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OIL & GAS
CONSERVATION COMMISSION

BEFORE THE OIL AND GAS CONSERVATION COMMISSION

OF THE STATE OF COLORADO

IN THE MATTER OF THE INVESTIGATION TO TAKE MEASURES TO PREVENT WASTE OF OIL AND GAS IN THE "D" AND "J" SANDS OF THE LITTLE BEAVER FIELD IN WASHINGTON AND ADAMS COUNTIES, COLORADO.

CAUSE NO. 30

REPORTER'S TRANSCRIPT

30-6

Before COMMISSIONERS:

H. C. BRETSCHNEIDER, Chairman

F. M. VAN TUYL

RUSSELL VOLK

330 State Office Building
Colfax Avenue and Sherman Street
Denver, Colorado
10:45 a.m., Wednesday, December 15, 1954

This matter came on regularly for hearing pursuant to notice at 10:45 o'clock a.m., Wednesday, December 15, 1954, before the above named Commissioners.

APPEARANCES:

WILBUR ROCCHIO, Deputy Attorney General

A. J. JERSIN, Deputy Director of the Commission

DOUGLAS ROGERS, Petroleum Engineer for the Commission

ANNABEL HOGSETT, Assistant Secretary of the Commission

PATRICK M. WESTFELDT, ESQ., representing Lion Oil Company

ROBERT C. HAWLEY, ESQ., representing Continental Oil Company.

APPEARANCES (Continued):

PAUL MILLER, representing Calstar Petroleum Company.

JOHN R. TURNQUIST, ESQ., representing Natural Gas Producers.

WESLEY GISH, representing Col-Tex National Drilling Company.

GENE WEDER, representing Goodall.

AL WARD, SR., representing Goodall.

DR. WILLIAM WARREN LONGLEY, representing Denver Basin Oil Company.

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CHAIRMAN BRETSCHNEIDER: The next matter is Cause No. 30, which deals with the Little Beaver Field along the same lines as the Adena proposition which we have just covered. Who of the operators will lead out on this problem?

MR. HAWLEY: My name is R. C. Hawley, Continental Oil Company.

First I will state that our position is that we have no objection to the continuation of the present order at the present time. I know that it is a matter of interest to all of the parties concerned in the field and to the Commission as to the present status of the gas plant, of which we are the operators; and so we have some testimony and facts we should like to present to everyone here on what is happening on the completion of that plant and construction of it. We would like to have Mr. Keith Shepphard testify to that.

CHAIRMAN BRETSCHNEIDER: I want to find out first how

many are appearing in this cause.

MR. WESTFELDT: Lion Oil Company will also appear, and we will have one or two witnesses with regard to the matter of oil and gas allowables.

CHAIRMAN BRETSCHNEIDER: I will suggest you lead off, if you will. And then I should like to know for the record who else appears besides Mr. Hawley and Mr. Westfeldt.

MR. MILLER: Paul Miller, representing Calstar Petroleum Company.

MR. TURNQUIST: I represent Natural Gas Producers. Before the hearing closes I should like to make a statement.

MR. WILLIAMS: For Denver Basin Oil Company Dr. Longley will appear about 11:30. He is unable to appear before that time on account of his work.

MR. GISH: Wesley Gish of Col-Tex National Drilling.

MR. WEDER: Gene Weder, representing Goodall.

MR. WARD: Al Ward, Sr., appearing for Goodall.

CHAIRMAN BRETSCHNEIDER: Mr. Westfeldt, would you proceed? There are going to be quite a number of witnesses, aren't there, to testify?

MR. WESTFELDT: I think we will have two from Lion Oil Company.

CHAIRMAN BRETSCHNEIDER: Let us have all the witnesses stand up and be sworn whether or not you are called.

(Whereupon, four individuals were sworn.)

MR. WESTFELDT: I should like to call Mr. O. F. Zimmerman to the witness stand. Prior to questioning this witness, I understand from the notice of hearing in this cause, which is Cause No. 30, that the matter covers both the Little Beaver "D" sand and the Little Beaver "J" sand. Is that correct?

CHAIRMAN BRETSCHNEIDER: Right.

O. F. ZIMMERMAN, JR.,

testified as follows:

DIRECT EXAMINATION

BY MR. WESTFELDT:

Q Would you please state your name?

A My name is O. F. Zimmerman, Jr.

Q Are you employed by Lion Oil Company?

A Yes, sir.

Q In what capacity are you employed?

A I am chief reservoir engineer.

Q Is that Eldorado, Arkansas?

A Yes, sir.

Q Have you testified before this Commission before, Mr. Zimmerman?

A Yes, I have.

CHAIRMAN BRETSCHNEIDER: We will accept him.

MR. WESTFELDT: If there is no objection, we should like to have that done at this time.

Q (By Mr. Westfeldt) Now, in preparation for this hearing, Mr. Zimmerman, have you made a study of the operations of the "D" sand in the Little Beaver Field?

A Yes, sir.

Q As a result of your study, Mr. Zimmerman, is it your opinion that there is waste occurring in operations at the Little Beaver Field?

A Yes, sir, that is my opinion.

Q Does the waste that you refer to include both surface and subsurface waste?

A Yes, sir, there is both surface and subsurface waste occurring.

Q Will you tell the Commission at this time with respect to surface waste what you think is occurring and what can be done in order to either avoid or reduce the wasteful operation?

A I would like to make a general remark or two about the field first.

Q Go ahead at this time.

A The Little Beaver "D" sand reservoir is a solution gas drive reservoir. The part that any other source of energy plays in the producing mechanism of that reservoir, to the best of our ability to determine, is negligible.

It is repeatedly said in discussing your solution gas drive reservoir that they are not rate sensitive, that is, that the ultimate recovery from a solution gas drive reservoir

is independent of the rate at which that reservoir is produced.

It is my opinion that that is true only as long as the reservoir is produced under ideal conditions, that is, as long as it is uniformly depleted throughout the reservoir. That is, when one area of the reserve is depleted at a faster rate than another area of the reserve, then more energy is used in this faster depleting area than should be used. Therefore, the reserve is wastefully depleted, and ultimate recovery will be reduced.

Now then, to control that is your rate control of both oil and gas; and I propose to show that both surface waste and subsurface waste are occurring in the Little Beaver "D" sand. Therefore, it needs a more workable, enforceable proration order.

Q At this time is the Little Beaver Field operated under ideal conditions?

A No, sir, it is not.

Q It is not subject to any unitization agreement or pressure maintenance program?

A No, it is not at this time.

Q And it is operated under an open competitive system?

A That's right. There is a proration order which sets a top gas allowable.

Q Will you proceed, then, Mr. Zimmerman, with the statements that you wanted to--

A The question concerns surface waste?

Q Yes.

A Surface waste--it is obvious that surface waste is occurring in the "D" sand, because gas is being flared, and that gas is then lost along with all the liquids contained in it.

The only way, of course, that that can be stopped is to shut the field in or to process all of the gas through a plant and sell the residue from the plant.

We don't recommend shutting the field in. A plant will be in operation within a reasonably short time so that at least the liquids will be saved.

The way that that surface waste can be reduced is to reduce the amount of gas being flared, and the way to reduce the amount of gas being flared is to have good and complete and adequate control of total withdrawals from the reservoir.

CHAIRMAN BRETSCHNEIDER: Like a gas-oil ratio?

THE WITNESS: Yes, sir.

CHAIRMAN BRETSCHNEIDER: Is the gas now being flared in excess of 100,000 cubic feet per well per day from the "D" sand?

THE WITNESS: My best estimates show that it is.

MR. JERSIN: Just for the record, we would like to state according to the records in the Commission's office it is below 100,000.

THE WITNESS: Yes, sir, I realize that.

CHAIRMAN BRETSCHNEIDER: Then you mean somebody is forging the report?

THE WITNESS: That is not necessarily the case, Mr. Bretschneider, although it could be. The way it could come about is that you have a producing condition in September that is governed by conditions that were established in June, and conditions can change a lot in three months.

CHAIRMAN BRETSCHNEIDER: Yes, I understand.

MR. WESTFELDT: Before going on further with your testimony, Mr. Zimmerman, I should like to have two exhibits marked.

(Whereupon, charts were marked for identification Lion Exhibit 1 and Lion Exhibit 2.)

Q (By Mr. Westfeldt) Mr. Zimmerman, we have just had marked and placed on the wall here Lion Exhibit No. 1. Would you please state to the Commission what that exhibit is and what it represents?

A This exhibit is a projection of our estimate of what the solution gas drive performance of the "D" sand should be with complete and adequate control of the reservoir. That is, it is the ideal condition of depleting a solution gas drive reservoir.

Along this side is plotted reservoir pressure from zero to 1400 pounds. The initial pressure was about 1300 pounds.

Along this side is the gas-oil ratio going on this curve from zero up to 10,000 cubic feet per barrel.

Along this horizontal axis is plotted fraction of original oil produced.

This curve illustrates the rate of decline in bottom hole pressure with this rate of increase in gas-oil ratio. It is a projection of ideal performance based on everything we could decide factually about the reservoir.

Q Mr. Zimmerman, you mean the black lines are a projection of ideal performance?

A That is right. What it illustrates is what ultimate recovery should be approximately. It shows ultimate recovery from this reservoir should be 24% of the original oil in place if it is operated efficiently as a solution gas drive reservoir could possibly be operated.

CHAIRMAN BRETSCHNEIDER: The black lines have no relation to the way the field is now being operated?

THE WITNESS: Yes, sir. This projection can be drawn before the field is in operation at all.

Now, in order to check to see whether we are reasonably close to what is going on in the reservoir, we run bottom hole pressures and we estimate gas-oil ratio to see whether these things are reasonably accurate. We think they are reasonably accurate, because on October 2nd, 1953, we measured 854 pounds. That is reasonably close to the projection. At the same time

we estimated gas-oil ratio which is very close to what the projected gas-oil ratio should be.

On March 1st, 1954, we measured a reservoir pressure of 742 pounds, and the gas-oil ratio was fairly well in line with what the projection was.

We come along to October 1st, 1954 when we measured a reservoir pressure of 654 pounds. That is not far off the line. It is below the line. Taken by itself you might say it is a reasonable check, but at the same time we come along and our best estimate of gas-oil ratio at that time was 1150 cubic feet per barrel. That is all the ratio information we could put together, and making our best estimate it appears to be 1150 feet per barrel.

Q (By Mr. Westfeldt) Please tell us where the information is obtained with respect to the gas-oil ratio estimate?

A The gas-oil ratio information is obtained from all reports to the Commission that we can get plus our own gas-oil ratio test.

We try to take a gas-oil ratio every 30 days, if we can, and some others do too, so we have considerable gas-oil ratio information. For example, if we see a ratio reported 50 to 60 cubic feet per barrel, I find it very difficult to believe that that condition could possibly exist. The original gas in solution was about 450 cubic feet per barrel, and I know

that under certain conditions the gas-oil ratio produced can be less than 450 cubic feet per barrel, but not to the extent of a ratio of 150. I think those ratios are for the most part inaccurate due to inaccurate measurement or some such.

To go on with this: This illustrates, these red projections, what appears to us at this time to be happening. That is, so many wells in the Little Beaver "D" sand are producing at ratios in excess of what they should be producing at the average state of depletion of the reservoir that we no longer are able to estimate, but we will be able to follow these projections. If this decreases in this manner and if solution gas is the only source of energy to produce oil, we certainly won't get out 24% ultimate recovery.

The purpose of this is to illustrate we think underground waste is occurring now. We think it is occurring, because we are departing now pretty rapidly from what our best estimate of what the reservoir should be doing.

We think the only way to adequately control this reservoir and control that waste until we can get unitization is to get a gas-oil ratio limit.

CHAIRMAN BRETSCHNEIDER: Do you have a suggestion as to what the gas-oil ratio should be?

THE WITNESS: Yes. I'll mention it later.

Q (By Mr. Westfeldt) The 24% estimated recovery, there again, Mr. Zimmerman, is by primary methods without unitization?

A That is right. It is my opinion the only way you could ever retain a uniform depletion would be to unitize it. I think the unitization is the only way you can ever effectively control what happens in this solution gas drive reservoir.

EXAMINATION

BY MR. JERSIN:

Q Mr. Zimmerman, you believe the reason for it coming away from the normal curve in black on your exhibit is due to nonuniform production of the field for the "D" sand?

A Yes, sir. The reservoir is not being uniformly depleted. Gas-oil ratios are excessively high in some wells. Those wells are producing much more gas than they should per barrel of oil; therefore, the average gas-oil ratio is considerably in excess.

EXAMINATION

BY COMMISSIONER VOLK:

Q Mr. Zimmerman, you have testified this is a completion type reservoir and all your energy is in solution gas, is that correct?

A That is the best of our ability to determine. That is correct.

Q If that is true, you want to testify the field is not rate sensitive?

A No, sir. I say it is not rate sensitive if it is produced under ideal control. It becomes rate sensitive when

it departs from that projection. The reason it departs is inadequate control of withdrawals.

FURTHER DIRECT EXAMINATION

BY MR. WESTFELDT:

Q Why don't you state what you think the ideal conditions would be? What would be ideal conditions for production of this field, and how do the present operations differ?

A I wish to recommend that an oil allowable be established for this reservoir and a gas-oil ratio limit. The proposal I will make is for 125 barrels of oil.

Q Per well per day?

A Per well per day with a limit of gas-oil ratio of 1000 cubic feet per barrel. I don't propose those as being ideal conditions. I propose those as being reasonable conditions with adequate control, and those will bring us more nearly--

MR. WESTFELDT: Mr. Volk, did you get your point cleared up?

COMMISSIONER VOLK: It is either two ways. It is either depletion type reservoir. Then it isn't rate sensitive.

Q (By Mr. Westfeldt) It is your opinion, Mr. Zimmerman, that it is not rate sensitive under ideal conditions but is rate sensitive under present conditions?

A I say, the only way you can obtain maximum recovery with solution gas drive is to control the rate of withdrawal. If you do not control the rate of withdrawal, then any in-

efficient producers will use more of the reservoir energy to produce their barrel of oil than the efficient producers do; and, therefore, that wasted energy can never be used.

Q Mr. Zimmerman, can you tell the Commission of some of the high gas-oil ratio wells in the field? Have you any information on any particular wells?

A I think that can be illustrated best by this next exhibit.

CHAIRMAN BRETSCHNEIDER: Before you put that up, does it make any difference whether it is rate sensitive or not if you have a control of gas-oil ratio?

THE WITNESS: I'm not sure I understand the question, Mr. Bretschneider.

CHAIRMAN BRETSCHNEIDER: As I understand, what you and Russell talked about is whether or not under normal conditions it is rate sensitive. Now, if you establish an abnormal condition but a gas-oil ratio, what has rate sensitive factor to do with it?

THE WITNESS: If you establish an abnormal condition, as appears to have been established in this solution gas drive reservoir, then the only way to correct that is to shut in the inefficient wells and produce the most efficient wells.

In the absence of that the next best thing to do is to control the rate of withdrawal from those wells by establishing a maximum withdrawal with a gas-oil ratio.

COMMISSIONER VOLK: I'm afraid I'm going to have to bring it back to: It is not rate sensitive because of ideal producing conditions?

THE WITNESS: Mr. Volk, I maintain it is not rate sensitive only because ideal producing conditions are assumed in making that statement. That is, somebody will say solution gas drive reservoir is not rate sensitive, and they assume in making that statement it will be uniformly depleted. I say with adequate control of gas and oil withdrawals you can't deplete it--

Q (By Mr. Westfeldt) Mr. Zimmerman, what would be the result if you shut in the most inefficient well and tried to produce all from that well?

A If you produced this reservoir only from the least efficient wells, then the--even if you had a limit on gas withdrawal and no gas-oil ratio control, then gas-oil ratio, in my opinion, would continue to climb in those least efficient wells; and, therefore, the total reservoir energy in the form of solution gas would be depleted long before you ever attained an order of 24% recovery.

COMMISSIONER VOLK: If it isn't rate sensitive, the only thing you would change would be the time, wouldn't it? The time of getting production?

THE WITNESS: Mr. Volk, I am of the opinion that a solution gas drive reservoir becomes rate sensitive unless it

is uniformly depleted.

Q (By Mr. Westfeldt) Mr. Zimmerman, referring to Lion Exhibit No. 1 on the wall, if your recommendations are followed and the gas-oil ratio curve is stabilized, will that increase the ultimate recovery? Will that cause the intersection of your reservoir pressure lines and your gas-oil ratio lines to be at a point farther to the right on your exhibit?

A Well, with adequate control of gas-oil ratios and the reduction of withdrawals from inefficient producers, we will have a tendency to come back to this curve, and ultimate recovery will be increased.

Q Let us move at this time, if we may, to the exhibit marked Lion Exhibit No. 2. Mr. Zimmerman, please tell the Commission what Lion Exhibit No. 2 is and what it represents.

A This exhibit was prepared to illustrate how much waste is occurring--subsurface waste is occurring in the reservoir at this time and what could be accomplished with adequate and effective control of total withdrawals.

This information is worked up based on September, 1954, production, because that is the latest information that we have. This top bar, the red portion of the bar illustrates one barrel of stock tank oil produced. The blue portion of the bar illustrates the amount of reservoir space occupied by the gas that was produced with that one barrel of stock tank oil. Then there is shown the total reservoir space voided by producing one barrel

of stock tank oil under the conditions actually existing in September, and that was 4.77 barrels. That is, each barrel of stock tank oil voided 4.77 barrels.

The average gas-oil ratio in September was 1150 cubic feet per barrel, and the average oil produced per well was only 52 barrels.

Now, this B graph illustrates what could have happened had an oil allowable of 125 barrels per day and a gas-oil ratio limit of 1000 cubic feet per barrel been in effect and rigidly enforced during September. What would have happened then is inefficient wells would have been restricted in the total amount of gas they could have produced, because their volume of oil would have been held to a maximum of 125 barrels. It shows that in producing one barrel of stock tank oil only 3.7 barrels of reservoir space was voided.

This graph is drawn a little bit incorrectly (marking on Lion Exhibit No. 2). In other words, in September with good, adequate control, good proration order, you could have produced a barrel of stock tank oil with only 3.7 barrels of reservoir space voided. What that means is you would have saved 1.07 barrels. That is a savings in energy of 28.4%. That illustrates what can be accomplished.

COMMISSIONER VOLK: Are you sure your production in this field total amount of gas?

THE WITNESS: Sir?

COMMISSIONER VOLK: Are you sure the total amount of gas is being produced in this field?

THE WITNESS: No, sir, I'm not sure of it. It is the best estimate that I can make, and I think it is a reasonable estimate and I think it is well within engineering accuracy, our estimate.

Q (By Mr. Westfeldt) Mr. Zimmerman, you are familiar, I know, with the present order affecting the "D" sand in the Little Beaver which merely sets a gas limit of 100,000 cubic feet per day per well. Would you please state to the Commission what in your opinion is wrong with an order that covers a gas limit only?

A I think that this kind of reservoir must be controlled by gas-oil ratio. The gas-oil ratio--the performance of gas-oil ratio is the key to efficiency or inefficiency that is occurring, not gas limit alone. Gas limit is only half of the control. You do not have a gas-oil ratio control with a gas limit only.

Q Where you have only a gas limit is it your opinion that there is a dissipation of reservoir energy in your inefficient well, the high gas-oil ratio well?

A I think it is occurring here, and, therefore, I say yes.

Q Mr. Zimmerman, there are plans or at least efforts being made at this time to unitize the operations in this reservoir, and, as I understand it, it is hoped this will be

accomplished and possibly pressure maintenance put in in the future. Do you consider it desirable to maintain this reservoir in the best condition possible until unitization and pressure maintenance program can be established?

A Yes, sir. I think it is important to keep as much of the natural energy in the reservoir prior to unitization as possible. I think that the operators will have a better chance of obtaining maximum recovery under water drive if the reservoir is not in an advanced state of depletion at the time they start the water drive.

Q Do you know how much oil has been recovered from this field?

A At this time approximately 4 million barrels.

Q What has been the over-all differential or reduction in bottom hole pressures while this oil has been recovered?

A About 640 pound drop from original pressure.

Q In other words, about 50%?

A Roughly 50%.

Q Production in bottom hole pressure?

A That's right.

Q Referring to an earlier hearing on Little Beaver "D" sand in March, were estimates made as to the total recoverable oil at that time by primary methods?

A Yes. The estimated ultimate recovery at that time was somewhere in the order of 25 to 30% of original oil in

place, and that meant that the ultimate recovery by solution gas drive could be in the order of 10 to 12 million barrels of oil.

Q In view of the information contained on Lion Exhibit No. 1, showing the drop in reservoir pressure and projected increase in gas-oil ratios, are you still of the opinion that 10 to 12 million barrels would be recovered by primary method, assuming a projected--

A Not if the--not if the reservoir is not adequately controlled. That is, if due to inadequate control inefficient producers are allowed to dissipate, I would say that recovery could never be obtained by solution gas drive.

Q Do you have any estimate as to what the recoverable oil would be under the present order of the Commission?

A Mr. Westfeldt, I don't have a firm estimate. In fact, I haven't made such an estimate.

Q Do you believe it would be lower than the earlier estimates which were made in March?

A Yes, sir, I do.

MR. WESTFELDT: I have no further questions of this witness at this time.

CHAIRMAN BRETSCHNEIDER: Would anyone else like to question the witness?

EXAMINATION

BY COMMISSIONER VAN TUYL:

Q What are the plans for water flooding? Have you done any testing of the lower sands?

A There have been numerous drill stem tests made in the "M" sand, and we believe that that will provide an adequate source of water to flood this reservoir. Of course, we are going to find out more about the "M" sand when the Goedert No. 2 well that Mr. Roll referred to is tested.

Q Do you have any evidence of the development of a gas cap in the higher part of the reservoir?

A No direct evidence except that gas-oil ratios are increasing.

Q They are increasing more rapidly in the higher part of the cap than elsewhere? I understand there is a topographic tie on top of the reservoir sand.

A Yes. In general the increase in gas-oil ratio is greater in the upper part of the reservoir.

Q Than the middle of the field?

A I can't really tie it down exactly, because it does extend down low in some cases. But most of the rapid increase will be--will have some relation to structure.

Q You might say the relief of the sand line, the topographic relief of the sand line?

A Yes, sir.

EXAMINATION

BY COMMISSIONER VOLK:

Q Do you know about the plant being constructed for production of natural gas?

A Yes.

Q How soon will that be ready?

A I understand it will be ready sometime in January.

MR. SHEPPHARD: We are prepared to make some statements relative to the gasoline plant being constructed out there now.

Q (By Commissioner Volk) May I ask the witness: Any reduction in the gas you would produce from the field would actually prevent physical waste on the surface, any gas you would save?

A Yes, sir.

FURTHER DIRECT EXAMINATION

BY MR. WESTFELDT:

Q Before leaving the stand, Mr. Zimmerman, it is your recommendation that oil allowable of 125 barrels per day and gas-oil ratio of a thousand to one be ordered by the Commission, is that true?

A Yes, sir.

Q And all of the testimony given up to this time relates only to the Little Beaver "D" sand, is that correct?

A Yes, sir, that is right.

Q One more question, Mr. Zimmerman. In your opinion would there be less gas actually produced under the suggestions which you make your recommendations to the Commission than under the present order of the Commission which merely sets a gas limit?

A Less gas actually produced?

Q Yes, under your recommendations than under the present order.

A Well, I don't know for sure, Mr. Westfeldt. I say that the gas-oil ratio would be less. Now, whether less gas would be actually produced would depend on, for one thing, how many of the wells were able to produce their maximum oil--

EXAMINATION

BY COMMISSIONER VOLK:

Q May I ask a question? If you are going to allow 125 barrels per day and a gas-oil ratio limit of 1000 cubic feet per barrel, how many wells will that affect in the Little Beaver Field?

A It will affect about 15 wells, I believe.

Q They are producing over a thousand to one now?

A Yes, sir.

BY COMMISSIONER VAN TUYL:

Q What is the total number of wells in the field?

A 70 wells, I believe.

MR. JERSIN: Mr. Volk, just one observation on this

gas question. Under an order of 125 barrels of oil per day per well with a gas-oil ratio limit of 1000 cubic feet per barrel there would be more allowable gas than under our present order.

MR. WESTFELDT: I have no further questions of this witness.

EXAMINATION

BY MR. HAWLEY:

Q I would just wonder if you would define what you mean by the thousand to one ratio.

A I mean that the limiting gas-oil ratio for a 125 barrel oil allowable will be 1000 cubic feet of gas per barrel of oil produced.

Q Did I understand that your ratio, say, would be 125 barrels of oil or 125,000 cubic feet of gas, whichever was produced first?

A Well, that's what it amounts to.

MR. WESTFELDT: In your opinion that would result in the most efficient recovery of oil at this time?

THE WITNESS: Yes, sir.

MR. WESTFELDT: If the Commission please, there may be other evidence to be presented in connection with the Little Beaver "D" sand reservoir; and, if you would like to go ahead with that at this time, maybe the other interested parties can present their evidence. When that matter is

completed and taken care of, then we should like to go ahead with the matter of the Little Beaver "J" sand, which is different.

CHAIRMAN BRETSCHNEIDER: Mr. Zimmerman, you are excused as a witness in connection with the "D" sand. Would Continental Oil Company like to present any testimony now?

MR. HAWLEY: Ours is dealing with the gas plant. I might state for the record we have no objection to the plan proposed by the Lion Oil Company, but, as at the first hearing, we do not concur with the testimony as to rate sensitivity, and we have not changed; we still disagree with Mr. Zimmerman's testimony. Whenever you want our testimony on the gas plant we will be very glad to bring that forward.

MR. WESTFELDT: Mr. Chairman, I should like to ask these exhibits be admitted.

CHAIRMAN BRETSCHNEIDER: They are admitted.

Does anyone else wish to present evidence concerning the "D" sand discussion?

MR. PAUL MILLER: Mr. Zimmerman impressed the Commission that 1100 to one gas-oil ratio was the amount of gas that was being produced from the "D" zone. I have had quite a bit of experience in the East Texas Field, and you know that the East Texas Field has been one of the greatest perfect fields that has ever been known. When that oil field came in--

CHAIRMAN BRETSCHNEIDER: Are you going to give us a

story about East Texas?

MR. MILLER: No. I am only inferring in regard to the gas-oil ratio.

CHAIRMAN BRETSCHNEIDER: Are you going to use East Texas as an example?

MR. MILLER: Yes, in establishing a gas-oil ratio.

CHAIRMAN BRETSCHNEIDER: I don't think we would like to have you go into that, because it is so far removed and the conditions are so different than this area. We are talking about the "D" sand in the Little Beaver up in Colorado; different geological horizon.

MR. MILLER: Well, I am talking about the gas-oil ratio, if it could be possible to get 2000 to one gas-oil ratio regardless of whether it is East Texas or whether it is in Colorado. I say the 2000 to one is the amount of gas-oil ratio that should be established in every well in Colorado.

CHAIRMAN BRETSCHNEIDER: Just a minute. That is all right for you to have that opinion. We are glad to have your opinion, but I don't think we want to argue the point about what you say about what goes on in Texas or any place else.

MR. MILLER: Well, leave Texas out of it.

CHAIRMAN BRETSCHNEIDER: Even if you are going to argue about Colorado, I don't think we want to argue with you about a 2000 to one rather than a 1000 to one. The Commission will listen to evidence. If you have evidence, expert

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evidence, then perhaps we will listen, but we don't want to listen to a discussion just as a general proposition, if you don't mind.

MR. MILLER: Thank you.

CHAIRMAN BRETSCHNEIDER: Does anyone else want to speak on that subject?

MR. ROCCHIO: Continue it, Mr. Bretschneider, until--

CHAIRMAN BRETSCHNEIDER: Yes, we will continue it until your party shows up. Shall we have now the discussion by Continental Oil Company on the plant situation?

KEITH SHEPPHARD,

testified as follows:

DIRECT EXAMINATION

BY MR. HAWLEY:

Q Would you state your name, please?

A Keith Shepphard.

Q By whom are you employed and in what capacity?

A Employed by Continental Oil Company as regional reservoir engineer.

MR. HAWLEY: If the Commission please, Mr. Shepphard has appeared before the Commission.

CHAIRMAN BRETSCHNEIDER: Yes, sir. We will accept him as an expert witness.

Q (By Mr. Hawley) Will you tell about the progress being

made in the gas plant at Little Beaver?

A I am sure the Commission and everyone else is aware of the fact that progress is being made in the gas plant at Little Beaver. The contract was awarded to Fish Engineering, and they moved on location a couple of months ago and are doing a very good job of getting the plant into shape.

It will be known as the Little Beaver Gas Production Plant No. 25, and the latest estimate we have from Fish is that the plant is currently 90 to 95% complete. They are estimating the plant should go on stream about January 1st, 1955.

I have here some pictures of the plant of various stabilizers, the storage and so forth. And I also would like to extend to the Commission and the engineers of the Commission the invitation to go out and visit the plant sometime with us if they would so desire.

CHAIRMAN BRETSCHNEIDER: We would like to do that.

MR. HAWLEY: We only have this one set of pictures, so we should like to take them back with us. However, anyone here is welcome to look at them.

We should like to identify them for the purpose of the record. There are nine pictures of various parts of the gas plant in the Little Beaver Field.

(Whereupon, nine photographs were exhibited to the Commission entitled as follows:)

1 Compressor installation

2 Process area

3 Gas coolers

4 Scrubber building, dryers, glycol still

5 Stabilizers, vapor overhead condenser

6 Stabilizers and process area

7 Completed station building, scrubber building, process building

8 Motor runs, regulators and compressor buildings

9 Gasoline LPG product storage

Q (By Mr. Hawley) Mr. Shepphard, will this gas plant take care of all the gas being produced at Little Beaver?

A Well, the plant is designed to handle 10 million cubic feet of gas per day, approximately 1 million high pressure and the remainder low pressure gas, and the Bobcat Field, Little Beaver "D" and "J", Badger Creek.

Q What is the quality of the gas?

A Well, it is a very rich gas. It will have good recovery in our plant, we are sure.

Q Have arrangements been made for sale of this gas?

A Well, I understand there has been, and I see we have, and was mentioned they would like to make a statement, some Colorado Interstate men here.

Q What is the cost of the plant and what investment?

A Well, the current estimate of cost--and this is always subject to change--is about $2 million $19 thousand.

Q That is all the questions. Do you have anything else you would like to mention about the plant? Those pictures were taken on what date, do you know, Mr. Shepphard?

A I'm not absolutely certain, but I believe it was just within the last day or two, because they brought them in this morning about 9:30.

Q You would say December of 1954?

A Yes, they have been taken very recently.

MR. HAWLEY: Would any of you gentlemen on the Commission like to ask questions?

COMMISSIONER VOLK: I would say we are very happy to prevent the waste of that gas. We want to compliment you on the way you have gone ahead.

EXAMINATION

BY CHAIRMAN BRETSCHNEIDER:

Q Is the plant going to handle all the gas produced in the Little Beaver?

A Yes, sir, the plant is going to handle all the gas produced in the Little Beaver and also the gas from the gas wells in the "J" sand.

Q And someone from Interstate is going to make a statement about purchasing the gas?

A That is correct.

Q Are they going to purchase all the gas that will come out of the plant?

A Yes, sir, tail gate of the plant.

Q Without any injections?

A I believe our contract is so written that, if we decide upon injection, we have that prerogative. But reference was mostly to water flooding.

MR. TURNQUIST: The Natural Gas Producers, Incorporated, yesterday filed an application with the Public Utilities Commission for a certificate of public convenience and necessity to construct, install, maintain and operate a natural gas transmission system to furnish natural gas for ultimate distribution in the cities of Denver and Fort Morgan, Colorado, and the environs of those cities.

Natural Gas Producers, Incorporated, is a subsidiary of Interstate Gas Company.

We now plan and have contracts for the purchase of natural gas in the Adena Field and in the Little Beaver Field and other fields up in that area which we will gather and tie into the Colorado Interstate Gas Company. We have contracts for purchase of this gas, and Natural Gas Producers has a contract with Colorado Interstate Gas Company for the sale of gas.

It will be wholly an intrastate operation. However, delivery will be made so that Natural Gas Producers will finally be serving Denver.

I believe that each member of the Commission has been

furnished with a copy of our application and a copy of the exhibits which show the existing lines and the proposed lines, gathering lines, gasoline plant and gas supply area.

If the Commission has any questions or if anyone else has any questions, we should be glad to go into further detail.

CHAIRMAN BRETSCHNEIDER: I have a copy of your report.

MR. TURNQUIST: If you would like to make it a part of the record--

CHAIRMAN BRETSCHNEIDER: If you wish, you may do so. We have plenty of copies.

MR. TURNQUIST: Suppose we make them a part of the record. This is my copy.

CHAIRMAN BRETSCHNEIDER: You can introduce it into the record.

Does anyone else wish to ask this gentleman any questions? Thank you very much. We will be very glad to have that report.

Who else has anything to say concerning the plant operation and plans for disposing of the gas?

MR. JERSIN: Mr. Bretschneider, while they are preparing their testimony I should like to state a letter was directed to the chairman of the Little Beaver operators committee for a progress report on unitization, and to give that report at this hearing. I notice the chairman of the Little Beaver is present.

CHAIRMAN BRETSCHNEIDER: All right. We will have that report now.

MR. R. I. WILLIAMS: My name is R. I. Williams. I am with Lion Oil Company and also chairman of Little Beaver operators committee.

This report has been prepared at your request to inform you of the results of the operators' efforts toward unitizing and repressuring the Little Beaver "D" Sand Field in Washington County, Colorado.

Initial efforts towards the unitization were made in October, 1953. At that time a meeting of the operators was held and it was decided that it would be to the best interests of all concerned if efforts were directed toward a unitization and pressure maintenance project in the Little Beaver "D" sand reservoir. As a result of the decision, a Geological Committee was formed and through the next several months representatives of each operator were invited to meet with the Geological Committee for the purpose of defining the limits of the reservoir and preparing structure and isopachus maps of the "D" sand reservoir of the Little Beaver Field. These maps were completed in the Spring of 1954.

The Engineering Committee was instructed to prepare a report to the operators to include:

1. The calculation of the sand volume in the reservoir and under each lease in accordance with the maps

prepared by the Geological Committee.

2. The calculation of the estimated recoverable oil in the reservoir and under each lease for both competitive operations and unitized operations.
3. Investigation of the benefits of pressure maintenance.
4. Recommendation to the operators of a basis for the distribution of equity between the various owners.

As a result of the Engineering Committee's report, it was determined that the governmental sections in this area were irregular and they recommended that the area be re-surveyed to determine the exact shape, size and area of each section to include the exact location of the wells. This survey was completed and the maps finished in the latter part of this past summer. The isopachus maps prepared by the Geological Committee were then transferred to this new base map and the acre feet recomputed independently by three of the operators. The results of these three measurements were very close.

As a result of a comprehensive engineering report it was concluded that the ultimate recovery can be increased by unitizing and pressure maintenance to approximately double the recovery to be expected under competitive conditions, and

that the operators' net profit would be increased by approximately $13,000,000.

At a meeting of the operators held on October 27, 1954 the matter of participation factors was discussed but no agreement reached. Several suggested factors and combination of factors, including acre feet, wells, reserves and surface acreage, were suggested but the operators could not agree to any combination. At this meeting one of the operators stated that they were making an independent investigation and would be able to advise the operators of their results at a later date.

The next meeting of the operators was held on December 6, 1954 and this same operator said that they still were not prepared to present their conclusions since their consultant was not available for that meeting.

At this last meeting the operators were in unanimous agreement that the reservoir should be unitized. However, after considerable discussion it was evident that the operators could not reach an agreement to determine an equitable basis for unitization. Since no conclusions or agreement could be reached, the meeting was adjourned until January 13, 1955, and the Engineering Committee was instructed to prepare additional calculations for a participation factor, using some new bases that had not been previously included.

The last bottom hole pressure survey was taken on

October 1, 1954. The average pressure at that time was 654 psi which is a drop of 636 psi from the original pressure of 1290 psi. On October 1, 1954 the cumulative oil production was 3,874,608 barrels. We have produced approximately 35% of the original primary oil recovery and the reservoir pressure has declined 49.3%.

We have discussed the possibility of repressuring the field with water injection without unitization but this has been looked upon as being almost impossible due to the several different operating interests as well as the different royalty interests.

We have not given up as far as unitizing this reservoir is concerned and we will continue to attempt unitization because in the opinion of most of us we will be recovering only about one-half of the available oil with our present method of operation. We realize that it is to the best interests of all parties concerned, including the operators, royalty interests and the State of Colorado, that this field be unitized and repressured.

Respectfully submitted, R. I. Williams, Chairman, Little Beaver "D" Sand Field, Operators Committee.

CHAIRMAN BRETSCHNEIDER: Mr. Williams, how many operators are there?

MR. WILLIAMS: There are seven operating operators who operate individual properties. I believe that is right.

Yes, sir.

CHAIRMAN BRETSCHNEIDER: They are the ones who have to finally agree on the basis of division of interests?

MR. WILLIAMS: No, sir. They are under one tract. That is just the people who operate the leases, and under several of the tracts the ownership is divided many ways.

CHAIRMAN BRETSCHNEIDER: How many of those? Do you have any idea?

MR. WILLIAMS: I don't know. On one tract there are 18.

CHAIRMAN BRETSCHNEIDER: It is quite a problem. We appreciate you would have considerable difficulty in getting everyone to agree to the percentage scale and divide up the interests.

I should like to suggest, if we could be of any service for arbitration purposes or sitting in on any of the conferences, we should like to offer that, although we have no jurisdiction enforcing units.

MR. WILLIAMS: We certainly appreciate your offer, and, if you can be of service, we shall certainly call you.

MR. WESLEY GISH: Mr. Commissioner, I represent the Col-Tex in the Little Beaver in the "D", which is operated by National Drilling.

We have heard about the technical phases of operating this field, and I want to make a very short statement as to

our real operating experience.

We have a superintendent, whom we feel is very capable, and he tells me that he can best produce his wells under winter and summer and hot and cold at about 100 barrels a day. He has the least gas trouble, he has the least paraffin trouble, and can best operate his pumps at that rate. So, naturally, we want to go along with the recommendation Lyons has made.

CHAIRMAN BRETSCHNEIDER: Thank you very much.

The only thing we have remaining is the "J" sand discussion.

Are you the engineer for the Denver Basin Oil Company?

DR. WILLIAM WARREN LONG: That is right.

CHAIRMAN BRETSCHNEIDER: Do you want to testify?

DR. LONG: I should like to.

WILLIAM WARREN LONG,

being first duly sworn, testified as follows:

My name is William Warren Long. As to the operations of the Denver Basin, I should first like to state that I am in favor of continuing the present regulations in regard to the operation of the field, that is, producing in such a way as to limit gas production to the 100,000 cubic feet per day per well.

In this work I have been on the committee investigating

the Little Beaver from the initial investigation. I have been watching the change in character, and as far as the pressure maintenance and gas-oil ratios are concerned, I believe the Denver basin wells have maintained at least equal in character to the other wells of the field, and our present gas-oil ratios are much better than the limit suggested by Lion on the 1000 cubic feet per barrel of oil.

So that in view of the character and behavior of the Denver Basin wells, I feel we can continue operating as we are without in any way injuring the field or injuring our wells. I want to go on record as supporting the continuation of the present order.

EXAMINATION

BY CHAIRMAN BRETSCHNEIDER:

Q You are not in favor of having the gas-oil ratio basis established, then?

A Well, at the present time they were attaching a gas-oil ratio to limit of production. I am in favor entirely with the gas-oil ratio, and I think the Commission should check that to assure yourselves of the correct records; but I think your present order will eliminate all waste in the field, which I understand is the fundamental object of the commission.

CHAIRMAN BRETSCHNEIDER: That is right.

COMMISSIONER VOLK: Are all your reports in on time

on the Little Beaver?

MR. JERSIN: No. I think probably the operators of the Little Beaver Field are abusing our requirements of reporting on time more than any other field in the state. After this hearing we would like to discuss with the Commission a recommendation to force these reports on time.

MR. WESTFELDT: In connection with this point, I do urge upon the Commission that Rules 4 and 5 in your earlier order, dated April 12, 1954, be continued in effect, and such machinery as can be established for enforcing those tests and reports be put into effect.

CHAIRMAN BRETSCHNEIDER: Of course, we have known some of the operators of the Little Beaver have not been very diligent about sending in the information when we want it and the way we want it, so I think we will have to do something about it. I wish everyone who knows about delinquencies will do something to catch up.

There is nothing more on the subject of the "D" sand. The next and the only part left is a discussion concerning the "J" . Is that lengthy?

MR. WESTFELDT: I don't think so. I should like to call Mr. Zimmerman back to the stand.

O. F. ZIMMERMAN,

returned to the witness stand and testified further as follows:

DIRECT EXAMINATION

BY MR. WESTFELDT:

Q Just for the sake of the record, you are O. F. Zimmerman of Lion Oil Company who testified earlier in connection with the Little Beaver "D" sand matter, and you have already been sworn, is that correct?

A Yes, sir.

Q Mr. Zimmerman, at this time we are considering the Commission's present order and any recommendations and suggestions in connection with that order as it affects the "J" sand in the Little Beaver Field. Now would you please state to the Commission such information as you have concerning the reservoir, concerning waste, concerning rate sensitivity and any recommendations which you and your company have with respect to a new order on the "J" sand in the Little Beaver Field?

A The "J" sand reservoir in the Little Beaver Field is a gas cap expansion type reservoir. The principal mechanism is the expansion of the gas cap.

Of course, playing a part will be the expansion of the solution gas also, and there may possibly be some amount of water drive. It appears that there could very well be water coming into the reservoir.

Because of the type of mechanism that will produce the oil from this reservoir, it is definitely a rate sensitive reservoir. The ultimate recovery will have a direct relationship to the rate of withdrawal, because inappropriate rates of

withdrawal will cause water cone, water channel and gas channeling.

We believe that under the present order of a gas limit only that fluids are moving in this reservoir in such a manner that it is being inefficiently produced.

I have an exhibit, Mr. Westfeldt.

(Whereupon, a chart was marked for identification Lion Exhibit 3.)

Q Referring to Lion Exhibit No. 3, would you please explain this exhibit to the Commission?

A This is a structural contour map showing the top of the "J" sand in the Little Beaver Field. It shows the outline of the field. The red line is the gas-oil contact. That is, this is the oil productive area and this is the gas productive area.

COMMISSIONER VAN TUYL: You mean that was the original contact?

THE WITNESS: Yes, sir.

COMMISSIONER VAN TUYL: There has probably been some sinking there?

THE WITNESS: Yes, sir. I believe it is. That was the original contact.

Now, under the present rule of a gas limit only we have observed some of Lion Oil Company's wells behaving in such a manner that we believe it is due to coning of gas down to the wells prematurely rather than an even sweep of the gas

cap down to the oil zone.

COMMISSIONER VAN TUYL: What is the location of the Lion Oil Company wells?

THE WITNESS: The Lion Oil Company Flessner lease includes all the wells north of this line and these two wells.

Q (By Mr. Westfeldt) The line you refer to is the north boundary of Section 3 and Township 1 South, Range 56 West?

A Yes.

Q And the other two wells are in the Northeast Quarter?

A Northeast Quarter of Section 30. The Lion Oil Company Flessner No. 2 well, located right here, during the first part of this year was producing with a ratio in the order of 500 to 600 cubic feet per barrel. During a period of about 30 days this well went up to a ratio of about 1200 to 1300 cubic feet per barrel. That occurred right about the end of the first quarter of this year.

We think that a rapid increase in gas-oil ratio of that nature is due to gas channeling down to that well prematurely.

Now, that same thing applies to Lion Oil Company Flessner No. 3, which is a direct offset to No. 2. No. 3 has just recently begun to show the effects of inefficient fluid movement in the reservoir. In June it had a ratio of 575, and in August a ratio of 965. We think that is too rapid an increase.

We also have other wells on the Flessner lease, No. 6 and No. 9. We observe that the gas-oil ratio in Flessner No. 6 increased from about 600 cubic feet per barrel in mid 1954 to approximately 2000 cubic feet per barrel currently.

The gas-oil ratio in Flessner No. 9 increased from about 2000 or 3000 in mid 1954 to about 8000 or 9000 now.

We think that those rapid increases in ratios are due to inefficient movement of the fluids in the reservoir.

Now, also these fluids are moving in some rather unexplainable manners even. Lion Flessner No. 1 is a well that has never been produced except for testing. The original tests on that well indicated that it was a very high ratio well. It was in the transition zone. The ratios were in the order of 40,000 to 50,000 cubic feet per barrel. For all intents and purposes it was a gas well. Presently gas-oil ratio is 4000 to 5000 cubic feet per barrel. The well hasn't been produced, and the only way it could have changed the ratio in that manner is for fluid to run in around that area due to migrating up into the gas cap. We think that is inefficient.

Now, it is a little difficult to interpret the movement of water at this time, because not very many wells are making water; but Lion Oil Company Flessner No. 7 has increased from about 50% water early this year to about 75% water now in spite of not being produced. Well, that could be an indication of coning. We don't know for sure whether it is or not. It

could be just the normal migration of water into the reservoir.

Our records indicate that the Tomberlin No. 1 Hogsett well, which is in the Northwest Quarter of Section 30, Township 1 South, Range 56 West, has increased in water production from about 4 barrels a day--I don't know that percentage--early this year to about 62 barrels a day currently. Now, while that is not an awful lot of water, this well is located quite a ways up from where you think the water-oil contact should be; and we don't have any knowledge of any of the surrounding wells producing water, so you would have a suspicion that might be due to coning.

What I have tried to show here is that fluids are moving in this reservoir in such a manner that we believe there will be oil bypassed or trapped, and the most efficient way to complete this reservoir is not being followed, and that would be to have a uniform expansion of the gas cap with full sweep of the oil. We think the reason for those inefficient movements is oil is not being taken out uniformly.

I wish to recommend that an oil allowable be established for this reservoir of 125 barrels of oil a day with the now existing gas limit to be maintained in effect.

Q That is 150,000 cubic feet?

A 150,000 cubic feet.

CHAIRMAN BRETSCHNEIDER: What is the average production of oil per well now, do you know?

MR. WESTFELDT: Perhaps Mr. Jersin has the answer to that.

MR. JERSIN: I thought I did, but I don't have the "J".

THE WITNESS: I have some information for September.

Q (By Mr. Westfeldt) Was this obtained from the Commission's records?

A This is pipeline run. This is actual pipeline run from the field, and I don't really know the source of it. For the Little Beaver "J" sand the Col-Tex Hogsett lease with three wells produced an average of 51 barrels of oil per day per well in September.

COMMISSIONER VAN TUYL: Will you show us the location of those?

THE WITNESS: That lease is located in the Southwest Quarter of Section 30, Township 1 South, Range 56 West. These three wells.

The Lion Oil Company Flessner lease with nine wells produced an average of 59 barrels of oil a day per well in September. That is the lease we referred to previously.

The Tomberlin-Hogsett lease with three wells produced an average of 229 barrels of oil per day per well during September.

Q (By Mr. Westfeldt) Point out the location of that, please.

A That lease is located in the Northwest Quarter of Section 30, Township 1 South, Range 56 West.

CHAIRMAN BRETSCHNEIDER: Is there anything on that report of a gas-oil ratio?

THE WITNESS: No, sir.

COMMISSIONER VOLK: What did you say the average was on the Flessner lease?

THE WITNESS: That is an average of 59. For example, Flessner No. 1 I mentioned is not produced at all. It was for testing.

COMMISSIONER VOLK: Wouldn't it be better to cut that oil per day below 125?

THE WITNESS: It could very well be better to cut it below 125. We don't know too much about this reservoir. We feel 125 is reasonable and that by operating that 125 limit with the gas-oil ratio that we will have a fair degree of uniformity.

CHAIRMAN BRETSCHNEIDER: Mr. Jersin, do you know whether the gas limit is being adhered to by all the operators in the area?

MR. JERSIN: According to the reports we received, they are being observed.

EXAMINATION

BY COMMISSIONER VAN TUYL:

Q Will you give us some data on bottom hole pressures

today as compared to the original pressures?

A A bottom hole pressure survey was run in October, and, while I don't have an exhibit prepared, the average pressure at that time, I believe, was about 1200 pounds per square inch over the whole reservoir. The original reservoir pressure was about 1360.

Q I would like to ask: Is the gas in the gas cap a wet or dry gas?

A Well, it has liquids in it. I don't know just how rich it is, but it does have extractible liquids, and I feel sure that those liquids will be taken out at the plant.

Q How much overlap is there in this "J" sand reservoir under the "D" sand?

A I can point it out approximately. This is the Lion Oil Company Borgmann No. 3 well, which is located in the Southeast Quarter of Section 31, Township 1 South, Range 56 West, and that is fairly well along the western limit of the "D" sand. That is, the "D" sand would not extend much farther west than that well.

MR. WESTFELDT: Mr. Zimmerman, with respect to the Little Beaver "J" sand, is that all you have?

THE WITNESS: Yes, sir, I believe it is.

MR. WESTFELDT: If the Commission please, I should like to have Lion Exhibit No. 3 admitted in evidence.

CHAIRMAN BRETSCHNEIDER: Okay.

MR. WESTFELDT: And I have no further questions.

CHAIRMAN BRETSCHNEIDER: Does anyone here have any questions?

EXAMINATION

BY DR. LONG:

Q What would you consider the character of the permeability of this field?

A It is very high permeability.

Q And uniform permeability or not? That is, would you expect a variation in permeability in short distances in this field judging from the character of the sand as you know it?

A I don't believe I am qualified to answer that question, Dr. Long. I'm sorry I can't competently answer it, but I would not expect large variations, but I can't possibly say they don't exist.

Q But it is your opinion you would be surprised to find large variations rather than that you would be surprised not to find large variations? Which would surprise you more, to find variations of considerable amount or not to find variations of considerable amount?

A Judging on the general character of the "J" sand in this area, I would be surprised to find large variations.

Q And next, which would you consider more readily to cone, gas or water?

A Gas will generally cone more readily with equal pressure differentials.

Q In that case you pointed out that apparently there had been an improvement of gas-oil ratio in this No. 1 Flessner adjacent to this Hogsett well?

A Yes.

Q If there was a production in this well, shouldn't that gas tend to deteriorate rather than improve?

A That is the reason I mentioned it is a little bit unexplainable.

Q Then you can't state the overproduction, if it is so, on this Tomberlin lease could have been responsible for damaging the well at that point, because your well shows an improvement of the field?

A Well, we think that damaging the field will occur if oil migrates into the gas cap, and the fact that Flessner No. 1 has improved in ratio indicates that oil has been migrating up structure.

Q Then the situation is oil is migrating to the east, and we don't want the water to migrate there. Would you then as an engineer recommend that this No. 1 Hogsett well be produced at a greater rate to prevent the oil in that location from migrating up dip?

A No, sir. I would recommend some uniformity be established throughout the reservoir in order to get the gas

to migrate uniformly down.

Q The oil is migrating to the east. Fluids will migrate in the direction of the Flessner. That is the only way they will migrate. We want to prevent them migrating, and we should decrease the pressure to the west to prevent them migrating in that direction?

A I don't think a decrease in the pressure around that southeast corner Hogsett well--I can't tell the number of it from here.

Q No. 1.

A --No. 1 would necessarily stop the movement of gas or oil right there at a line on that well, that is, the fact that you create a, perhaps, a low pressure area by large withdrawals from any one well will cause fluid to migrate to that area.

Our Flessner No. 1 is a direct offset of that particular Tomberlin well. It must have been affected at least partially by what has happened to that Tomberlin well. It will also be affected by what happens to the gas cap by production from all wells in the reservoir. That is, its performance is not necessarily exclusively controlled by what has happened in the Tomberlin well. It certainly must have affected it.

Q But you won't agree that reducing the pressure in the Tomberlin well would tend to move that gas cap downward in the vicinity of your well?

A It would appear much more logical to me that gas would

migrating towards a well that has very large withdrawals from it.

CHAIRMAN BRETSCHNEIDER: Are there any more questions of this witness?

EXAMINATION

BY MR. FRANK RICHARDS:

Q Mr. Zimmerman, it would also appear logical, would it not, that oil would move toward a low pressure area where you have rather large withdrawals of gas in a zone quite near the gas-oil contact?

A Yes, sir, that is right.

MR. WESTFELDT: I believe that is all.

If the Commission please, we request an order be entered as recommended by Mr. Zimmerman, and again refer you to Rules 4 and 5 in your earlier order and ask they be maintained and in force.

CHAIRMAN BRETSCHNEIDER: Thank you. If there are no other questions, you are excused.

That concludes the hearing. We will take both cases under advisement and advise you of the decision that will be made as soon as possible.

MR. WARD: I don't know I have a lot to say. I ask if the Commission would like to see our oil ratios for the last four weeks? I have a copy of that.

CHAIRMAN BRETSCHNEIDER: Give that to Mr. Jersin.

MR. WARD: Our gas-oil ratios are not out of line from that recommended by the Commission. However, I am very much interested in the Little Beaver Field and what is being done.

We would like to establish a unitization, what was spoken of here. Sometimes it looks to us like pressure is being put on us to establish unitization that is not altogether fair. However, we haven't received one so far as that is just like that.

I appreciate Lion Oil have had a lot to do with producing oil in eastern Colorado, but it seems to me it is more or less like a boy that put a quarter in the grabbag at the church festival and got an all-day sucker. It seems to me they are having thinner sands and having trouble. We appreciate that and would like to help them if we can.

CHAIRMAN BRETSCHNEIDER: Thank you, Mr. Ward. If no one else has anything to say--we invite everyone to make a statement or appear. If no one else has anything to say, we will adjourn the meeting.

CERTIFICATE

I, E. WENDELL MORTON, a Certified Shorthand Reporter of the State of Colorado, do hereby certify that I was present at said time and place; that I wrote all of the proceedings during the hearing of the foregoing entitled matter; and that the foregoing is a true transcript of the shorthand notes I wrote at said time and place.

E. Wendell Morton

Certified Shorthand Reporter