NEW MEXICO OIL CONSERVATION COMMISSION

EXAMINER HEARING

SANTA FE, NEW MEXICO

Hearing Date MARCH 5, 1992 Time: 8:15 A.M.

NAME	REPRESENTING	LOCATION
ERIC D. CARLSON	MARATHON OIL COMPANY	MIDLAND, TX
DONALD G. PRICE, JR.	MARATHON OIL COMPANY	MIDLAND, TX
TOM LOWRY	marathon Oil	midland, TX
W. Thomas Kellahin	Kellahin Kellahin & Aubrey	Santa Fe

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NEW MEXICO OIL CONSERVATION DIVISION

STATE LAND OFFICE BUILDING

STATE OF NEW MEXICO

CASE NO. 10443

IN THE MATTER OF:

The Application of Marathon Oil Company to Amend Division Order No. R-9503, Lea County, New Mexico.

BEFORE:

DAVID R. CATANACH

Hearing Examiner

State Land Office Building

March 5, 1992

REPORTED BY:

CARLA DIANE RODRIGUEZ
Certified Shorthand Reporter
for the State of New Mexico

ORIGINAL

A P P E A R A N C E S

FOR THE NEW MEXICO OIL CONSERVATION DIVISION:

ROBERT G. STOVALL, ESQ.
General Counsel
State Land Office Building
Santa Fe, New Mexico 87504

FOR THE APPLICANT:

KELLAHIN, KELLAHIN & AUBREY
Post Office Box 2265
Santa Fe, New Mexico 87504-2265
BY: **W. THOMAS KELLAHIN, ESQ.**

-and-

MARATHON OIL COMPANY
Post Office Box 552
Midland, Texas 79702
BY: **THOMAS C. LOWRY, ESQ.**

I N D E X

E X H I B I T S

EXAMINER CATANACH: Call the hearing to order this morning for Docket No. 7-92. On this particular docket, Case 10451 will be continued to March 19th.

At this time we'll call Case 10443.

MR. STOVALL: Application of Marathon Oil Company to amend Division Order No. R-9503, Lea County, New Mexico.

EXAMINER CATANACH: Are there appearances in this case?

MR. KELLAHIN: Mr. Examiner, I'm Tom Kellahin of the Santa Fe Law Firm Kellahin, Kellahin & Aubrey appearing on behalf of the Applicant, and I have two witnesses to be sworn.

EXAMINER CATANACH: Any other appearances?

Will the witnesses please stand to be sworn in.

(The witnesses were duly sworn.)

MR. KELLAHIN: Mr. Examiner, I would like to call, at this time, Don Price. Mr. Price is a petroleum engineer with Marathon.

DONALD G. PRICE, JR.

Having been first duly sworn upon his oath, was examined and testified as follows:

EXAMINATION

BY MR. KELLAHIN:

Q. Mr. Price, for the record, would you please state your name and occupation?

A. My name's Donald Gene Price, Jr. I'm operations engineer with Marathon Oil Company.

Q. Have you, on prior occasions, Mr. Price, testified before the Oil Conservation Division?

A. No, sir, I have not.

Q. Summarize for us when and where you obtained your degree.

A. I obtained my degree in May of 1986 from the University of Missouri-Rolla where I obtained a bachelor's of science degree in petroleum engineering.

Q. After your graduation, Mr. Price, summarize for us your employment experience as a petroleum engineer.

A. I took employment after graduation with Schlumberger Testing, and I worked for two years and three months out of Odessa, Texas, as a field engineer.

At the time I left Schlumberger I had the title of senior field engineer. I took

employment then with Marathon Oil, and I've been employed as an operations engineer with Marathon for the last three years.

Q. As an operations engineer for your company, what is your particular involvement with Marathon's project in what is called the McDonald State A/C-1 and 1-A waterflood project in Lea County, New Mexico?

A. The scope of my duties in reference to the McDonald State project was to oversee the open hole logging and to work with the design and the workover of all the wells, injectors and producers pertaining to the flood.

Q. This is a waterflood project that has previously been approved by the Oil Conservation Division, is it not?

A. That is correct.

Q. Are you familiar with Division Order R-9503 that's appended to the application in this case?

A. Yes, I am.

Q. And that is the approval of the project by the Oil Conservation Division?

A. Yes, sir, I am.

Q. Summarize for us, generally, the

criteria as it's important to you with regards to the initially approved interval for flooding.

A. The initial interval approved for flooding was the South Eunice Pool. There was certain stipulations on certain wells by offset owner requests, that the water injection be defined to just the top of the Queen interval.

MR. KELLAHIN: Mr. Examiner, for your information, here's an extra copy of Order No. R-9503 that Mr. Price is discussing.

Q. With knowledge about that Order in your operations within this project, have you made an engineering study to examine the facts and circumstances around what is characterized as Injector Well #30?

A. Yes, sir, I have.

Q. Based upon that study, do you have recommendations, conclusions and proposals for the Examiner today concerning that particular injector well?

A. Yes, sir, I do.

MR. KELLAHIN: Mr. Examiner, we tender Mr. Price as an expert operations engineer.

EXAMINER CATANACH: Mr. Price is so qualified.

Q. Mr. Price, let me direct your attention, sir, to what we've marked as Marathon Exhibit No. 1. To orient the Examiner, would you identify the display for us?

A. The display, Exhibit No. 1, is a plat of a portion of the South Eunice Field outside Eunice, New Mexico. It shows all the subsequent wells pertaining and surrounding our waterflood, which is confined to Section 16 and the western half of Section 15 in Lea County, New Mexico.

Q. Identify for us how the specific injector that's the subject of this hearing is shown on the display.

A. It is shown highlighted with yellow with a red circle around it, and it's labeled as an injection well in the southwest portion of the lease of Section 16.

Q. The dashed box, if you will, that surrounds Section 16, is simply a squared off half-mile radius around all your injector wells for this project, is it not?

A. That is correct.

Q. When you look around the injector well, within a half-mile radius of that, would you give us a sense of what Marathon is doing, as

operator, to initiate the flood initially in the Queen portion of the pool?

A. Okay. Initially in the Queen portion, Well #30 was perforated in the Queen interval and was acidized. The surrounding producers to the northeast, the #10 well, was opened in the Queen and the Lower Seven Rivers, and was treated.

The #9 well, located to the north and west of #30, was also--is open-hole intervaled in the Queen and is also perforated in the casing in the Lower Seven Rivers.

The Well #8, which is located south and west of Well #30, is open-hole intervaled in the Queen formation and is perforated in casing in the Lower Seven Rivers interval.

The producer, Well #47, is perforated--was a new drill pertaining to the project, and was perforated and completed in the Queen formation only.

Q. There's another key well that we're going to describe in your testimony, and it's identified as Marathon's McDonald State #6 well?

A. That is correct. It's a presently producing Jalmat well.

Q. Within the half-mile radius of the #30

injector, there are some Jalmat gas wells to the south that are not operated by Marathon. Would you identify those for the Examiner?

A. Okay. Them are starting in Section 20 in the northeast corner, Section 20. That is Well #3, which is operated by Doyle Hartman.

In Section 21, in the northwest quarter, we have two wells, Well #1 and Well #2 which are Jalmat gas wells, which are operated by Doyle Hartman.

Q. In implementing the approval and initiating the waterflood with the use of injector #30, what did you find?

A. Due to the agreements of the order, we've subsequently ran profile bond logs and profile logs and we have detected a slight channel up into the Lower Seven Rivers pay.

Q. That data was required and Marathon agreed to run it and provide it to the Division and to Mr. Hartman or those offset operators around this injector?

A. That's correct.

Q. An analysis of that profile demonstrates what to you?

A. The analysis of the profile

demonstrates to me that the majority of the water is going into the Queen, but there is a slight detection of a channel or water movement behind pipe up into the Lower Seven Rivers pay.

Q. Having determined that to be correct, in your opinion does that pose any risk to any of the Jalmat gas wells in the area of review for this injector well?

A. No, sir, it does not. Looking at the well and looking at the bond log where the Lower Seven Rivers pay is located in Well #30, we have approximately 65 to 70 feet of interval left in the South Eunice Pool before you get to the base of the Jalmat formation, and evaluating the bond log we have more than adequate bond to keep that water contained where it's at in the Lower Seven Rivers.

Q. What are you seeking to have the Examiner do for you with regards to this injector well?

A. To amend the order to where we're allowed to keep injecting water into Well 30 the way it presently is.

Q. To accomplish that result, what is the vertical distance above the top of the Queen in

this injector well that you need additional approval for injection?

A. Approximately at least 40 feet.

Q. That would still leave a buffer or a safety interval vertically in the wellbore of some 60 feet before you get into the Jalmat Pool itself?

A. That is correct.

Q. Let's now turn to the specifics of the reasons that support your conclusions, Mr. Price, and to do that let me ask you to look at two displays.

If you'll turn to what we've marked as Marathon Exhibit No. 2 and then, in addition, look at Exhibit No. 3. First of all, let's have you identify Exhibit No. 2.

A. Okay. Exhibit No. 2 is the injectivity profile log. Briefly describing the log, what you're looking at, starting on the left-hand side, we have marked the representative formations and boundaries based off the gamma ray that was taken on this profile log run.

In the left-hand track you see the gamma ray character which was used for the correlation. Over in the right-hand track, the

first curve that you come to is a solid line which is your flowing injection temperature that was taken while the well was still injecting.

The second line that you see, the dashed lines with enclosed circles, solid circles, that is, is the shut-in temperature profile run which was done one hour after the well was shut in.

On the far right-hand margin you have a collar log which shows the 2-3/8" collars at 3542, you see the packer, and then the collars after that are the casing collars from the 5-1/2" casing. So that gives you your whole look at the wellbore, as far as the mechanical part of it, the tubulars.

Down in the part of the zone of interest, you can see, in the middle margin, you can see where the perforations are located for the well, and you can see the percent of fluid going into these perforations off the velocity runs and off the tracer runs on the left-hand margin.

Back on the right-hand margin, you see another display which is for the velocity which is a percent of flow, with 100 percent being the

far right-hand margin and zero percent flow being the far left-hand margin, and you can see that the velocity is represented by the solid dots and the tracer is represented by your open circles.

Q. We'll come back to that display in a minute. Let me have you identify Exhibit No. 3 at this time.

A. Okay. Exhibit No. 3 is a portion of the logging procedure that was done. This is your channel check log, a portion of it, where we detected and were looking for the channel to verify the depth the way the channel was actually going to.

To just explain, I would like to point out first the tool diagram, that you see there in the middle of the exhibit, the way this tool was set up, you have one ejector and two detectors. Your top detector is your upper gamma ray above your ejector, and below your ejector, your bottom detector is your lower gamma ray. You can see the representative footages in between the distances for these detectors in the ejector.

Back over on the log itself, the left-hand track is for your bottom detector and for your right-hand track is your top detector.

If I may, this log is increasing time, going up, so you have--we'll start at the bottom of the log. The way this is done, the tool is set stationary and the material is ejected and it's monitored at the detectors when the radioactive material shows up.

So, if I can explain this, the first shot that you see is the tool with the bottom detector sitting at 3595. You see the quick spike on where the radioactive material was ejected out of the injector. You see the big signature on your bottom detector on the gamma ray which is the radioactive material slug passing that.

It goes down the casing, and since we suspect the channel--and we'll assume that we do have the channel--it goes up the back side and you see it come back and hit your bottom detector again. You see some detection from that detector behind pipe, and then a few seconds later you see it go past your top detector, and you see that signal that's received by your top detector there; so that they saw it on both the bottom and the top detector.

They moved up to 3590 with the bottom

detector, did the same sequence again, a little bit longer time since you're a little bit farther above that top perforation in the perforated interval. You see your deflection on your bottom detector, you see a slight deflection on your top detector. So you see the radioactive material pass both detectors again.

Then they moved up to 3580, did the same sequence again. You see a slight detection on the bottom detector and you see no detection on the top detector. And you can see that they stayed on that and monitored that for a while to make sure they did not see any kind of deflection of the radioactive material on the top detector.

So, by this sequence in these logs, it's my opinion that the fluid movement was somewhere between 3580 and 3570 by this exercise that was done.

Q. When we look at the top sequence here, where it's displayed with the red shading that says "channel" and we have the green line over to the top detector line, what does that represent?

A. That represents, more or less, just the trend that you're seeing. When you're seeing it hit the bottom detector, there's an established

trend that if the water is still moving, there's going to be a little bit of a lag time because of the distance, but you should be seeing it approximately, on your top detector if it's going to be there, at that same lag time.

Q. What do you conclude about the quality of the cement bonding in this particular injection well?

A. I conclude that the quality of cement bond, the log--the well was bond-logged before we did any completion work on the well and it looked very good to excellent over the zone of interest, and my conclusion is that this slight channeling that was created was due to the acid treatment that we did on the well upon completion.

Q. Do you see any evidence or indication that channeling will occur above this "A" member of the Seven Rivers zone, which is still within your particular pool?

A. I do not.

Q. Do you see any evidence that this wellbore is going to channel or otherwise communicate waterflood materials up into the Jalmat gas pool?

A. I do not. The mechanical integrity of

the well is very good.

Q. Let's turn back, then, to Exhibit No. 2. On the far-left column of the display is an index to give us a reference to where we are vertically when we look at the log information.

Using that reference on the left column, take us down the wellbore and show us, then, what is occurring when you examine and analyze the log.

First of all, you have identified for us the base of the Jalmat pool and the corresponding top of your pool?

A. Correct.

Q. Is there any question in your mind that you have done anything other than locate that properly?

A. We're very confident that's where it's located in the well.

Q. Then, as we move down vertically, you've identified what's called the Lower Seven Rivers "A"?

A. That is correct.

Q. And that is the zone in which you have channeling up above the top of the Queen into that particular zone?

A. That is correct.
Q. Below that, then, is a marker indicating the top of the Queen?
A. Correct.
Q. Again you have confidence that you've correctly identified the location of the top of the Queen?
A. That is correct.
Q. And then, with regards to your perforated interval, you've shown the floodable Upper Queen and then the Lower Queen Sand?
A. That's correct.
Q. Follow me now on that portion of the display that identifies the Lower Seven Rivers "A," move horizontally over until you find the area that's shaded with the green identification color, what's going on there?
A. Okay. What is going on there, by Exhibit 3, it's my opinion that the water is channeling up between 3570 and 3580. To get exactly the depth, to get an actual depth in where we're channeling to, the area shaded in green is on the shut-in temperature, which was done one hour--injection was ceased for one hour and then a shut-in temperature profile log was

run.

And the top of the channeling, the actual depth of 3575 was picked off an inflection point where you see a change in temperature, which defines the top of where the water is going.

Q. When you're analyzing this data, you look through magnifying instruments and try to look for a break or a change in the slope of that data?

A. That is correct.

Q. And that change in slope you've identified to be at this point?

A. That is correct.

Q. And from that you've concluded you have a small amount of channeling whereby floodable fluids are moving up as high as this Lower Seven Rivers "A" zone?

A. That is correct.

Q. You've described for us the area, you've identified the problem with this particular injection well. Let's go back to Exhibit No. 1 as a reference point and talk about some of the reasons you feel that the vertical limits for flood approval can be increased

without jeopardizing any Jalmat gas production.

First of all, using Exhibit No. 1, I'll have you describe for me what, if any, operational procedures your company has undertaken to take pressures off of the Seven Rivers "A" zone that's now subject to flood fluids?

A. Okay. Directly in reference to the Well #30, in the agreements, in the original order, Well #10, which is located to the north and the east, Well #9, which is located to the north and the west, and Well #8, which is located to the south and west, are all open in the Lower Seven Rivers pay. They're producing wells.

We keep the wells pumped off so, therefore, we create a pressure sink in that Lower Seven Rivers, that any fluid that enters that Lower Seven Rivers has very easy access to them wellbores, as far as keeping pressure off that zone.

Q. In your opinion as an operational engineer, is opening up of those three wellbores to the Seven Rivers "A" zone sufficient to accomplish that pressure sink, if you will, in the Seven Rivers "A"?

A. Yes.

Q. Is any further action required, in your opinion, with regards to opening up that particular interval in any other wellbore?

A. No.

Q. Let's look at what we talked about a while ago, Marathon's Jalmat gas well, the #6 well, which is to the south and to the east of the injector?

A. That's correct.

Q. If you'll turn to Exhibit No. 5, would you identify that for me, please?

A. Okay. Exhibit No. 5 is a wellbore comparison for the Well #6. Since the well was drilled in the late 1930's and Well #47 was a new drill producer for the waterflood and is located only 150 feet from Well #6, what you see here is the open hole density neutron log for Well #47, with a stick diagram showing the perforations in Well #6 in the Jalmat Pool.

Due to the close proximity of the wells and to give a better presentation of the porosity in that 40 acres, Well #6's perfs are shown correlated over the Well #47. Also in Well #47, you see the present perforations in the Queen

interval.

Q. When we look at the #6 Jalmat gas well that you operate, do you have an opinion as to whether or not all potential pay zones within the Jalmat Pool have been opened by perforations in the #6 well?

A. They have.

Q. When you compare the #6 well to the offsetting Hartman-Jalmat gas wells to the south, do you find that you have opened, in the #6 well, every possible pay stringer or zone in the Jalmat Pool that is either currently open in the Hartman wells or potentially production behind pipe in those wells?

A. Yes, I do.

Q. What significance do you, as an operational engineer, attach to the fact that you have the Jalmat #6 well that you operate in close proximity to the injector #30?

A. The significance of the Jalmat well, Well #6, is due to the mechanical integrity of the bond log and the impermeable rock in the upper part of the South Eunice Pool in that 60 foot, I feel confident that the water is going to stay in the Lower Seven Rivers zone, which is

part of the South Eunice Pool.

If, in fact, there becomes any kinds of problems, it is my opinion, due to the completeness of the perforations up and down the wellbore in Well #6, that that well will see any type of injected water that's encroached in the Jalmat zone before it even approaches the lease line.

Q. Will Marathon continue to use the #6 well as a monitor well, if you will?

A. We will.

Q. As we move to the south, are there any wells operated by others that are also open in the Seven Rivers "A" zone?

A. Yes. Referring back to Exhibit 1, in the northwest corner of Section 21, you see Well #66, which is a unit well for the Conoco waterflood, and upon investigation of the completion notices and their logs on their well, that well is perforated in the Lower Seven Rivers "A" sand.

Q. So what's the point?

A. That point there is that there is an active, open producer in the Lower Seven Rivers "A," another producer between our #30 well and

Doyle Hartman's Jalmat gas wells.

Q. In summary, then, Mr. Price, give us your ultimate conclusions about the safety, if you will, of increasing the injection approval area for Marathon in this injection well.

A. My opinion, the Lower Seven Rivers "A" is floodable, it's part of the South Eunice Pool, there is a slight channel into that pay.

Due to the analysis of the bond log and the mechanical integrity of Well #30, it's my opinion that that water will be contained to that Lower Seven Rivers "A" sand. We have offset wells open in the Lower Seven Rivers to take the water that does encroach into the Lower Seven Rivers, and we also have a Jalmat well that is perforated through the entire Jalmat interval so if there is any problems with the mechanical integrity later in the life of the flood, that obviously we will see this water in that well continuing water encroachment into the Jalmat before it even approaches the lease line.

Q. In your opinion, can we extend the vertical limits above the top of the Queen as you propose in this injection well, and do so without impairment of the correlative rights of others

and in the prevention of waste of hydrocarbons?

A. Yes, we can.

MR. KELLAHIN: That concludes my examination of Mr. Price, Mr. Examiner. We would move the introduction of his Exhibits 1 through 5.

EXAMINER CATANACH: Exhibits 1 through 5 will be admitted as evidence.

EXAMINATION

BY EXAMINER CATANACH:

A. Mr. Price, the current perforations in the #30 well, the top perforation is 3606, is that correct?

A. Yes, sir, that is correct.

Q. So you're seeking to extend the injection interval to approximately 3566, is that correct? You said 40 feet or so?

A. Yeah, approximately 40 feet, to the top of the Lower Seven Rivers "A" sand.

Q. Which occurs where?

A. The top of the Lower Seven Rivers "A" sand in Well #30 is located at 3570.

Q. The Seven Rivers "A" zone, does that have hydrocarbons in it? Is that producible?

A. Yes, sir, it does.

Q. It's my understanding that the reason that this all took place initially was to--or the reason you weren't allowed to inject above the Queen, was to protect the Jalmat gas reserves in offset wells?

A. That is correct.

Q. Have you subsequently talked to Doyle Hartman or any of his representatives about this case?

A. Yes, I have.

Q. What was their reaction?

A. Minimal response.

Q. Were they supplied copies of the tracer survey and bond logs?

A. Yes, they were.

EXAMINER CATANACH: Mr. Kellahin, the application contained also a #33 well. Is that not being addressed in this case?

MR. KELLAHIN: We moved in our prehearing statement, and we'll renew that motion, to delete the 33 well. That one is within an area of concern for Arco, and we are pursuing, independently of this case, a solution with them. At such point as we accomplish a solution, we'll simply refile an application for

that injector, #33.

In addition, on the #30 well, the application asks that we be approved injection up to the, I believe, 3560 interval, to give us a 10-foot buffer above the top of that Seven Rivers, so that if there is any channeling into that Seven Rivers "A" sand, that it's clear we have full approval for that interval.

And we've asked for an additional 10-foot buffer in there. That would still leave us 60 feet above the top of the approved interval before you get into the Jalmat pool, so there's a slight difference, if you look at the application, between what we filed and what Mr. Price has described for you as the top of the Seven Rivers "A."

EXAMINER CATANACH: You're actually asking to extend the injection interval to extend up to 3560?

MR. KELLAHIN: Yes, sir.

Q. (BY EXAMINER CATANACH) Mr. Price, from the logs you've run, is it possible to determine what kind of volume is channeling in this well?

A. The company that ran that was Holmes Wireline, and I've talked with them and our

experts in Littleton, Colorado at our Technology Center, and there's no way to quantify a number for the actual amount of volume that's going behind pipe.

You do get some dilution. The way this is run, the total slug and material goes down, and obviously some of it's going to go into the zone that we're injecting to, and then there's going to be a certain amount that's going to come behind and you get a dilution effect, so there's no way to really get any kind of amount of volume, barrels-per-day wise, to say what's going up and what's going into the formation.

Q. Once you start or once you've injected for a while and you start getting a little pressure on that formation, is it possible the channeling could become worse in this well?

A. There is a possibility of that. Due to the bond log that we see, the bond looked good over the whole zone of interest. I believe the slight channel that was created was created due to the treatment.

In my opinion, it will get no worse if we do increase any kind of rates, be it a step rate or whatever. I would assume it would be

some kind of proportionate means, to what is going into the zone and what is going up will be increased accordingly.

Q. Were you able to detect that channel at all from the bond log?

A. No, I was not. In examining the bond log, the bond log looks excellent. The bottom 400 feet of the well was sandblasted, the casing report was run in the hole. You see 1 to 4 millivolts, which is anywhere from 100 percent to 70 percent bond all the way up and down through that area over the whole South Eunice Pool.

You see good cement--I mean, casing to cement and cement to formation bond, and that's by the lack of railroad tracking on either margin of your VDL. So, when the log was run in the field, there was no concern that there was going to be any kind of completion problems at that time before we perforated the well and did the subsequent acid treatment.

Q. Can you determine that there is, actually, no channel above 3570 or 3560?

A. Yes, I can. And that was by Exhibit No. 3, where we moved up the hole doing the drop shots, detecting the channel where you saw it on

your bottom detector, your top detector, and you moved up the hole until you only saw it on your bottom detectir but not your top detector.

Then that was also confirmed by Exhibit No. 2, which was the shut-in temperature, where you see your inflection point on your shut-in temperature. What was determined by the drop shots was it was between 3580 and 3570, and then the actual depth picked was off that shut-in temperature profile of 3575, which directly correlates over to the Lower Seven Rivers "A" pool.

Q. Why would you choose not to perforate the #47 well in the Lower Seven Rivers "A"?

A. The reason it was not chosen, one, the main extent of the waterflood at this present time is the Queen. The other wells that I have specified were due to agreements that were signed upon initial issuing of the order. At that time there was no concern.

We also have that Jalmat well. The #47 was just perforated in the Queen interval itself and was frac'd with approximately about 65,000 pounds of sand. So at that time there were no stipulations on that well.

Q. Would you, as an added precaution, would you recommend that that be done in that #47 well? Would that help the situation?

A. I would say it would not hurt the situation. I do not at this time believe it's needed, due to the slight channel and the proximity of Well #6. There again, it's my opinion that the water is going to stay in the Lower Seven Rivers "A" due to the mechanical integrity of Well #30 and due to the geology of the rock.

It's my opinion that the water is not going to get any higher than that Lower Seven Rivers.

Q. Mr. Price, what rate in pressures was the temperature log run under, do you know?

A. The temperature log was run under a rate of approximately 1100 barrels a day, and the surface injection pressure, if my memory serves me right, was approximately about 650 pounds.

Q. What's your current pressure limitation on this well?

A. Approximately 720 pounds.

Q. Do you anticipate that you'll increase the rate and the pressure in standard use?

A. At present operations, no, not right now. The well is continuing to pressure up. This is one of our better wells. The southwest portion of this flood that we've developed is a lot better part of the field as far as porosity and permeability.

The well was on a vacuum for a certain amount of time, and we're finally now starting to catch pressure on the well, so it's a better part of the field. That's one reason we do not want to work on the well and get this Seven Rivers included in the well.

The only thing I can foresee in the future would be running the step rate test to get the injection pressure raised as the rates lower, as the well begins to keep pressuring up to the .2 psi per foot to the top perf.

Q. Would Marathon be willing to, if a pressure increase is granted in this well, be willing to run a subsequent tracer survey to make sure that--

A. I see no problem with that. There will be a continuing monitoring process probably on our part, anyway.

Q. Mr. Price, was that the highest

interval that was tested on the tracer survey?

A. The interval where we're seeing that 3580 for the bottom detector; is that correct?

Q. Right.

A. Yes. From that shot it was determined that the channel was up to some distance in between that 3580 and 3570, and then it was confirmed to actual top. Where it was channeling to was taken off the shut-in temperature profile log, which distinguished the top depth of where the channel was going between that 3570 and 3580.

Q. When was the bond log run on the well? Was it run under pressure, Mr. Price?

A. Yes, the bond log was run on the well, shown there at the bottom of the log at a thousand pounds, and over in the legend block it was run on September 16, 1991, upon initial completion of the well.

EXAMINER CATANACH: I believe that's all I have. Anybody else?

Okay. The witness may be excused.

EXAMINER CATANACH: Thank you, Mr. Examiner. I would like to call Mr. Eric Carlson. Mr. Carlson is a petroleum geologist with Marathon.

ERIC D. CARLSON

Having been first duly sworn upon his oath, was examined and testified as follows:

EXAMINATION

BY MR. KELLAHIN:

Q. Mr. Carlson, for the record, would you please state your name and occupation?

A. My name is Eric D. Carlson. I'm a petroleum geologist working for Marathon Oil Company.

Q. Mr. Carlson, on prior occasions have you testified before the Oil Conservation Division as an expert petroleum geologist?

A. Yes.

Q. Pursuant to your employment as a petroleum geologist for this particular project, have you made a geologic study to determine whether or not, in your opinion, the Seven Rivers "A" sand, that we're discussing here today, is an oil-bearing zone as opposed to a gas-bearing zone?

A. Yes.

Q. In addition, have you made a geologic study to satisfy yourself and to reach the ultimate conclusion that, geologically, there's

adequate separation between the base of the Jalmat gas pool and the top of this Seven Rivers "A" sand zone in the lower pool?

A. Yes.

MR. KELLAHIN: We tender Mr. Carlson as an expert petroleum geologist.

EXAMINER CATANACH: He is so qualified.

Q. Mr. Carlson, let me have you turn, sir, to what we've marked as Exhibit No. 6, and have you help us describe how you've gone about studying the reservoir to determine the conclusion that this Seven Rivers "A" sand is, in fact, an oil-bearing sand?

A. Exhibit 6 is a subsurface structure map on the top of the Lower Seven Rivers "A" sand. The center of the exhibit is Section 16, and you can see, from the wells shown, the symbols for the wells where our injectors are and where our producers are.

I would like to point out also especially Well #30, which is indicated once again by the yellow highlighting with the red circle around it. I would also like to point out, for purposes of identification, along the east lease line of Section 16, Well #33, which is

shown in green highlight, and just northeast of Well #33 I'll be talking about another well, the McDonald State No. 1 in Section 15, which I've indicated with a blue circle.

Generally speaking, the structure map shows that the structural dip is very slight out here. These are 25-foot contour intervals, so we see that across the entire lease we have only about a two-degree dip. Generally speaking, we can say in the area of this map that Well #30 is the highest well, structurally, and that in general, structure dips eastward/northeastward and southeastward and also off to the west.

Q. What conclusions do you draw from an examination of the structure of this particular sand member and the ultimate conclusion that this sand member is an oil zone as opposed to a gas zone?

A. I will show, with the help of further exhibits, that we have established oil in the core in Well #1 in Section 15 and that, from some log analyses, we also have oil in Well #30 in the Lower Seven Rivers "A" sand. So I will show that at both the top of the structure and the base of the structure, there is oil present.

Q. Have you also prepared an isopach or a sand map of this particular sand member of the Seven Rivers?

A. Yes, I have. Exhibit No. 7 is a net sand map for the Lower Seven Rivers "A" sand. As we can see, the sand quality varies from approximately 14 feet, in the very northernmost point of the map, to one small portion where we actually have no net sand.

This is a net sand as opposed to a gross sand map, but what we can see from this net sand is that across the lease from Well #30, which is again highlighted in the red circle, all the way downdip to Well #33 and Well #1, we see continuity of sand and, therefore, we expect no permeability barriers between these two points and have what we believe to be a continuous reservoir.

As you can see, the average thickness of this sand is only about five feet; therefore, we consider it a noncommercial hydrocarbon accumulation at this time. But indeed there is hydrocarbon present, and it's about five feet average thickness.

Q. While the Upper Queen is your primary

floodable target, geologically do you find adequate continuity in this Seven Rivers "A" member that that, in fact, is a floodable zone in and of itself, that it may add additional recoverable reserves to the project if flooded?

A. Yes.

Q. Let's turn now to Exhibit No. 8 which, I believe, is your core, is it not?

A. Exhibit 8 is a core report from Well #15, which once again I indicate to you on both the structure and the net sand maps as the well circled in blue in the southwest portion of Section 15, just east of the Section 16.

And I will point out to you, as we turn the opening page and get to the second page, at a depth of 3705 we see the top of the Lower Seven Rivers "A" sand. This sand is four-feet thick, we have cored it, and if you look at the lithology description, which is the little patterned log, and on the middle of the right portion of the log, we see, indeed, the visual description of the lithology of sand.

We also look to the porosity description. We see that this sand has approximately between--well, a maximum porosity

of about 16 percent declining down to less than 10 percent. We see that it, indeed, even after being pulled out of the core barrel, we had a residual oil saturation in this core of approximately 10 percent.

We also see that the interpretation by core labs of this indicated zone is that it would produce oil. That's found in the column just left of the log. We also look at permeability data, which they have measured from hole core permeabilities, and we see three core measurements points at points 7, 8 and 9, respectively, show permeabilities of 10 millidarcies, 17 millidarcies and 8.9 millidarcies for those three samples.

Additionally, we can look at the very top of this log, the interval above this Lower Seven Rivers sand, and we're of course in that 60-foot buffer zone that we have so described. First we see that the porosity, which, once again, is shown on the porosity track with little X's connected together, is really zero. We see that they expect no production of either oil or water from this zone.

You can see the permeability data all

through this is all showing less than 1/10 of a millidarcy through all the samples, 1 through 6, that they took through this zone. So we can conclude that this core shows that this buffer zone is impermeable to fluids.

Additionally, we can look at the very base of the log, the very base of the presentation, and we've attached some recoverable oil calculations that we did from what we call special core analysis where we looked at, from this core, what the recovery in these zones would be.

So, we have three samples here, two from the Queen which have helped us determine that this Queen waterflood was commercial, and one from the Lower Seven Rivers. You'll see they've indicated the Lower Seven Rivers between 3705 and 3709 feet. They got 100 percent core recovery. They've got four feet of net sand, which will exactly correspond to what I have on my net sand map.

And you'll see, down at the very bottom, the calculated recoverable oil by natural or gas expansion barrels per acre-foot. Once again in the Lower Seven Rivers column, 108

barrels per acre-foot. If we had a natural water drive or a waterflood, we would see an increased recovery to 231 barrels per acre-foot.

So, from this test we conclude that the zone is floodable and that it's oil-bearing.

Q. Is this the closest available core analysis to injector Well #30?

A. This is the closest available core analysis in the Lower Seven Rivers "A" sand.

Q. Is the core analysis reliable information for you, as a geologist, to base an opinion that the Lower Seven Rivers "A" sand is an oil-bearing sand?

A. Yes, it is.

Q. Have you applied conventional methodology of your discipline to interpret that the oil-bearing sand in the Seven Rivers A at the location of the core, represents an oil-bearing sand in the same formation when we get to the injector Well #30?

A. Yes. Additionally, when the core was taken back in the 50s, I believe, a Marathon representative by the name of Koenig was present to visually inspect the core and did also confirm that it was oil-bearing.

Q. It's reasonable, then, to take the core at this location and make the interpretation that this formation, being continuous, over, through and including the injector well location, is also going to show oil in that zone?

A. We feel that it is necessary to run some log and establish that for the Court simply because Well #30 is updip. So we've gone ahead and I've brought two other exhibits along to show you what we've done with science where we didn't have a core report. And if you'll turn to Exhibit No. 9?

Q. Yes, sir. Let's look at that.

A. Exhibit No. 9 is a computed Elan log, a Schlumberger product. As you look in the title block, you'll see this particular Well #33, which I pointed out to you already is on the east lease line of Section 16, very, very near the closest well, in fact, to our cored well.

This log used the LDT, CNL, Dual Lateral Log, Microspherical Log and Gamma Ray Log, in order to compute the values that we see. So this was a full suite of logs and it was an opportunity for us to compare, very near to our core, a full suite of logs, have a look and see

how to calibrate our logs, if you will, back to the core.

So the well was logged on June 19, 1991, and we recently computed it January 30, 1992. I would direct your attention to the actual displayed log now. This is a standard Schlumberger computer product. I've marked for you the extent of the Jalmat Pool, the political boundary between the South Eunice and the Jalmat Pool, marked for you the Lower Seven Rivers zone of interest, and also the two Queen zones.

I would like to turn your attention, if I could, please, to the right-most track of the Elan log, and I would also like to point out very quickly, I'm sorry, the vertical scale on the right. This is 2-1/2 inches to 100 feet on this presentation.

So, if we look at the depth track on the right--and this is a lithology indicator, the portion calculated once again by using the crossplots from the lithodensity tool and the other logs, and what we see, particularly focusing now, if I may, on the Lower Seven Rivers "A," we see that there is the porosity that I had indicated to you, I've shown that in green,

and a fairly large quartz fraction which I have shown in yellow on the display.

We believe the Lower Seven Rivers "A" is approximately 75 percent quartz in the matrix, or sand, and the other portion of that is dolomite.

Q. Before we leave Well #33 and Exhibit No. 9, also give us your opinion concerning the barrier or separation between the top of the Seven Rivers "A" and the base of the Jalmat Pool.

A. The third track from the left has four curves in it, and they are marked K-INT, K-OIL, K-GAS and K-WTR. These are permeabilities indicated, and we see, if we look above the Lower Seven Rivers "A" and below the top of the pool on that interval, approximately 70 feet there, we see that there are many places where there's no permeability to any fluid indicated. That is because this rock is an impermeable dolomite.

If we look over to the lithology track to the far right again, we see the overwhelming majority of the zone above the Lower Seven Rivers "A" and below the Jalmat is an impermeable dolomite. We also see a few shale beds in there,

that further indicate that there will be no permeability vertically through that zone.

Q. How did you take the information derived now from the cored Well #1, the Well #33, and reach the conclusion that over in injector 30 you had a similar environment over there that you're finding over by Well #33?

A. I would like to turn to Exhibit 10, please. Exhibit 10 is another computed log. It's a matrix corrected porosity log. And because of the nature of these two lithologies that we're dealing with in the area, one being almost 100-percent dolomite and the other one being a sand, we wanted to know how best to calculate a matrix density.

So we ran this Elan in Well #33 to tell us that the matrix density we should run to adequately evaluate the fluid content in the Lower Seven Rivers "A" would be 75 percent quartz sand and 25 percent dolomite. So, we ran the well in 33 where we had the open hole logs, to tell us what the matrix density for our calculations should be in Well 30.

Well 30, which is Exhibit 10, is a synthetic log created from two cased hole logs, a

cased hole sonic and a cased hole neutron log. Once again, your reference to Well 30 is at the top of the structure. We notice in the Lower Seven Rivers "A" zone, I show that just below, or 60 or 70 feet below the Jalmat Pool again and above the Queen Pool.

I would like to kind of just talk you through this scale. This is another rather complicated presentation. First of all, of course, the depth track, and to the left of that the gamma ray. On the right-hand side we have three curves which are kind of unusual to see in a courtroom.

The first one, the solid curve, is the actual sonic trace, cased hole sonic, and we see that it varies from in the dolomites approximately 44 microseconds per foot on the right, and the sands where it crosses well over 70 microseconds per foot.

This is a fairly standard result and it makes an excellent lithology indicator for us, because the dolomites stand out very clearly having very fast travel times and the sands, for the most part, have very slow travel times. So we're able to use that just to kind of clue us

in.

We look at the next curve up from the bottom, which is the matrix-corrected neutron NPHI, or N-PHI is Schlumbergese for neutron porosity. We see that curve as a sort of a large dash that we can follow up through the log, and finally the matrix-corrected PBHC--I believe that's actually matrix per corrected row, borehole compensated--a little more Schlumbergese, but that's the matrix-corrected sonic. So we can see that curve in the small dashes.

Now, when you have two lithology curves you can crossplot and determine a fluid content, and we've done that, assuming the matrix-corrected density that I gave you earlier. What we see is that, in sort of an analogue to what we do with the density neutron crossplot log, we can look at the Lower Seven Rivers "A" zone and see that the matrix-corrected sonic and matrix-corrected neutron curves, in fact, overly each other very well. We feel that this is an indication that this fluid is oil rather than gas.

If the fluid were gas, you would get

neutron excursion to the right just like you would on a density neutron crossplot. So since these curves overly, we believe that this is an oil zone.

Now, one of the proofs that we see that this technique actually works, is we go up to the Jalmat Pool which is a well-known gas zone, certainly very prolific, and we can look at the interval, for instance, 30 feet, 40 feet either way from 3210 feet, in the upper part of the Jalmat Pool which, as you know, consists of the Yates sand, and we can indeed, as I've indicated in red for you, show the crossover that we'd expect in a gas-bearing zone.

So, we contrast the gas-bearing zone up at the top with this zone down here at the Lower Seven Rivers "A," and we conclude that even on the top of the structure in Well #30, the Lower Seven Rivers "A" sand is oil-bearing.

Q. When you look at this log between the base of the Jalmat Pool and the top of the Lower Seven Rivers "A," what do you see?

A. I'm sorry. Would you please repeat that?

Q. Sure. From the top of the Lower Seven

Rivers "A" to the base of the Jalmat pool, what do you see? Do you see any oil- or gas-bearing potential within that interval?

A. We see no oil- or gas-bearing interval. What we see instead, especially from the sonic log curve, we're looking at dolomites.

Q. In summary, then, Mr. Carlson, what are your major geologic conclusions with regards to this application?

A. The major geologic conclusion is that the Lower Seven Rivers "A" is oil-bearing at the top of the structure in Well #30 and towards the base of the structure in the cored Well #1 and in Well #33, that this Lower Seven Rivers "A" is a continuous zone, that it is an oil-bearing zone, and contains potentially recoverable hydrocarbons that, as a result of waterflooding, we could see enhanced recovery there.

Additionally, the zone above the Lower Seven Rivers "A" and below the base of the Jalmat Pool, is tombstone, bluntly. It's dolomite that is impermeable.

Q. In your opinion, then, can the Examiner approve this application, increase the vertical limits of the area approved for flooding, and do

so without the impairment of correlative rights and in the best interest of prevention of waste of hydrocarbons?

A. Yes. Absolutely.

MR. KELLAHIN: That concludes my examination of Mr. Carlson. We would move the introduction of his Exhibits 6 through 10.

EXAMINER CATANACH: Exhibits 6 through 10 will be admitted as evidence.

EXAMINATION

BY EXAMINER CATANACH:

Q. Mr. Carlson, on Exhibit 7, what was the porosity cutoff you used for that map for the net sand?

A. I used a 10-percent porosity cutoff. About 10 percent, yeah.

Q. It's your opinion, Mr. Carlson, that any fluid that enters the "A" zone from the #30 well will, in fact, or has the capability of traveling through the "A" zone?

A. Yes. It should be able to travel through the "A" zone.

Q. Will the fluid have any preference as to what direction it might take?

A. I believe at this time it's too early

to say that, to answer that question.

MR. KELLAHIN: You're talking about a vertical, or horizontal?

EXAMINER CATANACH: I'm talking about horizontal.

A. We see a northwest/southeast grain out here to the actual net sand out here, and also the gross sand looks that way; but to actually say that that sand would necessarily go that direction, we can't say that yet. As you know, many times sand bars move in directions perpendicular to the strike of that bar.

EXAMINER CATANACH: I believe that's all I have of the witnesses. He may be excused.

Anything further, Mr. Kellahin?

MR. KELLAHIN: Finally, Mr. Examiner, we have our Affidavit of Notification of the offsetting operators within a half-mile radius of the injector, plus the owner of the surface at the injector well location. This is a state oil and gas lease area where the injector is located in, so we notified the Commissioner of Public Lands.

Exhibit #11 represents our certificate or affidavit of mailing, and we would move the

introduction of that exhibit.

EXAMINER CATANACH: Mr. Kellahin, Dasco Land Corporation Corporation would be the lessee?

MR. KELLAHIN: I need to verify that with Mr. Lowry.

MR. LOWRY: It is my understanding that it is the lessee--surface lessee.

EXAMINER CATANACH: Exhibit 11 will be admitted as evidence in this case, and there being nothing further, Case 10433 will be taken under advisement.

MR. KELLAHIN: Thank you.

(And the proceedings concluded.)

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 10433, heard by me on March 5 1992.

David R. Catanach, Examiner
Oil Conservation Division

CERTIFICATE OF REPORTER

STATE OF NEW MEXICO)
) ss.
COUNTY OF SANTA FE)

I, Carla Diane Rodriguez, Certified Shorthand Reporter and Notary Public, HEREBY CERTIFY that the foregoing transcript of proceedings before the Oil Conservation Division was reported by me; that I caused my notes to be transcribed under my personal supervision; and that the foregoing is a true and accurate record of the proceedings.

I FURTHER CERTIFY that I am not a relative or employee of any of the parties or attorneys involved in this matter and that I have no personal interest in the final disposition of this matter.

WITNESS MY HAND AND SEAL March 14, 1992.

Carla Diane Rodriguez

CARLA DIANE RODRIGUEZ, RPR
CSR No. 4