BEFORE THE
NEW MEXICO OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
June 10, 1970

EXAMINER HEARING

IN THE MATTER OF:	
Application of Mobil Oil Corporation for a waterflood expansion, Lea County, New Mexico	Case No. 4367
Application of Mobil Oil Corporation for a waterflood expansion and amendment of rules governing same, Lea County, New Mexico	Case No. 4368

BEFORE: Daniel S. Nutter
Examiner

TRANSCRIPT OF HEARING

MR. NUTTER: Case No. 4367.

MR. HATCH: Application of Mobil Oil Corporation for a waterflood expansion, Lea County, New Mexico.

MR. SPERLING: I am James E. Sperling with Modrall, Seymour, Sperling, Roehl and Harris, appearing for the applicant in this case. Mr. Examiner, at this time, we would like to request that this case 4367 and the following case 4368 be combined for the purpose of receiving testimony.

MR. NUTTER: 4368.

MR. HATCH: 4368; Application of Mobil Oil Corporation for a waterflood expansion and amendment of rules governing same, Lea County, New Mexico.

MR. NUTTER: 4367 and 4368 will be consolidated for purposes of testimony.

In an effort to streamline the hearing of this matter, we, on our own volition, took one of the wells out of the applicant's application for 4367, and advertised it as a part of 4368. Applicant, in his application for Case No. 4367, asked for authority to drill two locations for water injection wells, one was at a standard location and one was at a non-standard. So we took the non-standard location and included it in 4368, which was for the conversion of 13 wells at standard locations. Now, it appears that our efforts to streamline this may have resulted in a little bit of difficulty

in handling, and I am wondering if the interested parties would be willing to stipulate that Case No. 4367 would be for two wells to be drilled, one at the standard location and one at the non-standard location, and Case 4368 would concern itself only with the conversion of 13 injection wells.

MR. LOPEZ: That would be agreeable to us.

MR. NUTTER: At this time, I would like to ask for appearances in these two cases, 4367 and 4368.

MR. LOPEZ: My name is Owen M. Lopez, with Montgomery, Federici, Andrews, Hannahs and Morris, on behalf of Marathon Oil Company.

MR. KELLAHIN: Jason Kellahin, of Kellahin and Fox, appearing on behalf of Continental Oil Company. We have no objection.

MR. LOPEZ: Mr. Examiner, I would like to introduce Jack McAdams, counsel for Marathon from Texas.

MR. NUTTER: Do we have any other appearances? We have three appearances, then, Mr. Sperling on behalf of Mobil; Mr. Kellahin on behalf of Continental Oil Company; and Mr. Owen Lopez and Mr. McAdams on behalf of Marathon.

Are all three parties willing to stipulate to the inclusion of two wells to be drilled in Case No. 4367, and 4368 to concern itself only with the conversion of 13 existing wells?

MR. SPERLING: Mobil will join in the stipulation.

MR. NUTTER: In this case, we will proceed with our hearing of the two consolidated cases, and the order will be entered as described beforehand.

MR. SPERLING: I might inquire, Mr. Examiner, as to how you want to receive the exhibits. We have an area map which, of course, would be pertinent in both cases and it would be my suggestion that we mark a copy of the large area map in both of the cases and then mark the additional exhibits as appropriate in view of the stipulation and the implication of the two applications.

MR. NUTTER: This would be Exhibit No. 1 in each of the two cases?

MR. SPERLING: Yes, sir. I believe my appearance for Mobil has already been noted. We have one witness in these cases.

(Whereupon, Applicant's Exhibits 1 through 5 were marked for identification.)

(Witness sworn.)

PAT KELLY

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

DIRECT EXAMINATION

BY MR. SPERLING:

Q Please state, for the record, your name, place of

residence, your employer and the position in which you are employed.

A My name is Pat Kelly. I live in Midland. I work there for Mobil Oil Corporation as a Petroleum Engineer.

Q Have you on any previous occasion, testified before the Commission so that your qualifications as a Petroleum Engineer are a matter of record?

A Yes, sir.

MR. SPERLING: Are Mr. Kelly's qualifications acceptable?

MR. NUTTER: Yes, they are.

Q (by Mr. Sperling) Mr. Kelly, by way of background pertinent to these two applications which have been consolidated for the purpose of testimony, would you please give us a brief history of the production, both primary and secondary, that has occurred in the area, which is the subject of this hearing?

A San Andres production was established in the Vacuum Field, in 1929. Primary production was under solution gas expansion. There is possibility there is some water drive in the south end of the field. The field has produced 125 million barrels of oil to the end of 1969. Development of the Bridges State lease, State G, and State J leases, which are involved in this application, began in the 1930's. Most of

the primary reserves had been produced by the late '50's or the early '60's. A pilot waterflood operation was started on the Bridges State lease by injection through six San Andres wells located in Section 14, in forming part of the lease in December, 1958. That pilot operation was expanded to two more wells, one in Section 23 and in the other injector in Section 14 in 1963.

The performance of the expanded pilot, subsequent to 1963, justified a further expansion of injection operations to a total of 30 injection wells, late in 1967. The 1967 expansion extended down to the south lines of Sections 22, 23 and 24, generally speaking.

This application today is concerned with expansion of that waterflood to include injection wells covering the balance of the Bridges State lease on the south end. Some 2,236,000 barrels of oil have been produced from the San Andres formation on the Bridges State, State G and State J leases, since water-flooding operations were started in late 1958. Approximately 1,150,000 barrels of that oil is attributed to the waterflooding operation.

Q Now, for the purpose of identification, would you please refer to what has been marked as Exhibit 1 in both case 4367 and 4368, and identify that, please?

A Exhibit 1 is what I would call an area map of the Vacuum Field. It shows situated on it all of the wells that had been drilled or completed in that area up to January, 1970, which is the last date the plat was brought up to date. It shows, in the approximate center of the map, the Bridges State lease, which is the subject of this hearing. It covers all of the ownership and development within two miles of the Bridges lease.

Q Now, also for identification, refer to what has been marked as Exhibit 2 in both cases and explain what it portrays.

A Exhibit 2 is a small area map covering the Bridges State, State G and State J leases, in addition to acreage offsetting those leases. It shows, according to the legend, the injection wells which are currently in service as a result of the earlier flooding efforts. It shows, in red triangles, the injection wells which are requested for approval in these two applications and it shows in open triangles, on the north end, proposed injection wells which we will be extending lines to in cooperation with the offsetting Gulf Oil Corporation on the Lea State F E lease and the Yates Drilling Unit Flood, which was recently approved by the Commission.

We will expect to make application for administrative approval of those injection wells, following the approval of

these applications, part of which is an application to allow further expansions on an administrative basis, without the necessity of demonstrating response to waterflooding in the expansion area.

All those injection wells indicated on the north end of Bridges lease proposed for injection in the future are covered in a cooperative agreement which has been executed between Gulf, Yates and Mobil.

Q Now, would you please identify the location of the wells which are the subject of the application in Case No. 4367? Those are the two wells to be drilled, proposed to be drilled?

A Yes, sir. There is a well proposed for drilling for injection use, 330 feet from the south lease line in "E" location of Section 25, another well is proposed for drilling 100 feet from the south lease line in "N", location of Section 26.

Q And explain briefly the relief sought in application 4368.

A The application covered in Case No. 4368 is for the purpose of extending the flood to include injection authority in the remaining 13 red colored wells on Exhibit 2, all of which are at regular locations, all of which, with the exception of well No. 132, have been produced, or have been developed at some time with a producing well in the San Andres formation.

I might point out that there is no San Andres well in Unit E of Section 25 at this time. There are two wells at this time, one is completed in the Blineberry and the other is a Glorieta well.

Q Now, do the wells which are shown on Exhibit 2 represent San Andres wells or other wells drilled or completed in other formations?

A Exhibit 2 shows all of the wells that have been drilled insofar as we know of them, that have been drilled on this acreage. It includes wells completed in various reservoirs down through the Pennsylvanian. I believe there are a couple or three more wells indicated on the north end of the lease. For example, there have been twin or triplet wells drilled on different units at various places over the lease. They are completed in different arrangements. We do have logs on recently completed wells; the original San Andres wells we have only a few longs on.

Q These were the wells that were drilled in the late 30's?

A Yes, sir.

Q What completion method was used with respect to those wells?

A Most of those wells were open-hole, casing set up

that's what I would expect to happen.

Q Do you have anything else to add at this time, Mr. Kelly?

A I believe not, sir.

MR. SPERLING: At this time I would like to offer Exhibits 1 through 5 in Case No. 4368 and I believe we have two exhibits to offer in 4367.

MR. NUTTER: Exhibits 1 and 2 in case No. 4367 and Exhibits 1 through 5 in Case No. 4368 will be admitted in evidence.

MR. SPERLING: I believe there is a third exhibit in 4367 which includes the well sketch insofar as the completion and proposed wells to be drilled, which is substantially the same. They may not have gotten separated properly.

MR. NUTTER: Exhibit No. 3 in Case No. 4367 will be admitted in evidence.

(Whereupon, Exhibits 1, 2 and 3 in Case No. 4367 and Exhibits 1 through 5 in Case No. 4368 were admitted in evidence.)

MR. SPERLING: That's all we have.

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

CROSS EXAMINATION

BY MR. KELLAHIN:

Q Mr. Kelly, on looking at Exhibit No. 5, it seems to

in the San Andres somewhere, or Grayberg and/or the well completed natural if sufficient fluid entered the hole. If not, most wells were shot with nitro glycerine and most of them do have shot holes.

Q Now the Exhibit in Case 4368, marked 3, appears to consist of a number of logs. Would you explain what logs those are or what they consist of?

A Those are the logs that we have available on proposed injectors, covering this application. They have been marked to show the San Andres porosities that we expect to take water.

Q I believe I understood from your previous testimony that the waterflood operations conducted to date have been quite successful, is that correct?

A Yes, sir. The initial pout at the outset was not very successful. For several years water was introduced into the San Andres and at low volumes and at low pressure. There is in the north end of the Bridges State lease what I describe as a high porosity or high permeability streak within the body of the pay. It varies in thickness from 10 to about 20 feet and is found in a good many wells on the north end. It took water very readily, I think, at low injection pressures and is not flooding the balance of the rock.

In 1963, when the flood was expanded, we kicked the

injection pressure up pretty high and increased the rates and were successful in getting, I believe, some water into the tighter rock and as a result we produced quite a lot of waterflood oil up there.

Q Now, is production represented by Exhibit 4?

A Exhibit 4 is a graphical history of flooding operations since the first of 1966. It shows where injection increases in the '67 expansion. It shows that oil production increased to about 1200 barrels per day, approximately 18 months after the flood was expanded in 1967 and the last six or seven months' production has declined to about 920 to 940 barrels per day on the lease and it appears to be maintaining steadily at that level.

Q Now again with reference to Case No. 4368, would you explain the conversion procedure which you would expect to follow in connection with the wells indicated on Exhibit 2 to be converted?

A Most of these wells have already been converted. They were converted by cleaning out, cleaning out the well to the base of the porosity that we wanted to inject into and the running of cement line tubing set on a packer up on the casing. In one or two cases, we re-entered wells which had at one time been San Andres wells and had been deepened to other horizons

and depleted and we re-completed in the San Andres as injectors. We have re-completed those casings, we have drilled Bridges State this spring as an injector and completed it through perforations.

The casing annulus above the packer and behind the tubing has been loaded in each case with treated water. I might say that all the surface facilities, distribution system and injection and station piping is cement lined and most of it is in the ground right now.

Q Does Exhibit 5 in 4368 represent the completion of conversion procedures to be followed in the wells which are the subject of the application in that case?

A In case No. which, sir?

Q 4368.

A 4368. Exhibit 5 is a package of well-bore sketches portraying the completion method or condition of the wells after they have been converted. Most of those portray conditions as they are at present because the wells have actually been converted and a few of them, two or three, have not been converted yet and in those instances the sketch shows how we expect it to be, and, of course, in the case of the wells which we plan to drill, the sketch shows we expect to case through the pay and perforate for injection in the selected porosities

and that we will be injecting through cement-lined tubing set on a packer above the perforations.

Q Well, is that the completion method you anticipate to be used in connection with the two wells proposed to be drilled?

A Yes, sir.

Q That are the subject of 4367?

A That's right, so, essentially, the --

Q Methods to be employed are the same?

A Yes, sir. Where there is casing through the pay, it is perforated, or will be perforated, and where it's open hole, the packer is set up in the casing and we are injecting out the bottom of the casing.

Q You have mentioned previously the injection in the selected areas of porosity. How do you propose to select those areas of porosity?

A We have done quite a lot of geological work in the last year or two on our property here and have identified two principal sources of production, what I describe as an Upper San Andres porosity and a Lower San Andres porosity. The Lower San Andres porosity has been and will be perforated in, cased injection wells where the casing runs through the pay where that porosity is above what we have found to be the oil-work

contact in this area, in that zone, where there is indicated to be oil, recoverable oil, in the pattern that that injection well is going to serve in that porosity and, of course, we will perforate from the upper porosity, too. In the case of open hole injection completions where we have formed the opinion that the lower porosity could contain oil at a location, or within a pattern, we have deepened those wells so as to expose the lower porosity to injection.

The upper porosity is open in all wells and until recently the lower porosity has not been opened in all the wells.

Q Is there any separation as between these two porosity zones, that is, by any sort of impervious substance?

A Yes, sir, there is a combination of shale and limestone, or dolomite intervening between the two porous intervals on the Bridges State lease, at least I would have to refer to a specific well to give you my opinion of the exact interval between them but, in general, it's about 200 feet, vertically, between the two porosities.

Q Well, do I understand that you will be selective insofar as the point of injection in a given area of porosity?

A Yes, sir.

Q By well?

A We have been selective and we will expect to be selective in the future.

Q Now it appears from Exhibit 2 that this flood pattern follows the five-spot, ordinary five-spot pattern, is that correct?

A That is the pattern we started with in the pilot and we have found no reason to change it.

Q Now the two wells which are proposed to be drilled in Case No. 4367, which I think you identified as being located respectively in Sections 25 and 26, Unit "N" in 26, and Unit "E" in 25, are these wells required in connection with the preservation of the integrity of the pattern you have developed the flood on?

A Yes, sir, the well in Unit "E" of Section 25 is required because there is no well there, well-bore there available, for use to inject into. If the recoverable waterflood oil is to be produced, it will be necessary to close up the south end of that pattern with an injection well.

At this point, I might say that we have approached, through the mails, the offset operators to the south, Marathon, Continental and Texaco, in an effort to obtain lease-line cooperation in cooperative flooding operations. We offered to provide those parties with pressured water from our system

to inject into their wells which would complete the patterns that we have been butting up against the lease line. In the case of Texaco, who operates a unit offsetting to the south, that portion of the Bridges State lease which is found in Section 27, it is my understanding that and, it is I think public information, that they do have a waterflood under way on that unit. I forget the name of that unit, I believe the west Vacuum unit. They have a sparce injection well network and I believe they have learned that it is going to be necessary to inject a lot more water than they have been injecting, and have plans for expanding that flood to a five-spot pattern which would merge very well with the pattern that we have on the Bridges lease.

MR. NUTTER: Is it their intention to put that Arco Well No. 13 in Unit "A" of Section 34 on flood, or do you know?

THE WITNESS: It is my understanding that Texaco intends to convert Well No. 13 which goes by some other number, namely in the unit.

MR. NUTTER: That well in that forty-acre tract would be converted,then?

THE WITNESS: Yes, sir, but they have not indicated when this would be.

MR. NUTTER: Is the Phillips lease to the west part

of that unit, do you know?

THE WITNESS: I don't believe it is.

MR. NUTTER: Go ahead.

THE WITNESS: There is some question of when the budget funds will be available to do the work. It is a fact that the work is planned to be done. At this point, I have confidence, at least, that the well indicated, No. 13 in the Northeast corner of Section 4, will be converted to injection in time, to let us sufficiently flood our property.

With respect to Continental and Marathon, the letters that we wrote resulted in refusals or, or in other words, they both declined to participate in a cooperative waterflooding venture. I found no trouble in understanding why Marathon did not want to participate as their wells, my research had told me, were approximately top allowable wells and there was little incremental right to be gained by expanding the flood onto their property. My research indicated to me that some of the Continental wells in Section 35 had declined in productivity somewhat and could be helped by joining in the waterflood effort and so we approached them then through the mail and after some time, I'll say a period of several weeks, or perhaps a few months, we received another reply which said they had looked it over, in so many words, looked it over carefully, and couldn't

bring themselves to participate.

It was at that point that I began to be concerned about this waterflood,that we were in the process of expanding, producing the waterflood oil that it had to produce to generate the economics that justified the work because we did have some hope that we would gain lease-line cooperation and swap out the reserves that would cross the lease line.

All of our wells that are currently drilled along the south lease line and are proposed for injection are approximately 660 feet from the line. On top of that, the fact that no injection would be taking place to the south caused me to conclude that the ordinarily recoverable waterflood reserves in the north half of those patterns would not all be produced by the producing wells serving those patterns, if the patterns were allowed to remain open on the south.

I finally determined that we, in order to maintain the integrity of our flood on the south end, that it would be essential to have injection take place south of Well No. 26 for two reasons: to insure a reasonable opportunity of Mobil producing through Well No. 26 the recoverable waterflood reserves underlying its property in that pattern and to insure that the otherwise recoverable waterflood oil that would be pushed south of Well No. 26 outside the influence of a producing well-bore would be recovered at all, because it's my opinion

it will not be recovered at all because I expect to stop injecting when No. 26 reaches the economic limit and whatever oil has been pushed out of it will not be recovered.

Q (By Mr. Sperling) Now what governs your decisions as to the rate of injection, say in the pattern proposed, pattern in Section 26?

A On an average, our injection facilities and lines are designed to accommodate about 700 barrels of water per day per injection well because some wells have thicker pay exposed in them, and some thinner pay. I expect that the injection into those wells will range up and down and in proportion to the reservoir volume that I estimate is within those patterns.

In each case, insofar as it is possible, it will be my intention to bring about injection into each of those wells which will tend to flood out the pattern from all directions at approximately the same time.

Q Well this suggests then that if an injection well is further removed from the producing well in the pattern, that the injection rate, assuming some uniformity of pay section, the injection rate would be greater than the rate in a well which is located closer to the producing well, is that correct?

A Yes, sir, that's correct. Given uniform conditions,

indicate most of your proposed conversion will be completed open-hole?

A Yes, I think that's true.

Q And that your well No. 132 is perforated and open-hole 4912 feet?

A I believe that's correct. If you are looking at the exhibit, I will accept it.

Q Now, you propose to drill an injection well in Section 25 of Unit "E". How will that well be completed?

A In accordance with the sketch which was submitted in that case, a copy of which is on top of this package that I will hand you, the well is expected to be completed through perforations with pipe set through the pay.

Q Now, would those perforations from 4500 to 4850 feet cover the entire producing horizon in the Vacuum and San Andres River Field?

A I think insofar as I understand, the oil pay to be present, that would encompass the lower pay, that's if it's there; I don't know that it is.

Q You don't know if it is in that particular area or not. Do you know what zones Continental oil wells are completed in?

A I have searched the records the best way I know how and insofar as I have been able to determine, some of the wells

are completed open-hole through the upper and lower porosities and some of them --

Q Would that take it down to 4850 feet, is that the lower?

A Yes, sir, I think some of them are probably getting production out of the lower porosity and I think that one of them may not be getting production out of the lower porosity.

Q That is the zone you would deflate?

A To the extent that it is oil-bearing on our property. We have found, for example, that several of our wells penetrate that lower porosity below water and we will inject into those wells that did find water in the lower porosity only in those cases where it is indicated to be oil-saturated within the pattern that will be served by the injector.

Q Well, you don't know whether that situation exists on Continental's lease? You are talking about what exists on your own lease?

A I didn't follow you.

Q I say you don't know whether you found oil saturation on Continental's lease or not.

A I don't know what Continental has experienced with respect to the production out of that lower porosity. I know the work we have done indicates that some of Continental's

wells penetrated the lower porosity below water. But I know they've made a great deal more oil than our wells. In general, the production improves dramatically south of Mobil's lease line.

As a matter of fact, a number of wells have been deepened and have been made good producers and through the scout tickets I have been able to turn up, most of those wells penetrated a sufficient depth at the outset to uncover the lower porosity that I am concerned with.

Q When they were initially drilled?

A Yes, sir.

Q Now you stated that your production was about 940 barrels a day from this project, is that correct?

A Currently, yes, sir.

Q What water are you producing?

A In the neighborhood of currently 2200 barrels per day. It is a little difficult to break that precise volume out because we do transport water production from other zones into our system and I rely on the produced water meter, rather than the produced water estimates based on well tests for plotting my data. It may be that the reports made to the Oil Conservation Commission carry a different water production figure than I have plotted on this graph. I have more confidence in the metered column being correct than I do in the allocated

volume based on well tests.

Q Now you testified, I believe, that you increased the pressure in 1963?

A Yes, sir, a long time before that. I think we were flooding the, what I have termed the high porosity streak, the best streak of high quality pay in the body of the main pay and I do not believe we were flooding the balance of the reservoir.

Q You are still flooding that, are you not?

A Yes, sir.

Q Have you ever run an injectivity profile on these wells?

A Yes, sir.

Q What zone appears to be taking this to order?

A The injection profiles that we ran were confined to the pilots. I haven't run any outside the pilot; it's been a few years since I ran one up there, but intervals ranging between 15 feet and 250 feet were indicated to be taking water at different times and under different conditions. I can't say that I have drawn any correlation that I can speak intelligently on today which would demonstrate that the profile or the degree of sensitivity that profile has to injection pressures.

I have the opinion that the higher the injection

pressure is, the more pay we will get water into, as a general thing.

Q Now, there are actually a number of porosity zones in this pool?

A The point that we are flooding in the north end has just the upper pay and it thins quite a lot on the north.

Q So your injectivity profile would be confined to the upper pay, is that correct?

A Yes, sir.

Q Is that where you ran your profile?

A Yes, sir.

Q You don't know what the situation is in the southern portion?

A I don't know the situation with respect to what?

Q With respect to the injectivity of the various zones.

A No, sir, we haven't injected in the south end and run no injection profiles in there. I have the opinion that, from what I can see of the logs, that the second porosity is much higher quality, generally speaking quality, than the first porosity and I would expect to take water more readily in the first porosity.

Q You testified you propose to make a lease-line

agreement with Continental Oil. Are you familiar with the correspondence?

A Yes, sir, I wrote the correspondence, some of it.

Q What wells did Continental require to convert to water injection?

A I don't have the correspondence in front of me so I can't tell you for certain, but I would say that the well situated immediately south of the well that we propose for drilling in Unit "N" is one of the wells that we asked Continental to convert and, let's see if there is another. I don't recall whether we asked them to convert another or not. It's probably No. 2 well in the northeast.

Q Do you know what those wells are presently producing?

A No, sir. At the time that the correspondence was initiated, I have some faint recollection that the well to the west, which is probably well No. 6, was making something like ten or twenty barrels a day, but that is only a faint recollection.

Q Now, do you have any recollection as to what the volume is that is proposed to be converted?

A That is the well I am talking about.

Q That's 6, ten barrels?

A Yes, sir. I have the production records here. You can refer to them. There is no need to guess.

Q Now, you stated in your opinion, it was essential to drill the wells, this particular well in Unit "E" of Section 25 to protect your flood pattern because there is no well there. Does that requirement include a requirement that you drill one hundred feet from the lease line?

A I apologize for not following you, sir. I was referring to the production data. At the end of 1965, Well No. 6 was making on the order of ten barrels a day, ten to fifteen barrels a day, throughout that year. It ranged from below ten barrels a day up to fourteen or fifteen barrels a day, according to the production report that I am looking at here.

MR. NUTTER: What is the total for the year from the well?

THE WITNESS: 3994.

MR. NUTTER: That is No. 6?

THE WITNESS: No. 6, yes, sir. The total for No. 2, which I see was a much better well, was 17,719.

Q (By Mr. Kellahin) How many barrels a day?

A It was making 50 or 60 barrels a day toward the end of the year.

Q Now to get back to my next question. You say in your opinion it's essential to protect the integrity of the waterflood

pattern to drill the well in Unit "E", does that include the drilling of the well at a hundred feet from the lease line?

A Yes, sir. The closer I drill that well to the producing well, the more likely I am to prematurely flood it out with injection into that well.

Q Now, isn't the converse true?

A I wasn't through. And, of course, I would like to produce as much as possible. The recoverable waterflood reserves that lay underneath Mobil's lease, and a hundred feet from the line, is just as close as I felt obliged to ask the Commission to approve, that's all.

Q The closer you get to Continental's wells, the quicker you will flood it out.

A Assuming there is communication laterally between the wells, I think that's true, and I am willing to assume there is interchange of fluids in there. I assume Continental's wells have produced a great deal more oil than Mobil's wells have and there is something which happens, I believe, to the pay in the area intervening between Continental's lease and Mobil's lease and, for that matter, Marathon's and Mobil's lease.

Q You wouldn't consider it an effective barrier?

A I don't represent that it is, no, sir.

Q If it were, it would be an ample back-up for your flood, is that right?

A That's right.

Q Now what would be the result of not placing this last row of wells --

A It depends on how close it is. If it were close to the producing well, it would be satisfactory.

Q What would be the result of not placing this last row of wells on injection in the absence of a lease-line agreement?

A Well, I haven't calculated the volume, but in general, it looks like we would be cutting of a third of the south end, a third of those two Mobil's acreage in Sections 26 and 27 from any flooding at all and would be subjecting the wells in the center of that section, namely 33 and 39, to production from open patterns which would result in some part of the recoverable oil in the north part of those patterns being pushed out to the south where energy to getting it into a producing well bore would be pretty scarce in the absence of

injection, and speaking generally, I'll say that the sizeable share of the oil that we would expect to produce from this waterflood expansion would not be produced short of converting those wells to injection along the south line.

Q You say would not be produced, would not be produced as a result of the waterflood pattern you would then have although a subsequent injection program could be installed could it not?

A I will allow that the economics of any situation can be developed which will allow you to take certain steps at one time or another. The economics of the flood expansion that we have currently underway will not allow the south end of that lease not to be flooded at this time. The south end of the lease, in fact, in general, the wells in Sections 25, 26 and 27 are at or below the economic limit at the present and it is a matter of getting with it or getting without it.

Q You would still have a flooded Section 25 if you omitted the last row of injection wells, would you not?

A It would be a puny effort. I can see that we would have, we would gain two patterns, two complete patterns, if we did not complete the south row of injection wells in this expansion.

Q But those wells would remain on production and would

get the benefit of injection to the north, would they not?

A I don't know to what extent they would get the benefit of injection.

Q You have not calculated that?

A I assume they may get some.

MR. KELLAHIN: That's all, thank you, Mr. Kelly.

CROSS EXAMINATION

BY MR. LOPEZ:

Q How many wells are producing in the current flood zone?

A If memory serves me, I believe 61 San Andres wells on the lease that are currently producing.

Q Could you tell me what the average production per well is per day?

A I could divide it out for you. We are making 940 barrels a day from the lease, and I didn't bring the slide rule, but -- gosh, --

Q I direct your attention to your wells 13 and 11 that offset Marathon's wells No. 2 and 4 in Section 25. You have stated, I believe, that both of these wells are drilled to the Blineberry formation and the other to the Glorieta?

A I am certain that Well No. 13 is a Blineberry completion. My memory is hazy on where Well No. 103 is completed, but I

believe, it is the Glorieta. Those are both profitable wells where they are complete and they are not available to me in this expansion.

Q In the injection well you propose to drill near your Well 13, which offsets our Wells 4 and 2, I would say, you propose only to go to a depth of 4850 feet, is that correct? I believe you have it on your Exhibit 5.

A Well, the sketch shows schematically what we expect to take place. I expect to stay straight as I can. I expect we will want to inject into all the oil-bearing porosity that we find if and when we drill that well, that is such porosity as underlies our lease. Now, with the available of quality logs being pretty scarce, I think we'll get more information on what the well penetrates from the log of the well itself than we will by speculating as to what is there or where the porosity is found.

I don't know precisely where it will come in. The work that we have done indicates to me the second porosity will probably all be above 4850 feet, yes, sir.

Q This, of course, will mean you will have to convert your 13 and 11 wells to take advantage of this flooding action?

A No, sir, I don't intend to say that. Wells 13 and 103 are profitable wells, where they are completed, and I will expect

us to continue producing those wells in the zones to be completed in. I don't expect them to be completed in the San Andres.

Q That will entail,necessarily, Wells 11 and 16 that you believe will be advantaged by this drill and 33 and 16 from the San Andres?

A Thirty-six. I believe we have re-completed 36 in the San Andres, I am not clear on that. It is the well we intend to produce on the San Andres on that pattern.

Q Sixteen?

A Sixteen is up in the northwest quarter of the northeast quarter of 25, and I don't expect any straightforward help for that pattern from injection into the proposed well to be drilled.

Q I believe Mr. Kellahin already has indicated, has asked you, you cannot be certain that if you do propose, if your application is granted, that the flooding will not affect our Marathon's well in the section directionally south of this well site?

A It's true that I can't be certain of whether or what the effect will be. From what I have seen, I have the opinion that there will not be a great deal of effect on Marathon from injection into that well. We do have a log on 103 which would be a west twin to the well that I want to drill and while I wish there were second porosity there, I don't see it on the log so

I don't know whether we have it there or not.

Q Now I direct your attention to Well 25 which you have proposed to convert into an injection well. This is an open well at the present ant is it your proposal just to drill that deeper?

A Well 25 was drilled initially to a depth sufficient to expose the second porosity. At some period in its history it was jumped and at this time does not have the second porosity open. I will be evaluating that well for a work-over to get the second porosity on that because I believe that it contains more saturation in the upper parts of it.

MR. McADAM: Mr. Examiner, could I also ask some questions?

MR. NUTTER: Certainly.

CROSS EXAMINATION

BY MR. McADAM:

Q Do you know what depth Marathon's wells are on in the State of New Mexico, McAllister Lease, that are now producing, from what porosity zone?

A No, sir, I don't know what they are now producing. I have available to me the scout tickets, I suppose covered the initial drilling and completion operations.

Q As I understand, you propose to drill this well as a

direct offset to our No. 4 Well, to a depth of 4900 feet, is that correct?

A Well, sufficient to be sure that we have given the well a chance to penetrate the second porosity, if it's there.

Q As far as you know, there is just two porosity zones in the San Andres?

A Just two we have oil out of. There are a lot of San Andres porosities.

Q At what interval is the lower porosity found?

A Well, I don't have the data in front of me to tell precisely where it is. Let's see if I can give you an estimate. No, I don't have the information in front of me to tell me that. I think it's -- if what I have been calling second porosity is there, unless something unusual has happened geologically in the intervening area, it ought to come in above 4850 feet.

Q Do you know where the second porosity is found in your Well No. 13?

A No, sir.

Q I think it's drilled to the Blineberry. Do you have a log on that well available?

A I don't recall whether 13 was logged or not. I have been using a log on 103 which is about 330 feet south of 13 and I don't find any second porosity in 103 and the upper porosity

is pretty skinny there. I will be hoping for more than that thing shows.

Q So in your opinion, this second porosity is not found in your Well No. 13?

A It probably is not, if I can rely on the log. Well 103 as indicated is what is present in that area. Of course it may be the log's not any good.

Q Do you know what depth this so-called second porosity zone is found anywhere in this field?

A I have to refer to a log. If I can lay my hands on the log of Well 25, I can tell you where it is on that well. Let's see -- I think I know where it is in 132. In order to be absolutely certain, I would have to correlate with the log I have marked. I am looking at a Gamma Ray Neutron Log on State Bridges No. 25. I didn't run across the log of 25, and I see on that log a porous member which extends approximately 4694 or 95, on down to about 4720, something like that.

Q That is what you refer to as the second porosity?

A That is what I have been calling the second porosity.

Q Let me ask you this. Do you consider this lower zone more porous, more permeable zone, than what you have been encountering in the northern portion of your State Bridges lease?

A It looks a lot cleaner on the log, yes, sir. I think

it is better pay on most of the logs.

Q It would be more receptive to water injection?

A Yes, sir, I think the water will enter in proportion to the thickness and the permeability.

Q And it should enter better in the lower zone and should extend further and project the output further?

A I don't know that I can make that as a statement. I said it would enter -- I would expect it to enter in proportion to the thickness and the permeability. I would have to do some figuring to see if it would progress more rapidly in feet per second laterally in one than the other.

Q You would expect that -- it seems to me like it's more permeable, more porous, that the water is going to move better just as in the case of oil.

A I apologize for it not being clear to me right now.

Q It's not clear to me either. The other question I have -- on this offset here to the Marathon State of New Mexico McAllister lease, I didn't get while ago exactly what well is to be influenced. Did you say Well No. 36?

A Yes, sir, I believe 36 is the well that we have projected for our San Andres production in that pattern. Of course, it will influence No. 11 and Well No. 27.

Q Is Well No. 11 a Blineberry well?

A I believe that No. 11 has been substantially depleted of its Blineberry reserves and has been or is scheduled to be completed in the San Andres, although I will let the records correct me if I am wrong, we do have a producing well scheduled for that location and it is one of those three.

Q I thought you said a while ago that 11 and 13 were not scheduled.

A No, sir, I said 13 and 103 are producing from other horizons and they are making profit where they are.

Q How is this going to affect your existing pattern, your so-called --

A How is what going to affect it, sir?

Q -- the drilling of this well.

A It's going to close up the south end of the pattern that will be served by producing Well No. 36. It will close up the east side of the pattern that will be served by producing Well No. 27 or some other well that will be located. Twenty-seven produces from another horizon and it will be served by the producing well at the location of No. 11 to the east of the well. There are one, two, three producing wells that I expect to be influenced by injection into the proposed injection well.

Q Seventeen will be influenced by it?

A Seventeen? Seventeen is a proposed injection well in

the extreme northeast corner of Section 25.

Q Do you think 16 would be influenced by it?

A I think there is a possibility. Crazy things happen when you start injecting water. I don't have reason to think it will.

Q On any of those open hole completions, how do you control that water?

A By volume and pressure.

Q Volume and pressure, but you can't control the zones that it is going to enter into?

A Well, the zones themselves control that, if they're porous and permeable --

Q You can't tell the Commission which zones have been receptive nor can you say that since the early history of this field have you run any surveys to establish the course which this water has taken?

A I testified earlier that we have run a number of profiles in our pilot that if you rely on tracer surveys that show where the water went and it went into the pay.

Q Which pay?

A The pay that was exposed to the well bore, the upper pay.

Q Have you experienced -- let me ask this question --

how much oil do you think that you will lose, that you would lose, by backing up that proposed injection well off from Marathon's lease by, say, another 660 or 330, leaving off that last tier, how much would you lose there?

A If I would back off to 660 rather than 330? I haven't formed an estimate of that. I think there -- well, I ought not to speak from memory. I have calculated the incremental area and I don't remember what it was. I think it was thirteen or fourteen acres, it seems.

Q What amount of production would you say would be lost at that location should you adopt the suggestion that was made by Mr. Kellahin, backing it off, leaving off that last tier of wells, and particularly moving this one up?

MR. SPERLING: Which wells are you talking about, Continental's or yours?

MR. McADAM: I am not talking about mine, the one offsetting --

A The one well?

Q (By Mr. McAdam) -- the one well, moving it up.

A To 660 or not digging at all?

Q 660.

A I haven't made an estimate of that quantity of oil.

Q Excuse my ignorance. When you have a water break-

through, what actually occurs in the reservoir?

A I'm not sure precisely what occurs in the reservoir. I have the opinion that when water breaks through prematurely it is because there is some avenue of effective communication which is all out of proportion to the balance of the reservoir, of the rock. I think this is what happened on the north end in the early days.

Q Oil is left behind -- you mean it breaks through the oil column or fractures the reservoir, just leaves behind oil?

A Speaking in generalities, sometimes I think you can fracture impervious rocks and extend it with injection water. I don't think you can extend a fracture that is already there and permeable in porous rocks and thereby cause a channel in the area up north. We have enough information to convince me that there is a zone of very high, relatively speaking, high permeability within the body of the pay which correlates between wells and is generally present in some areas and those are the areas, by coincidence or whatever, that have experienced the water break-through. I attribute it to that zone being more permeable. I don't believe that we've communicated between wells with fractures, induced fractures.

Q You don't think you have had any fractures?

A No, sir.

Q At what pressure do you think this reservoir at this stage would fracture?

A Somewhere in the neighborhood of twenty-six or twenty-seven hundred pounds at the surface, and that's sort of a guess at this point. I have made computations in the past and that's the order of magnitude of fract pressure that sticks in my mind. We have fracted a good many wells, well several wells, in the north end, and found variable instantaneous shutins after the fract treatments which I will say have gone quite a lot above the pressure that this system is designed to handle, which is 2500 pounds.

Q In your list of exhibits, do you have any cross-sections?

A I haven't offered any cross-sections.

Q You mentioned a while ago that you had requested that Marathon enter into some cooperative plan?

A Yes, sir.

Q What was the proposed plan?

A I can't tell you in detail what it was. I can speak generally and say that Marathon was invited to convert a well or wells to injection offsetting the Bridges lease, with the understanding that Mobil would be willing to provide pressured waters for injection into that well or wells and delivered at a point, at some convenient point, for pickup. I think that was

probably Well No. 3, but I don't have the correspondence in front of me and so I can't -- I believe it was Well No. 3. Perhaps Well 2 and 3, it looks like, would close up that pattern. Those are probably the wells we asked you to convert.

Q 2 and 3?

A I don't have the correspondence with me and I can't tell you for certain. I believe that is -- that would close up the pattern. That's the logical thing that I would ask be done.

MR. McADAM: I think that's all I have.

MR. NUTTER: Take a recess until 1:30.

(Whereupon,a recess was taken.)

MR. NUTTER: The hearing will come to order, please. Does anyone have any further questions of Mr. Kelly?

CROSS EXAMINATION

BY MR. NUTTER:

Q Mr. Kelly, I note from all your schematic diagrams of wells that have been completed and wells that will be completed, injection wells, that in each case you are using cement-lined tubing packers?

A Yes, sir.

Q What is the treatment of the annulus by Mobil Oil Company?

A It's a solution of water and chemicals that goes by the trade name of Crotron.

Q In other words, you do use a corrosion inhibited fluid in the annulus?

A Yes.

Q And you are going to equip that with a pressure gauge at the surface?

A Yes, sir.

MR. NUTTER: Are there any other questions of Mr. Kelly?

MR. SPERLING: I have a question or two on redirect..

REDIRECT EXAMINATION

BY MR. SPERLING:

Q Mr. Kelly, I think there was some reference in your direct examination, or possible cross examination, about a water break-through experienced in the northern part of the Bridges lease which is shown on Exhibit 2, is that correct?

A Where specifically, did that occur?

A It occurred in and around the old pilot which was developed with injectors numbered two, thirty-seven, fifty-six, sixty-four, sixty-six, and seventy-one. Of course, it was later expanded to injection wells thirty-one and sixty-two. The premature water break-through occurred in the center

producer Well No. 34 of that pattern, described by injection Wells 2, 31, 37 and 62.

Q Now has that condition continued or has it been corrected?

A I think we have just about corrected it. The Well No. 34 had gone to a very high water clay, essentially watered out. After we expanded the operation and to increase injection pressure, we began to make oil out of it again. At the present we are making something in the neighborhood of 30 to 40 barrels of oil and 50 to 60 barrels of water per day out of the well, when it is on production.

Q So the fact that there was a water break-through initially or at the time of the pilot doesn't indicate that the production from that well or the area swept and produced through that well was lost, does it?

A No, sir, the other offset well, the No. 61 up to the northeast, which is in the original pilot, also suffered premature water break-through and it also has come back around and is making a decent oil cut at the present.

Q Well is the conclusion then, that there was no oil or substantially no recoverable oil by secondary methods left behind as a result of that break-through?

A The break-through did not result in us losing the

oil, recoverable oil that was still in the rock, no, sir. I think if we had not changed our techniques some that we could have lost it but we didn't change them and we have taken some other remedial measures, too, which have been helpful in our achieving a very decent recovery. I think we'll get a good recovery out of the whole pilot area.

Q Now, there was reference in direct examination or cross examination, to production figures relative to the flood project. I want you to refer to what has been marked Exhibit 4 in Case 4367 and tell me what that is.

A That is a tabulation of oil, gas and water production since 1960 for all of the wells which are within one location of the southline of the Bridges State lease to the extent that those wells are situated on the Bridges State, the Continental's H-35 and the Marathon-State-McAllister leases. It shows a cumulative oil to January 1, 1960, together with annual oil and gas for the years 1960 to '68, and monthly oil, gas and water for the years 1969 and 1970 up to the latest reports that are available.

Q Now where did those tabulations come from?

A They came out of the New Mexico Oil and Gas Engineering Committee's Annual Report and other Reports of the Committee.

Q Now, have you made any calculation as to the oil that

would be left unrecovered if the pattern in Section 26 on the south portion of that section by leaving the pattern open, by failure to drill a well along the bottom line, or the south line of that section?

A Yes, sir, I have estimated that a waterflood conducted in that pattern that is served by producing Well No. 26, would recover 92,000 barrels of oil less if it were left open on the south, than it would if an injection well were situated and used 560 feet south of Well No. 26.

Q Now, are those calculations that you have just referred to reflected on what has been marked as Exhibit 5 in Case 4367?

A Yes, sir, those calculations are. I might point out that I believe the figures set forth in --

Q Exhibit 4?

A -- Exhibit 4, are conservative for two reasons. From the standpoint of the amount of oil that would be unrecovered, I mean.

Q This is Exhibit 5 you are referring to now. I thought you were referring to Exhibit 4 which is a tabulation of --

A This hasn't been marked -- I beg your pardon, it has been marked. I think those figures are conservative for two reasons. In the first place, I note that the primary oil,

that volumes that I used for the wells run at the pattern in forming an estimate of primary and secondary ultimate are lower than the figures reported in the Engineering Committee Report. Those figures are lower by several thousand barrels per well and I don't understand exactly how that happened. I know that I asked for those reports to be gathered for me and I used them in my calculations. I did not notice until a moment ago that the primary oil figures don't agree. The figures that I used for estimating reserves are a little lower.

For example, for Well No. 15 in the Exhibit 5, is indicated to have a 1170 cumulative, 367 barrels. I see the reports available set forth in Exhibit 4 shows the well to have 392,000 barrels of recovery at that point so at the outset I used a primary oil which was smaller than is probably the case, as a basis for estimating, for estimating secondary oil which it estimated to be half primary ultimate for closed pattern. I also estimated that an open pattern would recover only half the oil that would be recovered from a closed pattern and that is the basis on which I arrived at the 92,000 barrels incremental oil because injection would not continue after the producing wells in the pattern are watered out. It would be my opinion that at least 92,000 barrels of oil that would not be recovered which Well No. 26 would not be

recovered but Well No. 26, would not be recovered by any well, because I don't believe that it would continue to migrate south toward the Continental lease without some energy pushing it down and with injection halted, I don't believe there is anything left to push it down.

Q Now, would the effect of the increase in the primary recovery figures as indicated on Exhibit 5 result in a revision upwards of your estimate of oil that would be lost if the pattern was not closed?

A Yes, sir, if I recalculate it, using the figures that are in the New Mexico Engineering Committee's report for production from those wells, I would have arrived at a higher figure. I might say that the calculation is only made for the purpose of illustrating an order of magnitude of incremental oil and is not intended to be finite. I actually expect that, although I haven't formed an opinion as to how much it would be, that the incremental oil would be quite a lot greater than 92,000 barrels of oil. But I am certain that it would be that much.

Q That would be lost to the Bridges lease?

A Yes, sir.

MR. SPERLING: I want to offer Exhibits 4 and 5 in Case 4367.

MR. NUTTER: What is 5?

MR. SPERLING: Five is his tabulation.

MR. NUTTER: Mobil's Exhibits 4 and 5 will be admitted in Case 4367.

(Whereupon, Mobil's Exhibits 4 and 5 offered and admitted in evidence in Case 4367.)

MR. HATCH: Jason, do you want to see those?

MR. KELLAHIN: Yes.

MR. SPERLING: That is all we have on redirect.

RE-CROSS EXAMINATION

BY MR. KELLAHIN:

Q I don't quite understand your testimony in regard to the open pattern, are you talking about omitting only the one well a hundred feet from the Continental lease line?

A Yes, sir, not closing the pattern out by injecting in the south end of it.

Q The other injectors you are thinking of?

A I don't know what you are talking about.

Q The south side of your lease, the other injector wells you propose to be injected or to be proposed?

A Yes, I envisioned that injection in my estimate injection would take place to the north, east and west.

MR. NUTTER: In all but the unorthodox location?

THE WITNESS: That's correct.

Q (By Mr. Kellahin) You are talking about 92,000 barrels of oil coming from that area between Well No. 26 and your proposed injection well?

A No, sir, I am talking about some of it coming from there. The Exhibit shows to what extent I think that it will come from the north half of that pattern and to what extent I think it will come from the south half.

Q You are talking about water coming from the north half of that pattern? You are not going to lose it by failure to inject a hundred feet from Continental's base line, are you?

A I'm sorry, I don't understand your question.

Q You are talking about oil coming from the north of the Well No. 26, failure to drill the other well wouldn't affect that, would it?

A It sure will.

Q You have injection backing up in the Well No. 13 -- I can't read your numbers, looks like --

MR. NUTTER: The one to the west is 29, Mr. Kellahin, and to the east is 15.

Q (By Mr. Kellahin) -- 15 and 29, would protect any drainage in that direction?

A No, sir, you'd have a situation where you are pushing

three sides and not pushing on the fourth and that's going to be an area of low pressure where the fluids will move pretty readily in my opinion.

Q Are you saying then, that oil being pushed in from the north will by-pass your Well 26?

A Yes, sir, unless the pattern is closed on the south side that my estimate is half the oil that is moved from the direction of 26 from the north will by-pass it and be lost to the south side of that pattern.

Q Would that not depend on your injection rate to a considerable degree?

A I suppose it's within the realm of possibility that some injection rate configuration could be developed which would control the amount of oil that would be forced to migrate out, yes, sir. I don't think it would be within reasonable limits, I think we are talking about a few barrels a day.

Q Actually, you are just guessing, aren't you? Aren't we both just guessing as to what might by-pass that well?

A Well, I've concerned myself with studying a lot of waterfloods and that's my business.

Q How much water are you going to put in those wells? What rate?

A That's my opinion from the experience that I have had.

I haven't designed individual well injection rates for those at the present time because I haven't analyzed my reservoir volumes as yet. I am having isopak maps prepared of the porosities in this area and I will base the individual well injection rates on those reservoir volumes.

Q Well, now, your Exhibit No. 5 here, which gives an estimate on the amount of oil that will be lost, is that based entirely on prior production as a basis for your reserves? How do you arrive at these reserves that you say are going to be lost?

A I have just made the assumption that waterflood oil in a closed pattern would equal half of primary, which is an order of magnitude thing itself. The fact is I believe we have seen performance to the north at present which would support a greater recovery than that. I have made the assumption we could do as well on the closed pattern on the south end of the lease as we are doing on the north end of the lease and that a secondary to primary of half is a reasonable rule of thumb to use in estimating what I would classify as a minimum reserve. I believe it would be at least that much.

Q You haven't made a study to determine the reserves that are there, have you?

A I am not sure I follow your question completely.

I study this reservoir all the time and I have formed some opinions about the reserves, yes, sir.

Q What factors do you take into consideration in forming that opinion?

A Well, performance.

Q Did you go into calculations, into reservoir capacity?

A Well, we don't know very much about reservoir capacity. The thing we do know is if the reports have been filed accurately is how much oil came out of the wells and that's the most sure thing that we have. As I said earlier, most of these wells were drilled in the 1930's and they were not logged.

Q You have no core area?

A The wells which were drilled on the extreme north end of the Bridges lease are fairly recent completions, within the last ten, fifteen years and a good many of those were logged and we did cut some cores in the extreme north end.

Q But you have no such reservoir --

A I have no such data on the central or south part. We do have a core, as I recall, on San Andres Well No. 27 in Section 26. I think that's the only well that was cored in the extreme north end.

Q You say according to your estimate, 92,000 barrels

will be lost. Do you mean lost, or would the recovery of that be postponed until additional flooding were done?

A Well, I assume that a system could be devised that would later be recovered. I question whether it would be an economical thing to do it. It's conceivable that after the producing well in that pattern is watered out, that we could leave the lease under an abandoned condition for some years or temporary abandoned condition and come back and get it. I doubt that we would want to leave the hardware sitting there. It would require some investment to get it back in the future. I doubt that it would economically recoverable. I think it would be lost.

Q What remaining life do you feel there is in this secondary recovery project which you are going to initiate in the south end? How long will it go on?

A I haven't the data at hand to tell you exactly how long I have projected it to continue, but off-hand, I could say that I recall it's in the order of 15 years.

Q Mr. Kelly, actually, waterflood was started as a project, pilot project, in 1958?

A Yes, sir.

Q And it's gone by stages progressively, towards the south and there is an extension to the north as I understand it?

A Well, there's going to be one.

Q But it has been a progressive flood, has it not?

A Yes, sir, we have expanded the flood already through the main body of the Bridges State lease with the exception of the two sections that are remaining on the south end of the lease and the six additional injection wells that will be placed on injection in cooperation with the Yates Unit and the Gulf Lease, State "FE", lease.

Q That is over a period of 12 years you have had a progressive flood through this area?

A Yes, sir, progressive, that is, we expanded the last time in 1967. This is a little less than three years later we are planning to go --

Q You estimate about fifteen more years on the southern portion during that period? Isn't it conceivable that it would be expanded to the south as depletion occurs, or do you think that the operators are going to leave the oil in the grounds?

A I don't know when it might be expanded on to the south. I mean, that's farther south of the Bridges State lease. I haven't studied that reservoir down there well enough to have an opinion whether it will ever need waterflood, really. I don't know for sure whether you've got a good water drive

affecting that or not. I know there is a marked difference in the characteristic of production which seems to coincide with the south line of the Bridges lease in there, as the reports have been filed with the authorities.

MR. KELLAHIN: Thank you, Mr. Kelly.

MR. NUTTER: Any other questions of Mr. Kelly? You may be excused.

(Whereupon, the witness was excused.)

MR. NUTTER: Anything further,Mr. Sperling?

MR. SPERLING: Not at this time.

* * * * * * * * *

PAUL ZEMAN

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

DIRECT EXAMINATION

BY MR. LOPEZ:

Q Would you please state your name,address and occupation?

A I am Paul Zeman. I live in Midland, Texas. I work for Marathon Oil Company at the present. At the present time I am District Reservoir Engineering Supervisor.

MR. NUTTER: How do you spell your last name?

THE WITNESS: Z-e-m-a-n.

Q (By Mr. Lopez) Have you ever before testified before

this Commission?

A No, I have not.

Q Would you give the Commission a little run-down on your educational background?

A Yes, sir. In 1953, I graduated with a Bachelor of Science in Petroleum Science from Marietta College, Ohio. During that summer I was employed with Buckeye Pipeline in Ohio before going to the University of Oklahoma to do graduate work. In 1954, I was employed by Marathon Oil Company and was sent to Hobbs, New Mexico, on a training program.

I stayed for a year working in the field, and after the year, 1955, I was transferred to Midland, Texas, as a Reservoir Engineer. I have been in Midland, Texas, since 1955, and have advanced to my present position as Reservoir Engineering Supervisor, which I have held for the past three years.

Q In your position as Engineering Supervisor, what District does that include?

A All the Permian Basin in Texas and New Mexico. I am registered in the State of Texas and Oklahoma.

MR. LOPEZ: Are his qualifications acceptable?

MR. NUTTER: Yes, they are. Please proceed.

Q (By Mr. Lopez) Mr. Zeman, have you prepared some exhibits in connection with the problem being discussed today?

A Yes, I have.

(Whereupon, Marathon's Exhibits 1 through 8 marked for identification)

Q (By Mr. Lopez) I hand you what has been marked as Marathon's Exhibit No. 1. Would you please identify this exhibit, Mr. Zeman?

A This Exhibit No. 1 is a portion of the Vacuum Field. It includes the area under discussion for this hearing, this case. The green line, which you notice borders here, encompasses Mobil's State Bridges lease as defined in their Order 1244 that they had on September 17, 1958. That same Order, they initiated a six-well injection pilot waterflood in Section 14, and these wells are colored in red.

From 1963 to 1967, they expanded this waterflood by converting fourteen more injection wells, wells to injection. These are colored in orange and I believe they were done by administrative approval because I couldn't find anything in the orders.

In 1967, they had Order R-3318 remanding Order 3244 on September 12, 1967, where they proposed to convert ten wells to injection. These wells are colored in purple. One of these wells, No. 52A of Section 27 in Township 17 South, Range 34 East, they originally wanted to convert in '67 and didn't do it and they are re-submitting that at this present hearing.

In 1967, they requested that 127 be converted to an injection well and the present case, the expansion to the south, includes the ones that are circled, that aren't filled in, and there is one well to be drilled, new well to be drilled in "N" 26, 17, 34, and drilled for injection, and one well to be drilled in "E" 25, 17, 34, and proposed to convert 13 other wells and these are all circled in brown there.

Q Now, Mr. Zeman --

A Our acreage is colored in yellow.

Q -- now at this point, I would like to go into the history of your production in your acreage. We might as well submit some more exhibits at this time. I hand you Exhibit No. 2.

A Now part of Mobil's current expansion will be adjacent to our State of New Mexico McAllister lease. They plan to drill an injection to offset our No. 4 to the north and converting Well No. 25 to injection on the west side. Now all these -- I don't have any deep wells on this map, they are all San Andres and all wells that have produced San Andres, possibly been drilled deeper. All of these wells have produced San Andres oil.

We are the operators in the State of New Mexico McAllister Reservoir, four single completed San Andres wells and the Exhibit that Owen has just given you shows an individual

oil basis, a cumulative oil production as of May 1, 1970, the April production, 1970, and the latest production tests. These wells were completed, drilled and completed, in 1938 and 1939 and you notice the No. 1 well is still flowing. The others, No. 3 and No. 4 are still top allowable wells. No. 2 is still making quite a bit of oil and some water.

Q At this time, we had better introduce Exhibit No. 3. Rather, not introducing -- I believe this is connected with the other?

A Basically, with the second exhibit. What I have shown here from 1959 on is the annual production for individual wells in our State McAllister lease and also on the top scale there the annual water production. I'd like to go over these exhibits with you.

No. 1, you can see the production has gone up from approximately 7500 barrels a year to roughly 27,000, absolutely no water introduced in this well at all since it was drilled.

No. 2 is producing approximately 12,000 barrels a year and we have begun to produce water in 1965, slight amount of water, and our major water got kicked up in '68 and '69 when we deepened all of our wells and I will get into that a little later on.

Here again in Well No. 3 we have established a

terrific kick in 1968 to '69 and our production is substantially high of 27,000 barrels a year, no water.

In No. 4, producing quite a bit of oil, 13,000, gone up as high as 19,000 barrels roughly.

Q Mr. Zeman, do you have any opinion as to why the production in these wells has been so successful, or apparently successful?

A These wells, I say, were drilled in 1938 and 1939 and were completed on that open hole, it was common practice in those days, and I'd like to discuss some of the procedures we have got to use to keep our production, maintain our production, up.

Q This is Exhibit No. 4 -- this one, I'm sorry, they are not all colored, but that one is.

A What we have here,as you know, is in 1960 we found some deeper pay in the Vacuum field. The original wells in the Vacuum field were not logged, geologist sample logs, things of that nature. I have taken our deep Blineberry-Glorieta duals, they are twin wells, to our Vacuum wells that were drilled in '60. We have not been able to use good logs. I have plotted a cross-section here. The data is zero sub-sea basis and I have the top of the San Andres shown and have the top of the Lovington and base of the Lovington shown and the Lovington is a minus

750 feet. Now, I have superimposed, since they are twin wells here, and elevation is basically flat in the Vacuum area, I have superimposed our Grayberg wells on the logs of these deeper tests and there is not much variation between the tops. For example, if you take the first one, No. 10 well, by using No. 10 and superimposing No. 1, the top of the San Andres in No. 10 is minus 324 and the top of No. 1 is minus 332.

In other words, 1 is only eight foot low to No. 10. If you go over here in Well No. 8, difference is only three feet so we are basically, practically, even with these twin wells. With these new logs, I would be able to evaluate the formation under our State of New Mexico-McAllister lease and I have also tried to show here what we have done in our work-over program.

As you noticed -- let's take the one, No. 10, it's Well No. 1, when this Well No. 1 was drilled, we set seven-inch casing at 4083 on the bottom of the hole and the initial total depth is 4,680 feet. That was a considerable distance in open hole interval there. In 1959, we drilled a well to a new total depth of 4705. We drilled 25 feet deeper and I hope you can see that on the cross-section. We ran a four-and-a-half-inch liner, we couldn't get it to the bottom, and we have the interval shown in green there, open to production at the present time.

I'd like to make some other statement on this

Well No. 1. Prior to running this liner and when this open hole section was open, the well was put on pump in 1947. Prior to doing the work-over on the liner, our No. 1 well was down to pumping 14 barrels of oil per day. After we ran the liner and treated the form, open hole section, you see there we re-potentialed the well flowing 69 barrels of oil and no water in six hours, or for a rate of 276 barrels of oil per day on a half-inch choke.

MR. NUTTER: When was this?

THE WITNESS: 1959.

MR. NUTTER: That explains the first jump in production?

THE WITNESS: That's right, and that's normal unit allowable in that, too.

Q (By Mr. Lopez) What is the advantage of running the liner, in your estimation?

A When you run a liner here, I can control your reservoir. We have more options of what we can do. We can selectively test each interval. We can treat and know basically that our treatment is going into a certain interval and what we are trying to do here, we are trying to establish an orderly method of depleting our reservoir. We will go up the hole as these things get depleted. Since 1959, we have run liners in

all our wells and, as you can see from our production curves, our lease is a pretty good lease. Maybe we can go back to this cross-section a little later on.

Q I hand you what is marked as Marathon's Exhibit No. 4, I believe, --

MR. HATCH: Five.

Q (By Mr. Lopez) -- and would ask you to identify it.

A Exhibit No. 4?

MR. NUTTER: This is Exhibit No. 5.

MR. LOPEZ: All right, I was mistaken.

A Exhibit No. 5 is a cross-section A-A Prime, that goes from the north to the south. It starts in Mobil's Bridges 58, goes through their 36, goes through their 13 and all of the line goes through our deep test six for a better quality log.

As is shown on this small cross-section, I have hung this, or used the datum here on top of the San Andres which is not quite the same as I had on this first cross-section and you can correlate the top of the Lovington Sand, the top of the Lovington Sand and what I call correlation point one and point two. As previously stated by Mobil, there is two separate upper San Andres and the lower San Andres and this is pretty common in the area and this Lovington Sand is common correlation

point.

I want to use this exhibit to show continuity of these zones from the north to the south and going over, say, from our No. 6, you can see the upper part that has porosity. These are sonic logs and sonic logs on the right-hand side, the Gamma Ray Neutron and a Gamma Ray log on the left-hand side. You come over to Mobil's No. 13, this is a well that used to produce from San Andres and moved it to Blineberry, still a Blineberry and producing 560 barrels a month. When they produced this well from the San Andres they shot this upper section of San Andres with 320 quarts of nitro. If you look at their log, the upper part of the San Andres, you will see besides the Gamma Ray, you will see a calipre log with a whole size of approximately, I'd say, 20 inches and again, if you go up to 36, I'm sure they shot that well with nitro because you see the calipre sticking up there.

Now, with these being sonic logs you cannot use that part of the log for any evaluation of the porosity because you've got a lot of cycle skipping and it is pretty well fractured up. You can see partsof the porosity going across there and going down to the lower porosity interval, correlation points one and two. You can basically correlate from our six across going north, although some of the porosity is getting kind of

erratic. There is some correlation there.

Q Have you made another correlation?

A Yes, I have.

Q I hand you Marathon's Exhibit No. 6 and ask you if you would identify that.

A This Exhibit No. 6 is Cross-Section B-B. It goes from Bridges State No. 27 through their old San Andres well, still producing, No. 25, through their No. 99 well which is a deep test for quality log and back into our No. 6. Again, I have used the datum of the top of the San Andres, top of the Lovington Sands, base of the Lovington Sands, and same correlation point, one and two, for lower porosity.

The No. 27 was drilled deeper and was a discovery well in the Vacuum-Blineberry Field well. Mobil discovered the deeper pay.

No. 25 is a San Andres well, still producing. This was a Gamma Ray Neutron Log which was run quite a while back and I have tried to show with their 99 an interval stops up there. We didn't have a large-scale log that didn't run a detailed log above this 99. There is a definite correlation between the 25 and 99, there should be because they are twin wells.

On 25, it doesn't go deep enough to pick up the

lower porosity. Going over to the right-hand side, to our No. 6, you see this massive porosity interval in the lower San Andres. We correlate that to 99. It looks about the same. So Mobil should drill their 25 deeper and make an oil well.

Q Does your study, especially reflected in these two last exhibits, show that there is a similarity in formation between the Marathon section and that where Mobil proposes to extend its flood project?

A Pardon, now?

Q Does your study, especially reflected by these two last exhibits, indicate that there is a similarity in formation between the Marathon section --

A There is a continuity across. I was trying to get one coming from the north and one coming from the west. That is the difference between the A-A and the B Prime and --

Q Mr. Zeman, I would like to ask you if you have done any studies on the pilot injection wells and the other wells, water injection wells.

A Yes, I have.

Q Done by Mobil toward the north?

A I have. I would like to say now Mobil plans to drill this well, this north offset down to 4700 feet which would pick up both the upper and lower San Andres. Now we have the upper

case. We're working on the lower part now. At some future date we hope to go up there and stimulate this. We have new techniques, selectively perforate, and I think we can do some good. Now I don't know what they plan on doing with 25. I think they plan drilling deeper and open hole, that is my understanding, deeper to pick up this lower porosity and complete an open hole.

MR. NUTTER: Mr. Zeman, when Mr. McAdam was discussing with Mr. Kelly, during his direct testimony and cross examination, what he was referring to was the lower porosity, mentions the lower porosity.

THE WITNESS: That's right.

MR. NUTTER: What did you finally decide he was talking about?

THE WITNESS: My interpretation --

MR. NUTTER: The area point between correlation points one and two on your exhibit?

THE WITNESS: That's right.

MR. NUTTER: So that is the lower porosity he is talking about here and that they are flooding and these are between 1 and 2 on yours?

THE WITNESS: That's right. They are going to drill 25 deeper to get to that point.

MR. NUTTER: That 25 doesn't reach that deep?

THE WITNESS: That's my understanding of that log. Now, they propose to put water into this well that they are going to drill and convert this 25, No. 25, to an injection well and one of the problems I envision that when they start putting water in there, it's going to start pushing water on our acreage and a good possibility, in my opinion, that could be water put on our acreage.

Q (By Mr. Lopez) You have done studies, Mr. Zeman, of the water injections from Mobil towards the north and I think at this time it would be good to introduce those. I hand you Marathon's Exhibits No. 7 and No. 8 and ask you to identify them.

A We are producing oil down here, top allowable, it would be definitely our position now that we cannot convert any wells to the injection to cooperate with Mobil. We have been asked and this is our reason for top allowable wells. I think that's pretty apparent. Now, if they drill this well and convert this 25, I believe they are going to put water in the lower porosity and we won't have the advantage of producing the upper porosity because it's behind pipe right now and the Commission doesn't recognize the upper and lower as separate reservoirs.

Since two are on top allowable, we wouldn't get any benefit at the present time. There is a good possibility while we are producing the lower zone and they are flooding the upper zone when our time comes to go up and perforate we'll be full of water. The oil will have migrated past our wells.

Q Do you have any knowledge of how long you project your wells to be producing as they are now?

A I think two or three of our wells, two or three at the present interval for top allowable, at least three years and assuming normal decline of 15%, another ten to twelve years on that with the option to go and do a liner program.

Now, if they start putting water, one of the things that can intrigue me is how fast will this water move in here from the injection well into our lease. I really don't know so I thought -- well, they've had some experience in their State Bridges flood to the north and I have tried in these two last exhibits to observe the performance of some of their selected wells to the north and they include some of the pilot area and some of the additions coming to the south.

Q These wells you have selected, is it a basic cross-section of their area, will it give you a fair indication of what results will be, in your opinion?

A Yes, sir, in my opinion. I have 13 producing wells

in one booklet here, not labeled, and fourteen injection wells. Now you notice on your copy that I have made a correction on the injection wells and I would like to get into that. There is a typographical error and if you look at the scale on the left-hand side, annual water injected barrels, that should be raised to another tenth power. In other words, instead of 10,000, it should be 100,000, and instead of 50,000 it should be 500,000. I have tried to do that with a pencil and initial each sheet, a typographical error, for injection wells.

You go back to the producers now -- let's look at the first one, for example. This is Well No. 8 and is a producing well located in "J", 23, 17, 34, if you can find that.

Q If you go back to Exhibit No. 1, you will find where the wells are located?

A If you look at this first.

MR. SPERLING: I was trying to see, in "J", where?

THE WITNESS: "J", 23, 17, 34, and it is a new well, not one of the old pilots. If you look there from '59 to '67, '68, our normal decline, stripper stage, and they did get a kick in '69 although they made approximately 7,000 barrels of oil. It had a break-through the same year, making about 15,000 barrels of water.

Let's go to No. 10, "F" 23,17; that is still in Section 23 there, yes. It's the northwest well to No. 8. You can see here that they got an initial break-through in 1963 and they're kicking production on the bottom curve there is not too nominal until they start putting more water in the ground, and will have to go to injection wells to see this and when they did get a kick from oil, around 8,000 to 13,000 barrels a year, their water break-through and production, you can see it's off the scale. And here is one in Well No. 23 and "L" 24, 17, 34. That is in the section to the east. Now that well is surrounded by relatively new injection wells and although they get a kick, immediate response, they also get an immediate response to water, too.

I have tried to do this, I don't think it is important enough to go through each well, but you can thumb through here, some wells are all right and some wells have had quite a bit of break-through.

Take for example now, Well No. 67 in "L" 14, 17, 34, that well is an offset to the original pilot and you can see that he didn't get too much of a response, production-wise annually. The best they could do for '59 to '63 was about 5500 barrels a year and then they must have kicked up the water injection because they got an increase in oil, but

immediate break-through of water. You can see the rate's up annually.

I would like to go to these injection wells and in here, this curve, with out injections, the curve on the left reflects the annual water injected and the curve on the top of the scale on the right shows the injection pressure and, take the first one for example, No. 2, this is the south well in the original pilot. They got most of their water high, from 350,000 barrels when they have gotten pressure of about 2300 pounds.

Now, if we can look at Well 55 to the south, on this other curve, from a producing well, let's just get a correlation here. Go back to the producing wells -- 55 -- in '67, on injection No. 2 well, they put in approximately 355,000 barrels of water and that same year, '64, they produced --

MR. NUTTER: In '64, not '67?

THE WITNESS: We are looking --

MR. NUTTER: You're on injection well No. 2?

THE WITNESS: That's right, in Well -- the south offset from 55.

MR. NUTTER: Right.

Q (By Mr. Lopez) In the year '64, you're right.

A As I say again, they put 355,000 barrels of water and their highest rate in 1964 in the south offset immediately

in '64, produced approximately 50,000 barrels that year while only making roughly 7,000 barrels of oil, so your water cut is pretty darn high.

You can go through these and see this trend. What I am saying, when they have injection water, they have a break-through within a year or two. That's pretty fast.

Q Mr. Zeman, if their application to drill their proposed injection well, which is an offset to Marathon's Well No. 4, and their conversion of Well No. 25 which also appears to be an offset to Marathon's Well No. 4, is it your opinion that if they do their, their application is granted in these instances, there would be initial break-through of water into your area which would substantially harm your interest?

A In my opinion, based on what I see of the flood to the north, there is a good possibility we would have premature break-through, possibly killing our flowing well, possibly putting water into our pumping well, which would reduce our capacity.

In addition, some of the zones not open now because they are behind our lines but at a later date when we try to recomplete there, they probably would be full of water.

Q Now, as you recall, Mr. Kelly on Redirect, discussed reservoirs which he estimated to exist in Mobil's Section 26 in

the south part between Marathon's Wells 29, 35, 15 and 26. Have you made any studies and can you estimate the reservoirs that exists in your area of operation?

A In relation to the reservoirs under our acreage, if I may refer you back to that small cross-section of the colored line, tried to color it up, in addition to showing the pay here I have done a little qualitative work on attempting to find the reserves under our acreage. As you note, there is some colored red coloring in the Upper San Andres and in the Lower. They also show some porosity scale. I have used a cutoff porosity of 3% all the way up, coloring stops at 3%, the porosity scale goes up to 20.

You can kind of get a relative idea of what porosity looks like and if you look on the Gamma Ray side you will notice the lower section and the upper, the section is relatively clean. I have estimated that the in-place oil under our acreage is 9.7 million barrels. We, Marathon, have produced approximately 1.8 million barrels to date on these four wells for a recovery factor of 18.4%.

If it is a solution-type gas reserve, we have produced 18%. That's pretty good for a solution gas reservoir. It's obviously, with our top allowable, we are going to produce a lot more than 18%.

MR. NUTTER: You had 9.3 million original oil on flood?

THE WITNESS: 9.7 million.

MR. NUTTER: And you have produced to date 1.8?

THE WITNESS: 1.8, roughly 1.79, as of the first of the year and our leases are still pretty good. I estimated that this, I think, can be a conservative estimate, a recovery of 25% since we have produced 15%, this might be a conservative estimate because we might have gravity drainage and other mechanism that will benefit us. If this is the case, this is 640,000 barrels of primary reserve left under our lease and if at some distant date we assume that this production will have to go down from where it is right now, from the zones it is producing from right now, at a rate of 15% out of the 638,000 barrels, approximately 465,000 barrels will be produced during the declining period. Therefore, we'd have 174,000 produced on a current rate. We still have top allowable of about 3 years.

Q (By Mr. Lopez) Now, I will direct your attention to another question. Is it your opinion that there is a substantial possibility if Mobil's application to extend its waterflood project is permitted, since you do not have a back-up to your quarter section, that there will be a substantial amount of oil irretrievably lost?

A Yes, sir, it is my opinion.

Q Is there any way there could be a further expansion of this waterflood project to the south at this time?

A We can't do anything on our lease. We have got 15 years primary production, 600,000 barrels before we think of a secondary.

Q And therefore, you could not agree to the proposed cooperation with Mobil because you are not even close --

A We are not ready for flood. I think the evidence shown here shows the quality of our acreage.

MR. LOPEZ: I have no further questions.

MR. NUTTER: Any questions of Mr. Zeman?

MR. LOPEZ: I forgot to offer my exhibits into evidence.

MR. NUTTER: Marathon's Exhibits 1 through 8 will be admitted in evidence.

(Whereupon, Marathon's Exhibits 1 through 8 offered and admitted in evidence.)

CROSS EXAMINATION

BY MR. SPERLING:

Q Do you have any measured bottom hole pressures in your wells?

A Yes, sir. The No. 1 well last year, the Commission took a bottom hole pressure and it was seven hundred and some

pounds, I think 751 - do you have that list - a little over seven hundred pounds.

Q That's the only well where you had a break made?

A There is only seven wells taking pressure in the Vacuum Field and these, I'm sure, are flowing wells to the south because to take a bottom hole pressure on these pumping wells would be pretty expensive, you'd have to just pull your rods and pump. Every year they have cut the number of bottom hole pressures they have taken.

Q Mr. Zeman, if you feel as you apparently do, that the continuity of the San Andres is as you have explained it here, why is it that Mobil's wells aren't as good as yours?

A No. 13 was a San Andres well and I don't know what the cumulative production is on that. They shot that well in the upper section, thereby limiting what they could do to that well, and if you can run a liner in there, but there is a pretty good sized hole in there and while that well was shut in and we went during that time, increment period, ran a liner and selectively perforated and treated these wells and maintained our production.

Q Well, do I understand that none of the four Marathon wells were open hole completions?

A They were originally all open hole completions. The No. 1 well, with production down to 19 barrels a day before we

ran the liner. All our wells before we ran liners, production decreased to 20 barrels a day and we figured we could increase production by running a liner and selectively treating because on original completions they gave it a little acid.

Q Were any of the four Marathon wells completed naturally initially, that is, without treatment of any kind, shooting?

A Our No. 1 Well flowed naturally 51 barrels an hour.

Q Was that well subsequently shot?

A No, our holes were in good condition before we ran a liner, otherwise, if we shot them we couldn't run a liner.

Q Well, that suggests to me that at least the conclusion of extreme negligence on Mobil's part in shooting wells in the first place, is that your conclusion?

MR. LOPEZ: That is a legal conclusion, I believe.

MR. SPERLING: No, it isn't, it's an engineering conclusion.

THE WITNESS: It is my opinion that they ruined their wells; not all of them. I am looking at some of the calipre logs.

Q Now, do you think that if Mobil had a 51 barrel well naturally that they would have shot it?

A No, sir, they shot theirs and their well came in flowing 320 barrels a day, one of them. It's on the cross-section.

Q Do you have available any decline curves on your wells?

A No, sir, our lease is going straight across.

Q Which well was it that flowed three hundred some barrels initially?

A Let's look at some wells in these cross-sections, if somebody is interested. Let's look at cross-section A-A Prime. Their well No. 36 up there in "D", that well was completed 7-9-59 and it flowed natural 376 barrels of oil per day.

Let's take a look at another one, No. 13 here, off-setting off to the north, cross-section A, that's the one that they used 320 quarts of nitro. They used 5,000 gallons of acid, too, and they placed their nitro opposite 4390 to 4550 and the test shown here is 110 barrels per day in 24 hours.

Now, we can go over to this cross-section B-B Prime. Let's stay on cross-section A-A and we'll get that '58 well there. That's a Glorieta test. That was drilled deeper to the Glorieta test. The original completion in 4-1-40, they shot that with 380 quarts from about 4478 to 4600, I don't know if that's shown up on the calipre log there. They had initial potential flow of 288 barrels per day, initial flow.

I will go to cross-section B-B, No. 27, which is the discovery well in the Blineberry, was originally a San Andres

well, and that was completed in 4-27-39 and that was shot with 240 quarts from 4430 to 4450 and flowed 464 and Mobil's No. 25 which is in Section 26 there, on the cross-section, it had a natural flow of 140 barrels per day. That well was completed in 2-26-39. It's not a No. 99, that's a deep test. That's it, basically, Mobil's wells on these two cross-sections.

MR. SPERLING: That's all I have, Mr. Nutter.

CROSS EXAMINATION

BY MR. NUTTER:

Q Mr. Zeman, what is Marathon's position. They're opposed to any flooding by Mobil in this area, or what?

A No, I don't believe that is the case. We would, and I think Continental will concur with us, that we are not opposed to Mobil waterflooding. We would like to, due to our lease, quality of our lease, to possibly put in a buffer zone of one row of wells, keep your injection wells one row up.

Q It's obvious you are not ready for flooding, if you want to call waterflooding a secondary recovery --

A That's right.

Q -- and by the Commission's definition, you certainly wouldn't qualify.

A We couldn't convert waterflooding.

Q That would refer to maintenance but not waterflooding?

A That's right.

Q What you are thinking of is at least one row of producing wells without any injection wells. Do you think that injection wells that were maintained at a minimum of two locations away would have any detrimental effect on production from your lease?

A It would give us a little more time to produce our wells, I think. The likelihood of us watering out would be minimized.

Q Do you know what the status of Texaco "Q" lease is, to the east of you?

A The "Q" lease. "Q" lease, Well No. 1, and I am referring to the March production figures, Well No. 1 pumped 73 barrels of oil per day, 7.6 barrels of water per day for a water cut of 9.4. Their "Q" No. 2 pumped 73 barrels of oil, 7.6 barrels of water per day for9.4 water cut.

Q Those are the exact same figures?

A I think they just proportioned it out.

Q What is No. 3?

A They pumped 24.3 barrels a day and no water.

Q And these tests that you gave us on your Exhibit No. 2 are the latest tests that you have run?

A That's right, yes, the latest tests --

Q One made 37, the other one made 38, No. 3 made 81 and No. 4 made 68.

MR. NUTTER: Are there any other questions of Mr. Zeman? You may be excused.

(Whereupon, the witness was excused.

MR. NUTTER: Do you have anything else, Mr. Lopez?

MR. LOPEZ: No, I don't. I would like to make a brief statement at the end if I deem it necessary.

MR. NUTTER: Mr. Kellahin, were you going to present any testimony?

MR. KELLAHIN: A short witness.

* * * * * * * * * * * *

VICTOR LYON

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

DIRECT EXAMINATION

BY MR. KELLAHIN:

Q Would you state your name, please?

A Victor T. Lyon.

Q By whom are you employed and what position, Mr. Lyon?

A Continental Oil Company Conservation Coordinator in Hobbs Division Office.

Q Have you testified before the Oil Commission, and made your qualifications as an engineer a matter of record?

A Yes, I have.

MR. KELLAHIN: Are the witness's qualifications acceptable?

MR. NUTTER: Yes, they are.

Q (By Mr. Kellahin) Are you familiar with the application presently before the Commission, and have you heard the testimony that has been presented up to the present time in this Case?

A Yes, sir.

Q In connection with this application, is Continental Oil Company an offset operator to the proposed expansion of this waterflood, and if so, where?

A We are an offset operator to the proposed expansion as our State H 35 lease adjoins the Bridges State lease to the south. Our lease consists of the northeast quarter and the east half of the northwest quarter of Section 35 in the same area.

Q 17 South, Range 34 East?

A Right.

Q Would you discuss briefly the situation as to your producing wells, what their production is and what their present

situation is?

A Yes, sir, we have six wells which are completed in the Grayberg San Andres on our State H 35 lease, No. 1 which is located in Unit "H", last test of this was in February, 25 barrels of oil, 4 barrels of water per day.

No. 2, which is located in Unit "A", tested 60 barrels of oil, no water per day.

No. 3, which is in Unit "B", tested 31 barrels of oil, no water.

Well No. 4, which is in Unit "F" is shut in. Its last test was in December of '69 when it produced no oil, 15 barrels of water.

Well No. 5 in Unit "G", last tested 27 barrels of oil, no water.

Well No. 6 in Unit "C" tested 12 barrels of oil, 2 barrels of water.

I believe that this is average, of 26 barrels of oil, one barrel of water per day per well.

Q Would you consider this lease at an advanced stage of depletion?

A No, I wouldn't.

Q Would you consider it ready at this point, as a reservoi engineer, would you consider this lease ready for waterflooding?

A No, not only from the basis of its current production, but because of some remedial possibilities which we feel exist on our lease.

Q Now, in connection with the remedial possibilities, would you state to the Commission what you do propose to do with these wells?

A We have recently given some studies to the work that Marathon did on State-McAllister lease and believe we have very good possibilities of developing the same zone on our lease which, if anywhere near as successful as Marathon's program, should bring our wells up to or close to top allowable production.

Q Would you propose to form a similar recompletion by running a liner as Marathon did or some similar operation?

A Our initial evaluation test is proposed to be performed in Well No. 10 which is a twin well to 5. This is a slant-holed dual completion in the Glorieta and Blineberry. The Blineberry is not commercially productive. We propose to plug off the perforations in that well and use the casing to perforate and evaluate the lower zone in that well.

Q Now, how are your other wells completed in the Grayburg and San Andres?

A They have large open hole sections.

Q Were any of them stimulated by shooting or axerciser?

A Well, there were none shot. One well was treated with 5,000 gallons of acid, that was No. 4, and my information indicates the others were not stimulated, not on initial completion.

Q In your opinion, would those wells lend themselves to recompletion as was done by Marathon?

A Yes, I think very definitely.

Q Now, you heard Mr. Kelly testify as to Mobil's offer to enter into a land agreement, did you not?

A Yes, sir.

Q Did Continental refuse to enter into that agreement?

A Yes, we did.

Q Are you familiar with that?

A Somewhat.

Q For what reason did Continental decline to enter into the agreement?

A There are two reasons. In the first place, they asked that we convert our No. 2 well into an injection well as our No. 6. No. 2 is a 60 barrel per day well. No. 6 is a 12 barrel per day well and we were a little reluctant to convert a 60 barrel well to injection. There was another reason. In every waterflood where you stop your waterflood pattern short of the

boundaries of the pool, there is a loss of efficiency because all of the producing wells are not completely enclosed by injectors and it's highly desirable, of course, to have all wells, oil wells, backed up. But when all leases are not ready to be stimulated by water injection, these patterns have got to stop somewhere and we are reluctant to place our wells on injectio or our lease on injection, without a backup from the other side.

The other side happens to be Phillip's Hale lease and those wells are essentially top allowable and certainly they are not interested in converting any of their wells to injection.

Q Then if Continental were to enter into a land agreement and put their wells on injection, would they find themselves then in the same position Mobil finds itself in now, without a back-up to the south?

A Yes, sir, that is very true.

Q What remedy do you propose for Mobil which would adequately protect Continental in this case?

A In order to give us time to evaluate our reserves by the proposed recompletion project, and to let our wells decline a little bit further, we would like for them to refrain from injecting water in wells which directly offset our lease.

Q That would be No. 29 and No. 15 and the proposed well

on the lease lines, practically on the lease lines, is that correct?

A Yes, sir.

Q In your opinion, and based on the evidence you have heard here today, you feel water would encroach on Continental's lease if this application of Mobil's is approved?

A I think that the likelihood is so great it is a virtual certainty.

Q Would that result in a loss to Continental Oil Company?

A We feel that the encroachment of water into our wells will certainly lift our lifting cost, certainly a possibility that could change fluid saturation to the extent that future waterflooding on our lease would be impaired.

Q Would it move oil past your wells which would not be ultimately recovered by you?

A I don't know.

Q You say it would increase your lifting cost. Do you have any salt water disposal problems in this area?

A We produced very little water. We do have a facility for disposing of produced water but it still represents some expense, not only in lifting, but also in separating and disposal.

Q If water did encroach on Continental's lease that would be an economic loss to Continental, would it not?

A Yes, and I think also that it would certainly place our remaining reserves, to some degree, in jeopardy, the fact that outside water has been introduced into our wells.

Q Now, would you sum up the position of Continental Oil Company in regard to this application?

A I have a statement here which summarizes pretty well our position on this. Unfortunately, it frequently occurs that all properties in a reservoir do not decline in production at a uniform rate. While one operator's property may be essentially depleted another's may still be in a flush or semi-flush stage of production. When this occurs, it becomes necessary for the one operator to institute secondary recovery operations while the other is still operating profitably on primary production. It is recognized that in waterflooding, unbalanced floods where there is no back-up, frequently results in a loss of efficiency and a loss of recoverable reserves.

Continental Oil Company in this instance, finds itself in the position of being unable to cooperate in a waterflood project because one, its production is still at a fairly high rate with one well producing as high as 60 barrels per day, because the offset operator on the opposite side of our lease

has top allowable production and cannot furnish a back-up for our injection pattern.

Furthermore, recent developments indicate the probability that initial reserves are available on our lease by deepening of existing wells or plugging back of wells in deeper horizons. It is our position that the placing on injection of offset wells will create waste and impair our correlative rights in that, one, injected water will probably channel to our wells, increasing the volume of water to be lifted and possibly drowning producing zones and, two, the fluid content on our lease will be distorted such that secondary recovery operations, when conducted on our lease, will be less efficient than they otherwise would be.

Consequently, Continental Oil Company must respectfully request that no injection well be located within less than 1650 feet from our lease line at the present time, and until such time as a cooperative project which will protect the rights of all parties can be initiated.

MR. KELLAHIN: That's all we have, Mr. Nutter.

CROSS EXAMINATION

BY MR. NUTTER:

Q Mr. Lyon, would you go very quickly through the latest tests which you have on that San Andres well, please?

A No. 1, 25 oil, 4 water per day; No. 2, 60 oil, no water; No. 3, 31 oil, no water; No. 4, shut in; No. 5, 27 oil, no water; No. 6, 12 oil, 2 water.

Q Why is the No. 4 shut in?

A It stopped producing oil.

Q Did it have a pump on it?

A I don't know -- yes, it did have a co-pump installed in 1950.

Q When was it shut in?

A December of '69, was the date on these tests, approximate, about February 24th.

Q This would be in February of 1970?

A Yes, sir.

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

MR. SPERLING: I have a couple of questions.

CROSS EXAMINATION

BY MR. SPERLING:

Q Mr. Lyon, do you think that the injection of water as proposed by Mobil would result in stimulation and increased production of oil and possible water, as to your Wells 3 and 6?

A Yes, I think that you will probably create an oil bank and that we may receive some slight stimulation from it.

Q When do you expect to conduct this remedial work?

A I have an A F E in my possession here which was approved May 18th, the work is scheduled to begin, I believe, within the next week.

Q And how long would it be before you would be able to make an evaluation as a result of that remedial work, the success of it?

A In this particular well, we should have the results probably within 30 days.

Q And as you mentioned, the particular well, I didn't understand which well it was you are going to conduct work on first.

A Well No. 10, twin well to No. 5.

Q Do you expect to undertake any remedial work with reference to Wells 2, 3 and 6?

A If No. 10 is successful, I believe that wells on all of the other five remaining locations, there is a very good possibility.

Q You mentioned that the increased volume of water which you would anticipate having to handle as a result of injection by Mobil would increase your costs. Do you think those costs would exceed the additional recovery in oil?

A Well, I don't know how long our oil production would be stimulated. Some of the results I have seen from Marathon's

work indicates that we might have a very short stimulation with a long period of substantial water.

I might point out, Mr. Sperling, that if we thought we were going to benefit from your flood, I don't believe we would be objecting to your placing wells offsetting us.

Q When were your wells drilled?

A About 1938.

Q Was that substantially before the wells operated by Mobil, offsetting particularly the 26 well, was drilled, do you know?

A I don't know.

Q I was wondering if they were drilled approximately the same time and if you would explain Mobil's wells being in a more advanced stage of depletion than yours.

A I haven't studied anything other than our lease and I have not studied that a great deal, and I couldn't give you an intelligent answer. I am sure there is a reason for it, but I don't know what it is.

Q Have you made any study to determine whether or not the Mobil 26 well is producing from the same interval as say, your No. 3 well?

A Would you repeat that, please?

Q Have you made any investigation as to whether or not

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the Mobil 26 well is producing from the same zone as your No. 3 Well, or your No. 6 Well?

A I have given a very brief review of the general wells in this area and they are all producing from substantial intervals in the San Andres and I am confident there is a considerable over-lap between the completion in No. 6 and all of our wells.

Q Would you have an opinion, Mr. Lyon, as to whether the proposed expansion could be carried on economically at all, if the interval that you suggest, the buffer there, were adopted?

A I have not made this study and I have an opinion based on very little information. I think that Mobil would substantiall improve their position as far as placing this property under waterflood by expanding to the wells which would be available even by leaving off the buffer zone, but, as I say, I have not studied your economics.

Q I think your suggestion was in your statement, that there be a buffer zone of some 1660 feet or something like that between your lease line and the nearest injection well?

A 1650 feet.

MR. NUTTER: That is one thing I wanted to clarify. Did you mean 1650 feet from an injection well to your producing well, or to your lease line?

THE WITNESS: To our lease line.

MR. NUTTER: Excuse me, Mr. Sperling.

Q (By Mr. Sperling) Well that suggestion would eliminate two tiers of proposed injection wells in the expanded area, would it not?

A I don't believe so. We would not have any objections to your placing No. 35 or 48 on injection. This would be standard location in the second row of proration units away from our lease.

Q So in effect, that suggests the elimination of the proposed four injection wells shown, that would be 15, the 29 and the 42, and the proposed well to be drilled?

A No.

Q Not 42?

A Not 42. This is somebody else's business.

MR. NUTTER: I think Mr. Kelly testified Texaco was operating a flood over there?

THE WITNESS: Yes, sir.

MR. SPERLING: That's all I have.

MR. NUTTER: Any further questions of Mr. Lyon? You may be excused.

(Whereupon, witness was excused.)

MR. KELLAHIN: Thank you.

MR. NUTTER: Does anyone wish to present any testimony?

We will call for statements now.

MR. SPERLING: I would like to offer some rebuttal testimony.

MR. NUTTER: O. K.

MR. SPERLING: If you would care to recess at this time, we might be better able to get along faster.

MR. NUTTER: That's a very good idea -- 15 minutes.

(Whereupon, a 15-minute recess was taken.)

MR. NUTTER: The hearing will come to order. Mr. Sperling, do you have your witness?

* * * * * * * * *

PAT KELLY

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

(Whereupon, Mobil's Exhibits 6 through 11 marked for identificatio

REDIRECT EXAMINATION

BY MR. SPERLING:

Q Mr. Kelly, you are the same Pat Kelly that testified previously for Mobil?

A Yes, sir.

Q You are still under oath?

A Yes, sir.

Q Mr. Kelly, would you refer to what has been re-marked for rebuttal purposes as Mobil's Exhibit No. 6 and indicate what that is?

A Exhibit 6 is a copy of the same plat that we had offered as Exhibit 2 without the colors on it. It is submitted for the purpose of showing four log cross-sections identified as A-A Prime, B-B Prime, C-C Prime and D-D Prime.

Q Now would you please refer to what is marked --

A Those are the only two copies of that particular plat. We have the lines of Section R shown on the cross-sections themselves, but the scale is distorted. It is hard to read well numbers off of it.

Q If you will refer to what has been marked as Exhibit 7, Mobil's, identify that, please?

A Exhibit 7 is a log cross-section of A-A Prime which extends in an east-west direction across the north end of the Bridges State lease. It extends from Bridges State Well No. 87 on the west to No. 88 on the east.

This section is submitted for the purpose of identifying what I have referred to earlier as the high porosity or high permeability zone that occurs within the body of the San Andres pay in the north end of the field. It can be seen from this section that the porosity or log porosity in that interval

is quite a lot higher than the rocks immediately adjacent to it.

Q Now, refer to Exhibit 8, please.

A Exhibit 8 is a package of core analysis information on four wells, on four of the wells that are contained within the cross-section identified as A-A Prime. Those four wells are No. 87, 79, 78 and 88. The interval that is colored on Section A-A Prime, denoting the high permeability zone, have been correlated with the core analysis information and can be seen in each of these tabulations of core data that that interval has much higher permeability and permeability of rocks above and below. For example, in Well No. 87, the permeability goes to one twenty-five millidarces in that interval, has concentrated with eight millidarces below and one half millidarces above. In Well 79, the permeability interval goes to 406 millidarces as concentrated with 9.2 millidarces above and 5.8 immediately below.

In Well No. 78, the permeability of the high porosity interval goes to 956 millidarces compared with 20 above and 5 below. It is the order of 900 to 1000 millidarces in Well No. 88 compared with 16 below and 36 above and, of course, there are streaks running down to less than one-tenth.

I submit these to show that within that interval that I call a high permeability interval that there is a substantial

difference in the quality of the rock or character of the rock.

Q (By Mr. Sperling) Well, now, is this pertinent to Mr. Zeman's testimony concerning his apprehension about channeling?

A I think so. The well in the north part of the field extending on down as far south as our Bridges State No. 8 and 43 and even 23 and 47, in Section 23 and 24, do have a high permeability streak, the one that is identified on this section and then the core analysis data. Not all wells do. Some wells don't, but in every instance where high water production has been noticed early in the life of the flood, this 10 to 20 feet of high porous rock is readily identifiable from whatever data there is available.

In some cases it is a drilling time log in some of those holes. You can find there is an interval in that that falls into where that zone should correlate, that is drilled a lot faster than the rocks above and below it, and so -- we find that it is true that a lot of water production is experienced in the portion of the flood where this streak is present and it is a high expense flood.

We have to fight pretty hard to get the oil, but it is profitable and it is the only way we are going to get it.

Q Would you refer to Exhibit 9, please?

A Exhibit 9 is cross-section B-B Prime which extends north-south direction through extending from the south in the Phillips Petroleum Company Hale No. 7 to Continental's "H" 35, No. 12 "H" 35 8, Mobil's Bridges 95, 99, 96 and 30. This section shows colored in green the intervals that we interpret as being oil saturated porosity, colored in below the oil water contact of approximately minus 698 feet is the interval that we interpret to be saturated with water.

As you can see, Continental's "H" 35 No. 12, which is a twin to Well No. 1 in the southeast corner of the lease, has a nice section of oil-saturated porosity in the second zone. Well No. 2, according to -- which is a twin to Well No. 8 on the section in the northeast corner of the lease is indicated by our work, to be water-saturated throughout the second porosity.

I seem to remember from the test data that this is the best well Continental has. The upper interval is pretty decent in that well. It looks better in the "H" 35 No. 8 than it does in the Bridges 95 to the north. We find that there is some oil-saturated and some water-saturated porosity in the second interval in the second zone and Bridges No. 95 which is a twin to our No. 12 San Andres well.

Likewise, in Bridges 99, which is a twin to proposed injector No. 25, I would like to comment while we are on the

subject of Well No. 25, that that well has been deepened at some time in the past, sufficient to uncover the lower porosity but at the present time it is junked and plugged back to 4579. Which by interpretation is a couple of hundred feet above that lower porosity and it has been equipped for injection the way that it is shown here on the chart. We found a small amount of oil-saturated porosity in the second porosity, in No. 96 and Well No. 30. I might comment at this point on the oil-water content that we are using here. I notice that Marathon portrayed an oil-water contact of minus 750 feet. I think this is whqt we call the second porosity, the porosity that they have evidently been getting so much oil out of.

We had a drill stem test wherein we produced water at minus 6908 in our Bridges No. 27, in that second porosity and became suspicious at that time that the water level may be that high in that vicinity. We subsequently drilled our Bridges No. 32 which encountered the second porosity a little bit below minus 700 feet and it produced an abundance of water with no oil out of the lower porosity.

So it may be that we have a variation in water level in this area, so the other one of the sections in a moment that the second porosity in the Continental's "H" 35 No. 1, a twin to No. 6, is also indicated by our work to be below the

oil-water contact of minus 698.

Q Does that conclude your comment on Exhibit 10, -- I mean 9? Now refer to Exhibit 10.

A Exhibit 10 is a line section which runs on the south from Getty, formerly Tidewater, State No. 7 in the northwest quarter of Section 36 up to the Marathon State-McAllister No. 8, a twin to San Andres Well No. 3, up to the 6 which is a twin to San Andres Well No. 4, up to our 103 which is a Glorieta Well, and on up to Bridges 105 which was a deep well that has been recently plugged back and perforated for injection in the San Andres.

This section shows that all of the porosity that we picked up in Well No. 103, which is a twin to the well that we want to drill, is below our water level of minus 700 feet, minus 69 feet in the second zone. The upper porosity in that well is awfully thin, perhaps bearing out the low productivity that was experienced on No. 13, a twin, about 330 feet north, which is, I remember producing something like 60,000 barrels before it reached the economic limit and was deepened to the Blineberry.

This section shows once again that the pay improves materially to the south. It would be my opinion that any water injected into 103, assuming that it were not injected

into 103 or a well like it, assuming that it were not injected into water-bearing zone in the base, would have very little likelihood of materially influencing any existing production to the south. It is conceivable that the rocks could be pressured up behind the pipe in those wells where they have been deepened and perforated in the lower zone.

I don't think there is a chance that water would get into that lower interval there, but of course, if we were to drill a well and found oil-saturated lower porosity, we would want to inject into it and attempt to flood it out and introduce it. We have not found anything approaching the prolific nature of the lower porosity production on the Bridges State lease that have been encountered to the south. I think there is a radical difference in the quality of the log.

Q Does that conclude your comments on Exhibit 10?

A Yes, sir.

Q Now, refer to Exhibit marked 11.

A This is a cross-section D-D Prime which extends on the south from Continental's "H" 35 No. 11, a twin to San Andres Well No. 6 up through Mobil's Bridges No. 26, to the Bridges 98, a twin to 33, up to Bridges 30, which has a log on it in the San Andres, this is the well that I mentioned earlier.

If No. 6 has anything in it like No. 11 on the

Continental's "H" 35 lease, by our standards it has no oil-saturated porosity in the second interval. It is conceivable as I said once before, that there is a variable water level in here. I am convinced that we have found water as high as minus 698 and I thought some completion on the State-McAllister wells to be southeast and south that went some distance below that extends to Continental's 5. That there is a variable water table in that level. It is conceivable that Continental has more pay in No., the No. 6 well, than is indicated on this "H" 35 No. 11 log because I don't see anything about that log that makes the well look better than the wells that we have to the north and it has produced quite a lot more oil, the order of three times the amount of oil that some of our wells have been getting from the standpoint of cumulative recovery.

Q Do you have any other comment on D?

A I might say that the log on this section, Bridges No. 6, is a Gamma Ray Neutron log and you can see the 5% porosity line that has been drawn there. No porosity has been colored in because there is obviously something wrong with the log. It runs to 40 or 50% porosity which we don't believe is true and the log goes off scale. This well at the present time makes 100% water as the result of a hydromatic plug in the bottom of the well, bringing down and allowing the water to

re-enter the well bore from the bottom, drowning it out.

You can see that its total depth does go below minus 698. Another bit of information that tends to confirm that up in this vicinity, that is water as high as minus 700. The only other thing I have to comment on this section is that No. 30 was shot in the porosity, too, and is of no value in that well in estimating pay thickness. It did have a little bit lower porosity which came in below water. As I have said before, it is our intention to inject into all of the oil-bearing porosity that we can uncover on the lease, or into all of the porosity that is indicated to have oil in it within the pattern being served by that injection well. Most of these cases here, for example, a well drilled south of No. 26 for injection, encountered water-bearing porosity that we seem to have found as present at that, subject into the datum.

We would not intend to inject into there because we would not have any chance of recovering any oil out of it.

Q Is that all the comments you have on D-D Prime?

A Yes, sir. The only other thing that I feel obliged to comment on at this time, it is inconceivable to me that Mobil or anyone else has any business trying to carry on this waterflood to the south end of the Bridges lease without the use of these injection wells situated along the south line.

There is not enough there to flood. We would be wasting our money without any inclusion of the pattern.

Q Is that your reaction to Mr. Lyon's suggesting a barrier of some 1650 feet between the nearest injection well and Continental's lease line?

A Yes, sir, it's inconceivable to me that we could flood it on that basis. We have to go down and flood it all or we haven't anything to flood. The reserves are not all that attractive. This is a pretty doggy end of the field. It is not nearly the same quality as that farther south and we have no alternative but to either give up on it or try to get the reservoir of oil and this is the only way we can do it.

Q I recall a comment you made during a recess, Mr. Kelly, I would ask you to confirm at this time. I think you said that where a barrier like that to be observed that you build a tremendous memoral conversion in the south end of the field.

A Yes, sir, we have a ten thousand barrel per day injection station which has been constructed there in Section 26 in the past few months, together with the distribution lines that have been extended to these wells colored in red.

Q Do you have anything else to add?

A No, sir.

MR. SPERLING: That is all.

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

RE-CROSS EXAMINATION

BY MR. LOPEZ:

Q Mr. Kelly, in these last four exhibits, when you showed these water levels, did you actually physically test each of these wells?

A No, sir. I summarized the test data that oil-water contact is based on. It is based on a drillstem test in Bridges State No. 27. I don't have the details of the test here which produced water at minus 698 feet. It is based also on a production test of the lower porosity in our Bridges 132 which was in the vicinity of minus 700 feet and produced an abundant supply of water and no oil and it is also based on the recent watering out of our Bridges State No. 26 which I attribute to the introduction of bottom water through the lower porosity which had been opened in the well when it was first drilled. Water was tested in it then, and a hydromatic plug was set in the bottom of the well until recently when eventually the plug broke down because the supply of water came in on the well and drowned it out.

This has taken place there just the past few weeks and that well is bottom of close to minus 700 feet.

Q Isn't it true that we have already established there is a great variation, that the testimony of Mr. Zeman was 750,000, you said 698?

A Yes, 52 feet.

Q Right, so based on -- do you think just based on 3 test wells that you can establish this pattern reliably?

A I accept that as reliable information insofar as Section 26 is concerned. Over half of it has been condemned below minus 700 by three separate tests.

Q You mentioned the wells 132, 27 and 36, is that correct?

A Yes, sir. I might mention also that when we drilled 127 which is the northeast in the southwest corner of Section 24, in early 1968, we acidized and tested the lower porosity without getting anything out of it. I accepted that as evidence that it did not have water in it, true or not, and 127 picked up that porosity low enough to produce water. If it had communicated between it and No. 27 to the south, so there are variations in permeability evidently in the lower porosity, which impede the flow of fluids all over.

Q Are all these contacts drawn at 698?

A No, sir. They are just close. The minus 698 figure resulted out of drillstem tests in Bridges No. 27. The log of 132 had been placed in evidence and I could arrive at the exact datum that we got it from there, if you were to look at this time. It was in the vicinity of minus 700 feet

that the well picked up the lower porosity. In the case of No. 26, I see that it was drilled 25 or 26 feet below minus 698 and produced water when it was initially drilled in the bottom, cemented off, and it has recently produced a lot of water again.

I don't think it is coming out of the upper porosity. I don't believe we have ever produced any water out of the upper porosity in meaningful amounts. All of these sections which cross the south line of the Bridges State lease confirm, in my mind, at least, that there is nothing like the high permeability, high porosity zone, that we have in the north end. These logs look very similar to the logs of wells that have not experienced premature break-through of water.

MR. LOPEZ: I will pass the witness on to you.

RE-CROSS EXAMINATION

BY MR. KELLAHIN:

Q Mr. Kelly, if I understand, you base your oil-water contact of 698 or about 700, on the basis of water encountered in two wells?

A Three wells.

Q Were there any wells where water was encountered at a lower level?

A Well, of course, our Bridges No. 132 went well below

minus 700.

Q And had no water?

A It did have water but as I remember, the porosity came up to about minus 700 feet and it produced 100% water. We did not get any oil at all out of the bottom zone.

Q Where did you encounter the water then, are you saying it was at 700 then?

A I know it was present up to there at that point and I know in Bridges 27 it was present.

Q You know, of course, that it was not present on the Marathon's lease?

A Yes, sir, I accept that.

Q But you won't say it is not possible the same situation exists on the Continental lease?

A It could be. There is nothing peculiar about the "H" 35 No. 11 well. As I mentioned earlier, the pay that I see in it is no better than the pay we have and yet the well has three hundred seventy or eighty thousand barrels of oil.

Q Now you refer to the south end of the pool as being rather doggy?

A I am talking about Bridges State lease which is situated on -- it starts at the south line of Section 26 and goes north and in general it deteriorates to the north.

Q You are talking about Mobil's lease and not Continental's or --

A Yes, I am talking about Mobil's lease.

Q Are you familiar with Phillips Petroleum Company offset to Continental's No. 4 well?

A No. 4 to the east or south?

Q To the west.

A I have had occasion to look at some production figures on it.

Q That was completed as a top allowable well last year, was it not?

A It may have been.

Q I think the production figures that I looked at were in the 1968 Annual, and I will refresh my memory on that. I think the well you are referring to is a twin well, was completed in 1969.

A A brand new well?

Q Yes, sir.

MR. NUTTER: Are you talking about the Mobil Lease, Mr. Kellahin?

MR. KELLAHIN: Yes.

MR. NUTTER: Are you talking about No. 2 or No. 1?

MR. KELLAHIN: No. 3.

MR. NUTTER: Where is No. 3, it is not on the map.

MR. KELLAHIN: It is a twin to the No. 1 well.

Q (By Mr. Kellahin) Do you have any information on that well?

A I see that the No. 1 well is credited with making 1,068 barrels in the year 1968 and was producing about a barrel and a half a day at the year end.

MR. NUTTER: The No. 1?

THE WITNESS: The No. 1.

MR. NUTTER: The No. 3 was drilled as a twin to the No. 1 and depleted in the Grayburg-San Andres?

MR. KELLAHIN: Yes, that is our question.

THE WITNESS: I don't know that to be true.

MR. KELLAHIN: You don't have that information?

MR. LOPEZ: Mr. Kelly, on this cross section, C-C 1, for Marathon No. 8, you indicate the water contact to be at about 4712. However it is a fact that we have drilled that well to 4763 on porosity and make less than 1% water. How would you get that? Does that not indicate that your calculations here are incorrect?

THE WITNESS: No, sir. That indicates that water wasn't made from that well and from that interval. We have had an initial drillstem test and two confirmations, what appears to

me to be a higher water level in the Bridges lease.

I would be tickled pink if it had oil in it.

MR. NUTTER: How would you account then for 4712 making less than one per cent?

THE WITNESS: At 4712 we are into water. I don't see it showing up on the log correlation that you are in a separate reservoir. Perhaps there is a tilted water level, various possibilities.

MR. LOPEZ: I have no further questions, Mr. Examiner.

MR. SPERLING: I offer Mobil's Exhibits 6 through 11.

MR. HATCH: In both cases?

MR. SPERLING: Both.

MR. NUTTER: Mobil's Exhibits 6 through 11 will be admitted in evidence in cases 4367 and 4368.

(Whereupon, Mobil's Exhibits 6 through 11 offered and admitted in evidence.)

MR. NUTTER: Do you have any further questions?

MR. SPERLING: That is all I have, Mr. Examiner.

MR. NUTTER: Do you have any further questions of Mr. Kelly?

MR. KELLAHIN: I would like to request that the Examiner take administrative notice of the Commission's own records in regard to Phillips, namely No. 3 located in Unit "E", Section

17 South, 34 East.

MR. NUTTER: Section 35?

MR. KELLAHIN: 34 East.

MR. NUTTER: We will take administrative notice of the existence of that well.

MR. KELLAHIN: And the monthly statistical reports for the month of March which shows production from that well was 77 barrels.

MR. NUTTER: In the Grayburg-San Andres?

MR. KELLAHIN: Vacuum.

MR. NUTTER: Thank you, Mr. Kellahin. We will take notice of that fact. Is there any further testimony by any parties? We will call for statements at this time.

Mr. Sperling, as applicant, you can go last.

MR. SPERLING: All right, sir.

MR. KELLAHIN: If the Examiner please, on behalf of Continental Oil Company, I think our position is quite clear. Our chief concern is that with a lease not yet ready for secondary recovery and if we are offset by waterflood project, that production from that lease will be damaged. We feel Mobil will suffer no damage by delaying the injection in those wells immediately adjacent to the Continental lease and we ask that insofar as those wells immediately offsetting Continental Oil

Company are concerned, the injection application be denied.

MR. NUTTER: Thank you. Mr. Lopez?

MR. LOPEZ: Mr. Examiner, just a brief statement, with reference to higher members of the Bar that are chopping at the bit, I would like to make our position very clear, though. We would question that there would be established that buffer zone as has been requested by Continental of 1650 feet. This would affect us on the north and east or west boundaries of the Marathon lease and I shall adopt Mr. Kellahin's brief statement as coinciding with our own.

I think it is clear that to allow this application by Mobil at this time is premature especially as it affects the various successful leases of Marathon to the South of the Mobil application and that great reserves, oil reserves,could be irretriebably lost and that the expense that Marathon has gone to line the wells and to properly develop and retrieve the oil under that lease would be lost. Thank you.

MR. NUTTER: Thank you. Mr. Sperling?

MR. SPERLING: In answer to Mr. Kellahin's statement which is an obvious conclusion that no damage will result to Mobil by delaying until such time as Continental has decided that it is propituous time to commence a waterflood, I think the evidence supports the conclusion irrefutably that Mobil

will suffer great damage economically and that the possibility of the loss of considerable amounts of oil is established.

The evidence, I think, has shown that there is a distinct possibility of separate reservoirs existing between the Bridges lease and those leases which are not far removed from it. There is a mass of data here which the Examiner and his staff are going to have to digest over a period of time, in order to reach a conclusion, and the resolution of what now appears, at least from the standpoint of Continental and Marathon, a near irreconcilable dilemma. If all of the statements and the testimony is taken at face value, it looks to me like there is possibly equitable consideration to both sides which the Commission is going to have to weigh at some point.

I don't think it is the Commission's position in the past that the waterflood should be delayed until such time as it might be convenient to conduct a companion or neighboring flood. I think it has been shown that the possibility of the damage insofar as the adjoining leases are concerned is simply that it is a possibility and by no means a probability. And we therefore ask the favorable consideration of the Commission on the application.

MR. NUTTER: Thank you. Mr. Kelly, before you get away, I've got the latest tests from Marathon and from

Continental on their wells. I wonder if you could give me the latest tests in your wells, particularly in Sections 26 and 25, if you have got the oil and water tests, to date.

MR. KELLY: I don't have the recent tests of the wells on the south end of the Bridges lease. The most recent information I have is with regard to their producing ability, is the production report that I estimated in an earlier tabulation which comes up through the month of April, I believe, for our wells.

MR. NUTTER: Do you have tests on the wells more recent than that?

MR. KELLY: Of course we do, but I don't have them with me. I would be pleased to obtain the most recent tests that we have from our records and forward them to you.

MR. NUTTER: If you would do that, please, Mr. Kelly, if you can give me the tests on the wells in the south half and the northeast quarter of Section 26 and the north half of 25.

MR. LOPEZ: Could we be supplied with a copy?

MR. NUTTER: I am sure he would be happy to supply copies to interested parties.

MR. KELLY: Yes, sir, the south half of Section 26?

MR. NUTTER: North half of 25 and the northeast quarter and south half of 26, please.

MR. KELLY: I know there is only one well still producing in the southeast quarter of Section 26. The others are depleted and drilled deeper to some other zone or temporarily abandoned.

MR. NUTTER: Whatever they are capable of, let us know. Does anyone have anything else they would like to offer in Case No. 4367 and Case No. 4368, consolidated? The case will be taken under advisement.

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STATE OF NEW MEXICO)
) ss
COUNTY OF BERNALILLO)

I, the undersigned Notary Public in and for the County of Bernalillo, State of New Mexico, do hereby certify that the foregoing and attached Transcript of Hearing before the New Mexico Oil Conservation Commission was reported by me; and that the same is a true and correct record of the said proceedings, to the best of my knowledge, skill and ability.

Notary Public

My Commission Expires:

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