

A Yes, sir, that would be a factor, if it indicated to us that, say we had a perfect or an equal condition in the reservoir throughout this five-spot pattern and the outside producing well peaked at roughly fifty percent of the injected volume going into the -- total injected volume going into the two injection wells inside, then it would definitely be timed to put those outside injection wells on because usually in the operation of a flood, the moment of peak is the moment that actual water breakthrough occurs, theoretically.

Q Then you put more emphasis on water breakthrough than you do volume of fluid, is that right?

A Yes, sir.

MR. UTZ: I believe that's all I have.

MR. ELLIOTT: Could I ask another question?

MR. NUTTER: Yes, sir, Mr. Elliott.

MR. ELLIOTT: There are two questions I would like to ask Mr. Vick.

REDIRECT EXAMINATION

By MR. ELLIOTT:

Q One thing I would like to know, we are making a request for these four injection wells now. Do you think that the delay which has necessarily been caused by getting approval for these four injection wells, rather than having the order to go ahead and put them in two weeks or a month ago, might have caused waste in some respect?

A Yes, I do, I feel that.

Q In other words, if we hadn't had to wait for the approval you would already have had these four wells on some time ago?

A Yes, definitely.

Q Let me ask you this now. There's some indication from the Examiner that it's possible that you could get by with less injection wells than these four that you have asked for, and certainly less than the eight that you have asked for. Do you feel that if you are allowed less than the four required immediately, and would have to come back for another hearing and delay of a month or two on the next two or four, that you would need, that it

would result in additional waste and inefficiency of your flooding?

A Yes, sir.

MR. ELLIOTT: That's all I have.

RECROSS EXAMINATION

By MR. NUTTER:

Q Do you happen to have prepared a tabulation of the total production from the pilot water flood area since, monthly production figures since injection was commenced?

A Yes, sir, I can give them to you. They will be approximate off of the curve, Mr. Nutter. I don't have all of the monthly statements that we prepare on it.

Q Well, do you have a curve that you could present as an exhibit in this hearing showing the monthly production for the pilot water flood area?

A Yes, sir, it's not very presentable, but it's had some work done on it. We could offer it as an exhibit. I believe actually you all have copies of the same curve with your previous applications concerning the formation of the unit. Wasn't that exhibit on the formation of the unit?

M MR. ELLIOTT: I don't believe I recall.

MR. NUTTER: Let's take a recess and we will see if we have the exhibit. If we have that exhibit, we can get along without one here.

(Recess.)

MR. NUTTER: The hearing will come to order, please. Mr.

Vick, an investigation of the case file in the North Caprock Queen Unit case did not reveal that we have a graph showing the production of the pilot area, so if you can furnish us with an exhibit, it would be appreciated. If you could furnish us with a tabulation of the monthly production.

MR. ELLIOTT: Which would you rather have?

MR. NUTTER: It's immaterial, tabulation if you want to.

A All right.

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

MR. ELLIOTT: Did we ever have the exhibits approved?

MR. NUTTER: I don't believe so.

MR. UTZ: I have one.

MR. NUTTER: Mr. Utz.

By MR. UTZ:

Q Mr. Vick, as I understand it, you are the consultant who recommends when to develop and put into operation more injection wells for this project?

A Yes, sir.

Q They pretty well follow your recommendations?

A Yes, sir, to a fairly good degree.

Q Pardon?

A To a fairly good degree, yes, sir.

Q What you are asking for for the immediate future is four injection wells, which are colored in yellow on Exhibit 1, is that

right?

A Yes, sir.

Q And you want to put into operation four more injection wells that are colored in green?

A Yes, sir.

Q At your pleasure?

A Yes, sir.

Q Can you tell me on what basis and when you are going to recommend that the four green injection wells be put into operation?

A Well, we will, if approved, immediately put on the four yellow wells, and as we discussed a little bit earlier, watch the performance of the surrounding offset producers and take all that, evaluate all that information as it transpires week by week, and if after fifteen days or a month's injection into 32-12 and 32-14 and 31-8, if the producing wells 32-5 and 32-11 and also the eventual injection wells, 32-6 and 32-10 and 32-4, should start increasing soon, my recommendation would follow that to put them on.

Q Increasing in total fluids now, or what?

A Well, it would be oil, I'm at least hoping.

Q As soon as you have response from 32-5 and 32-11, then you would start getting ready to inject water in the four green injection wells?

A Yes, sir.

Q You would be injecting water in the wells 32-5 and 32-11 and possibly 31-1 had a chance to peak?

A Yes, sir.

MR. UTZ: That's all.

MR. NUTTER: Any further questions?

MR. LAMB: Mr. Nutter, I have a question. Raymond Lamb with Wilson Oil Company.

By MR. LAMB:

Q Do you have any indication, Mr. Vick, that the area southeast of your original pilot project is out of balance, or do you have any prediction that it will be out of balance?

A Do you mean southwest?

Q Southwest, yes.

A Well, from the production performance of 31-13 and 6-3 and 6-7, the outside producers to the present pilot area, their limited production indicates to us that we definitely are losing water drive in that direction outside of the pilot area, and that as a result it wouldn't be out of balance.

Q You have no indication of when it will be out of balance in that direction?

A No, sir. Now there is a point, we feel like that when we get our new pump set in and our plant and have a little more injection pressure, that we will be able to kick up the injection rate in 31-14 and 6-8, which have been, have had very low cumulative injection figures. We feel like that our oil increase will come up according to that rise in injection volume.

Q I notice that you didn't have any new input wells in that

area?

A No, sir.

Q That they are all --

A (Interrupting) We feel like that, as we explained from this Exhibit 3, that the primary production histories of actually those four outside producing wells have been very low, and from that we derive that the area has some sort of permeability variation or restriction or porosity condition that is more or less forming a barrier in this one area right along here.

Q Well, then, in establishing the entire unit area, you will have a barrier across the middle of your unitized area currently?

A Currently, yes, sir.

Q On this entire area, did I understand you correctly that the top unit allowable times the number of producing proration units would be a limit under which you could produce and operate your water flood?

A I definitely feel like we could produce for a time. We have no way of definitely stating right now that it would be adequate or that it might be in excess, actually we don't know.

Q You would have, then, some control over the maximum capacity wells by the rate at which you put on new input wells?

A Well, I believe I stated earlier that it would be my recommendation to continue evaluating our current performance data and that if no restriction were up there as far as the top allowable and that if we approached that to take it into consideration at the

time that the problem came up; otherwise, to go about our normal engineering procedures just like we normally would.

Q Under the cases that I have read, has this project been converted from a pilot project into a full-fledged water flood, or are we still in the state of a pilot project, even though it is unitized to seventy-two 40-acre units?

A I would consider it is in the pilot stage. Actually we are injecting into the six wells which were the original pilot wells, but considering the performance data of the northwest producing wells that have increased, it's definitely progressed beyond pilot stage, I mean we should have had injection wells on prior to this.

Q So it's beyond the stage of the pilot project?

A In that sense, yes, sir.

MR. LAMB: That's all.

MR. NUTTER: Any further questions of Mr. Vick?

By MR. NUTTER:

Q To what do you attribute the low cumulative injection into the No. 31-14?

A We have had a series of mechanical problems there. To begin with, we set a liner in the well, and the liner collapsed and we had to go in and re-work that; and then we lost that job and we had to re-work it a second time, and that actually has been the big factor during the progress of these re-work jobs in these liner failures. We had a lot of sloughing of the red bed section

or shale section immediately above the pay, down into the pay, and with its subsequent plugging, and we have fractured a well with a small fracture and tried everything that we know, with the exception of going up on pressure, that we have run some pressure tests that indicate that with the increase of approximately 100 or 150 pounds that we can get in a normal injection rate into it; but with the present facilities in the plant, we don't have that 100 to 150 pounds right now so we had to be satisfied with the present injection rate until we could get the additional pressure.

Q Well, this well had a relatively high primary production history, however, did it not?

A Yes, sir.

Q Which would indicate that the thing must be permeable?

A Yes, sir. Well, these injectivity tests with the higher pressure indicates that it actually is porous and permeable, but the subsequent workover jobs have allowed foreign material and such to get into the pay zone, and actually it's a mechanical restriction other than a formation restriction.

Q So you feel that perhaps the formation in the vicinity of the well bore is not permeable now, but it's on account of having been plugged by extraneous material?

A Yes, sir, mechanical, yes, sir.

Q To what do you attribute the fact that No. 31-15 has never yielded any startling results as a result of this water flood?

A Well, there again we don't know. We have cut off a small

fracture in the well, and we are contemplating a larger fracture job;after the first fracturing job on the well, it appeared that the well was going to come around and start increasing, but we got up to our 25 or so barrels a day, and it's just remained at that. It was definitely evaluated along with all the rest of the data concerning the possibility that it might be trouble from our injection wells, as far as the water going away from this producing well instead of centering on it, but it appears now, as in 31-14, there is some type of mechanical restriction around the well bore that we haven't relieved, and possibly the larger fracture job will, sand frac job, will fix that up.

Q The eight proposed injection wells that are the subject of this hearing being the yellow wells and the green wells on these exhibits, are the only wells that you contemplate converting to water injection at the present time?

A Well, yes, sir, at the present time.

Q What will be the next wells that will be put on injection?

A Well, it possibly will be some wells on a back-up arrangement to the Ambassador pilot flood which is in the northeast corner of their unit there, Mr. Nutter, or it could be.

Q Where would those be?

A Well, it would be in this vicinity of Section 6 here, the western half of Section 6, along in there; but there again we have that permeability and porosity condition that might alleviate any present back-up, we don't know yet, or we could have need for an

injection well or so along the northwest side of the area here now.

Q What would be the result of a state of inbalance occurring on the northwest side of the pilot flood?

A As we increased our pressure, I stated earlier, then 31-11 and 31-13 had just begun to respond with increased production , if those come up materially, well, we would be looking at the same condition offsetting those four injection wells for back-up that we have discussed over on the other side.

Q Do you think that what has happened here in the area colored in yellow on your Exhibit 2 is in essence a line water drive that's resulting from this pilot project?

A It could be to a degree called so, yes.

Q Is there anything particularly objectionable about a line drive type of water flood?

A Well, one point here is the fact that it's going down-dip instead of normally up-dip like a natural water drive goes, and you have problems centered around that, but mainly the point that we discussed earlier, as far as the economic limit of the producing wells.

Q Is the payout normally about the same or a little slower or a little faster on a line drive than on a five-spot type of water flood?

A It would be normally slower.

MR. NUTTER: Are there any other questions? If not, the witness may be excused.

(Witness excused.)

MR. ELLIOTT: At this time I would like to ask the three exhibits presented and prepared by Mr. Vick be entered into the record, if there is no objection?

MR. NUTTER: Is there objection to the introduction of Graridge Exhibits 1 through 3 in this case? If not, they will be received. Do you have anything further, Mr. Elliott?

MR. ELLIOTT: I believe not.

MR. NUTTER: Does anyone have anything they wish to offer in Case 1433?

MR. ROSS: John Ross, representing the Gulf Oil Corporation. The Gulf Oil Corporation being a working interest owner with a participation factor of approximately five percent in this unit, concurs in the recommendation of the Graridge Corporation and requests that the application be approved.

MR. COOLEY: Mr. Ross, where are your offices?

MR. ROSS: Fort Worth, Texas.

MR. McCRACKEN: McCracken with Ambassador Oil. I would like to concur in the application of Graridge.

MR. HAMPTON: John Hampton, Great Western Drilling Company. Great Western Drilling Company being a working interest owner in this unit would like to concur in Ambassador's recommendation.

MR. NUTTER: If there are no further statements in Case 1433, we will take the case under advisement.

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C E R T I F I C A T E

STATE OF NEW MEXICO)
) ss
COUNTY OF BERNALILLO)

I, ADA DEARNLEY, 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 under my personal supervision, 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 10th day of May, 1958, in the City of Albuquerque, County of Bernalillo, State of New Mexico.

Ada Dearnley
NOTARY PUBLIC

My commission expires:

June 19, 1959.

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 1433 heard by me on 5-6, 1958.

..... Examiner
New Mexico Oil Conservation Commission