



BEFORE THE OIL AND GAS CONSERVATION COMMISSION
OF THE STATE OF COLORADO

66-4
Pg 1-40

HEARING ON COMMISSION'S OWN MOTION)
FOR FURTHER CONSIDERATION OF FIELD) CAUSE NO. 66
RULES AND REGULATIONS, CLIFF FIELD)

PURSUANT TO NOTICE to all parties in interest,
the above-entitled matter came duly on for hearing at the
State Office Building, Denver, Colorado, at the hour of
10:30 o'clock a.m., January 24, 1956.

BEFORE:

- Mr. H. C. Bretschneider, Commissioner
- Mr. F. M. Van Tuyl, Commissioner
- Mr. W. A. Dillon, Commissioner
- Mr. Prescott Eames, Commissioner

APPEARANCES:

- Ted P. Stockmar, Jr., Esq., Denver, Colorado,
for the British-American Oil Company;
- Raymond J. Gengler, Esq., Denver, Colorado,
for Don M. Rounds Drilling Company,
Gibraltar Oil Company, Murfin & Sutton,
and Sanford Production Company;
- James H. McGowan, Esq., Denver, Colorado, for
Sinclair Oil & Gas Company;
- Roy S. Scott, Jr., Esq., Denver, Colorado, for
Anderson-Prichard Oil Corporation;
- Richard H. Shaw, Esq., Denver, Colorado, for
the T & T Oil Company;
- A. J. Jersin, Denver, Colorado, Deputy Director,
Sam Freeman, Esq., Denver, Colorado, for the
Oil and Gas Conservation Commission.

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CHAIRMAN DOWNING: All right; we will now proceed with the Cliff hearing, and I am not going to take any part in the case at all, and Mr. Bretschneider will preside. I may sit here and listen for awhile, because the Commission has a noon appointment. Go ahead.

MR. STOCKMAR: Gentlemen of the Commission, Ted Stockmar representing British-American. I think the first question we have is to decide who is to proceed. I would like to offer as a strong suggestion that in the two prior hearings with respect to this matter British-American has taken second place with respect to proceeding, and I would like to now ask that we be permitted to present our case and testimony first this time. I would also like to suggest that without respect to who proceeds, that each of the parties make a clear statement in advance of any testimony of the proposal which they hope to support so that the Commission in reviewing the testimony can do it against the background of having the respective proposals before them.

MR. MC GOWAN: We agree entirely with Mr. Stockmar's suggestion. We think unquestionably that British-American should have the opportunity of presenting their side of the case first, and I think most certainly it will help in the hearing if each party makes their recommendation to the Commission.

MR. BRETSCHEIDER: You represent Sinclair, do you?

MR. MC GOWAN: Yes, sir.

MR. BRETSCHEIDER: All right; if there is no objection on the procedure, Mr. Stockmar, you may proceed for the British-American.

MR. STOCKMAR: Will it also be agreeable that before we actually put on our witnesses that we have available your proposals?

MR. MC GOWAN: Yes, sir.

MR. STOCKMAR: The proposal that you intend to make?

MR. MC GOWAN: Yes.

MR. STOCKMAR: Thank you, sir. Gentlemen of the Commission---

MR. FREEMAN: Before you start may we have all the witnesses on both sides sworn?

MR. STOCKMAR: That is fair enough.

(All witnesses listed on the index page were duly sworn by Mr. Bretschneider.)

MR. FREEMAN: May I ask one question of all the representatives. As you know, Mr. Downing has disqualified himself from participation. Is there any objection to having Mr. Bretschneider appearing at this time?

MR. STOCKMAR: None on behalf of British-American.

MR. MC GOWAN: We have no objection.

MR. STOCKMAR: Gentlemen of the Commission, as was stated at the attempted rehearing of this matter on November 22nd, the proposal which the British-American has to make with respect to the Cliff Field is that a minor modification of the existing order 66-3 be made to remove from the order the arbitrary limitation on the production of oil of 200 barrels per well per day, to make the order one which limits oil production by placing a limitation on the amount of gas that can be produced. We seek and will happily support an order permitting 300,000 cubic feet of gas per well per day to be produced without any direct limitation on oil, to be produced on a lease basis. When I say that the order should not contain a limitation on oil that does not mean that there would not in fact be a limitation on oil production. It would be a limitation arrived at either by the ability or capacity of a well to produce, or by the production of 300,000 cubic feet of gas per day times the number of wells on the lease.

Now, the problems which have been presented here and the difficulties which we have had in arriving at an order which can be unanimously supported have been differences not of fact or opinion, but differences of principle; and it

is for that reason that British-American has fought so vigorously to achieve the type of order that it feels to be proper here.

Now, the questions of fact which are to be resolved by this Commission are the determination and definitions of underground waste as it might or might not exist in this reservoir, the question of surface waste as it might or might not exist, and the question of the abuse, and protection of correlative rights. Now, those three items are quite distinct in terms of the concepts that we use to think of them. They are, however, quite intermingled both in the statute and in the normal fact situation which is presented to you, but for the moment let us consider them separately.

With respect to underground waste itself, I believe that all engineers will agree that there are certain reservoirs, the straight dissolved dry gas reservoirs, which are not rate sensitive in the slightest which can be produced at any rate which is feasible, and the ultimate recovery will not be changed. All that is changed is the daily rate of production, and you might extend the life of the field to get your million barrels, or you might get it in one year. I believe that all engineers will subscribe to that.

Now, in many states fields of that nature do

have restricted production, but the restriction is not because underground waste would result, but because other factors of proration or market demand limitations are involved.

Now, as to the Cliff Field, it is the position of British-American that the field has no measurable sensitivity to rate even though there is a small gas cap involved. British-American does, however, believe that the most efficient use of the gas energy which is contained in that gas cap and in the gas in solution in the oil is required to give the best recovery; but, this use of the energy is again independent of the rate of production and the efficient use. To take an example, if the field produced or could produce 10,000 barrels a day at an average gas-oil ratio of 600 to one, that would be substantially more efficient than the field producing 1,000 barrels a day at a gas-oil ratio of 2,000. It is the efficient use of the energy that is involved and not necessarily the rate of the production.

Now, what we intend to show to you is that the British-American proposal on the basis of the December well tests which have been made would--if we continue order 66-3 in its present form--permit the production of 4,034 barrels per day with 6,351,000 cubic feet of gas, giving a gas-oil ratio of 1574 to one. Now, this is neither the maximum nor

minimum gas-oil ratio which is possible under the statute, but it is the intelligent application, giving the operators credit for balancing selectivity on one hand against operating costs on the other.

COMMISSIONER EAMES: Mr. Stockmar, would you give those figures again?

MR. STOCKMAR: Yes, sir. Under the existing order 66-3 the December well test would permit the production of 4,034 barrels per day of oil and 6,351,000 cubic feet of gas.

COMMISSIONER EAMES: What is that amount of gas?

MR. STOCKMAR: 6,351,000 cubic feet of gas, giving a gas-oil ratio of 1574 cubic feet of gas produced for each barrel of oil produced.

Under the proposal which British-American is now making, and under the same set of tests which were made, the field can produce 5,075 barrels of oil per day, together with 6,962,000 cubic feet of gas. You will note an increase of over 1,000 barrels a day for an increase of only 600,000 cubic feet of gas. Under the British-American proposal the gas-oil ratio would be 1372; over 200 cubic feet of gas per barrel of oil less than under the present order.

Now, that is our position with respect to underground waste.

COMMISSIONER EAMES: What was that last figure

again, please?

MR. STOCKMAR: The gas-oil ratio?

COMMISSIONER EAMES: The very last thing you gave there.

MR. STOCKMAR: The gas-oil ratio of 1372 cubic feet to one barrel of oil. 5,075 barrels per day against 6,962,000 cubic feet of gas. That is British-American's position with respect to the advantage of our proposal to conserve and best utilize the reservoir energy independent of the rate of production.

Now, the second question that you must consider is the question of surface waste. Now, under our statute every operator is permitted a reasonable flare. The surface waste as to gas produced from oil wells only arises when the flaring is excessive and unreasonable. Now, it is possible for you gentlemen to determine what is a reasonable flare. In the Cliff Field we believe that British-American's position is unassailable with respect to surface waste. There is always some flaring incident to the initial discovery of a field. We plan to present testimony which will demonstrate that a record of diligence and earnestness with respect to putting British-American's gas into market has been established that is rarely equalled.

Now, that is speaking for British-American only.

There still may be questions with respect to surface waste caused by other parties. It is British-American's position that it should not be penalized, if restriction is to come about on account of waste caused by other operators. That type of thing leads us into and is probably part of correlative rights as we understand it.

Now, the real definition of correlative rights includes the opportunity to get a fair share of the oil in the reservoir. This does not mean only that you are entitled to the oil that is under your ground. The law of the State of Colorado has not yet stated, and I doubt that it ever will, that a man who owns the minerals also owns the oil that is in place. He has a right to go after it, to get it, but if a more efficient fellow comes along or an earlier fellow comes along, he is the fellow that has the right to that oil under that law. Determinations of what happens to underlying particular property is just one of the elements involved in the correlative rights question. The others are diligence, efficiency, and so forth. It is the determination of those three things and the measuring of them against the respective proposals of the parties and your existing order that we are asking today.

On the question of correlative rights it is clearly indicated in the existing order that this Commission wishes

to meet the correlative rights problem by most evenly dividing between the parties the oil and gas that happens to underlie their respective properties. We subscribe to that as being a very important element and we believe that our proposal makes a more even distribution of the present oil and gas under the properties than the present order does.

Now, with that rather lengthy but I feel important opening statement I would like before calling the witnesses to inject something that has only been hinted at in previous hearings. I shouldn't say that it was only hinted at because it appears in the record as a rather definite statement that a great deal of the trouble between the parties has arisen out of a difference in ability to sell oil. Now, I do not know whether that is to be part of the issue to be involved here directly or whether it is part of the problem indirectly, but I want to state before you for this record the position of the British-American Oil Producing Company with respect to crude marketing, and then if there is a problem we can go on from there. If there is not, we would not like to have any more innuendo and insinuations which may have some effect on your thinking.

COMMISSIONER BRETSCHNEIDER: Wasn't there a similar statement made by somebody on the ability to sell gas?

MR. STOCKMAR: We do have some testimony with

Legal Counsel - General Management Department
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respect to that, but what I would like to do is to state for the record British-American's position with respect to the crude oil market. We will come to the question of gas sales as part of the testimony.

COMMISSIONER BRETSCHNEIDER: Are you going to make an explanation now of what the set-up is concerning the disposition of gas?

MR. STOCKMAR: Not at this time. I can do that.

COMMISSIONER BRETSCHNEIDER: I didn't know whether you were going to put that in your opening remarks or not.

MR. STOCKMAR: No, sir. Here are the facts with respect to oil production: Toronto Pipeline is a wholly owned subsidiary of the British-American Company. It stands ready, willing and able to take from any operator in the Cliff Field all of the oil that that operator is permitted to produce. Now, that may sound like a generous offer; it is not. It is made because Toronto Pipeline is not a purchaser of oil. It is a carrier of oil, and it would be delighted to carry some additional oil. It would charge each operator the same tariff that it charges British-American, which is ten cents a barrel, to move the oil from the Cliff Field to the pipeline connections at Sterling. Now, that is the only function of Toronto. It is not a

purchaser of oil.

COMMISSIONER BRETSCHNEIDER: Is British-American a purchaser of oil?

MR. STOCKMAR: Secondly, the British-American Oil Producing Company is not a purchaser of crude oil, with an isolated exception or two which I will mention, and does not in its whole corporate structure have a single barrel of refinery capacity. That includes all subsidiary companies.

Now, as an accomodation to some of the co-owners of its operations in the State of Colorado it does purchase oil from them, but it has the problem of immediately reselling that oil to someone else just as if it had produced it itself. I think at the present time the total amount that it purchases is 500 and some barrels a day on an accomodation basis.

A third very important feature is that some of the operators in the Cliff Field who were heard to complain about the market situation at the earlier hearings do have substantial refinery capacity, and are purchasers of crude. To sum that up, British-American, like the smallest independent operator, has to knock on doors and beg and plead and finagle to sell every barrel of oil that it produces. It is not a buyer; it is a seller.

Now, these are unsworn statements which I am making

here. If this comes into issue we have here Mr. Myron B. Messner whose problem it is to sell British-American's crude oil, and we can put him on, swear him in as a witness, and the other parties or the Commission can grill him to their heart's content.

With that I would like to call Mr. John Stein as our first witness.

MR. MC GOWAN: I would like to make an opening statement, if I may.

MR. STOCKMAR: Yes, sir, I would be very glad to have you do so.

MR. MC GOWAN: I am James H. McGowan. I represent Sinclair Oil and Gas Company, and in so far as opinions go, why, I will restrict the voicing of my opinions to a representation of Sinclair. I will make to this Commission a recommendation concerning the hearing today before I sit down, in which it is my understanding that all the operators in the field concur, with the exception of British-American. Some of their attorneys might not exactly agree with my interpretation of certain legal points, but in view of the opening statement made by Mr. Stockmar I feel compelled to state what seems to me to be the issues of this case, and to try to get all the side issues out of it--which to me we have far too many of at each of these hearings.

This matter started by the Commission, on its own motion as I understand it, calling a hearing to attempt to determine an MER for the Cliff pool to eliminate waste, which is a very usual and normal procedure of this Commission in the State of Colorado. It is your means of preventing waste. It appeared, as I recall, at the first hearing which was set sometime in August that a disagreement had developed among the operators, and there not being a quorum of the Commission present, it was continued until September 8th. At that time considerable testimony was put on concerning waste and production capacity, and the various tests and the information available from the Cliff pool.

As I recall, there were certain statements and side remarks made concerning who could sell their oil and who couldn't, and Sinclair is not concerned with that. In so far as we are concerned it is not an issue in this case; it has no bearing whatsoever on the outcome of this case. It has no place in the case. This is a hearing to determine EMR for the Cliff pool.

Now, pursuant to the hearing on September 8th this Commission issued an order based upon the evidence adduced at that hearing, which I assume was unquestionably the opinion of the Commission, which came the nearest, based upon the evidence that they could determine--which

would come as near as possible at that time to preventing waste in the pool and at the same time protect the various property and correlative rights of the parties involved in the pool. That order has been in effect now I think in excess of ninety days and the tests which that order requested to be run have now been run. The results from those tests are available and the engineers have had them and studied them and platted them and graphed them and argued about them and worked over them and have reached their conclusions, and at this time the conclusions that Sinclair has reached and that all the other operators other than British-American concur in is this:

We feel that the information obtained from the gas-oil ratio tests and bottom hole pressure tests and the further information developed about the reservoir in the ninety days that order 66-3 has been in effect has shown that the order was very, very close to right. It has proved conclusively that the MER of the field is the 200 barrels of oil per day per well that the Commission set, or less.

That is our recommendation. We will put on testimony to support it from an engineering standpoint. The gas-oil ratio has balanced out within less than 100 of an average of 1500 to one, which is what the order prescribes.

Keith Hesson - General Steamograph Reporting
1400 Detroit Street - Denver, Colorado

The gas allowable, of course, is automatic when you have an oil limitation and a gas-oil ratio, so the order itself has proved very workable and very nearly correct. Our position is that the order substantially should be continued, that the MER is certainly 200 barrels of oil per day or less. It possibly is some lesser figure, but the evidence will show unquestionably that it cannot be a higher figure.

Now, that is the evidence that we will put on when we put on our testimony and exhibits, and that is the conclusion that our evidence will support. It is the conclusion of all of the engineers of all of the operators-- other than British-American--working together on these tests, and that is their conclusion and that will be their recommendation.

Now, to get down to the issues of this case and what we are talking about, as I understand British-American's recommendation it is to put a limit on gas and turn the oil loose. Such a farceful recommendation I cannot understand because it has no basis in law whatsoever. Neither does this Commission have any authority to define waste, nor does it have any duty to define waste. The legislature of the State of Colorado has defined waste both as to gas and as to oil. This Commission was created by the legislature of the State of Colorado to enforce the Oil and Gas Conservation

Act of the State of Colorado. It gave you the authority and imposed upon you the duty of enforcing that act. The first section of that Act is less than two lines long and it says simply, "Waste is prohibited," period.

Section 3, or Section 5 I believe it is, of the Act then says that the Commission, speaking of this Commission, "Shall have jurisdiction and authority over all persons and property, public and private, necessary to enforce the provisions of this article, and shall have the power and authority to make and enforce rules, regulations and orders pursuant to this article, and do whatever it may be reasonably necessary to do in order to carry out the provisions of this article." That is this Commission's authority and it is this Commission's duty.

The section further goes on and provides that "any duties or authorities in connection with conservation of oil and gas that have heretofore been given to other bodies is now vested in this Commission."

There is one other statute I wish to mention before I talk about the statutory definition of waste, and that is Section 18 of the Act. First let me say this: Under your authority in this section and under the prohibition of waste, those two things together would unquestionably give this Commission authority to limit production and to

prohibit waste. Waste is prohibited. You are charged with the duty of prohibiting it and to do whatever is reasonable and necessary to prohibit waste. There is no limitation on that, and that is Section 18 of the Act; and it says that, "in limiting production you shall not limit it below what a pool can produce without waste based upon reasonable and acceptable engineering standards." That is the only limitation on your authority to prevent waste by the proration of production. You cannot limit it below what could be produced without waste, but you may and you must under the statute limit it to what can be produced without waste, so as to eliminate waste.

Now, the definition of waste is not a point of controversy in this hearing. The statute defines waste. Subsection 9 of Section 3 of the Act, being the definition section, defines waste of oil as "underground waste, inefficient, excessive or improper use or dissipation of reservoir energy, including gas energy," so an improper or excessive use of gas energy under the statute is not only a waste of gas but a waste of oil. By the statute that is the definition of waste of oil before this hearing.

The definition of the waste of gas for this hearing: "The production of gas in quantities or in such a manner as will unreasonably reduce reservoir pressure or unreasonably

diminish the quantity of oil or gas that might ultimately be produced from the gas." It also defines waste of gas as "the unreasonable or excessive flaring of gas from wells that produce oil and gas."

I submit to you, gentlemen, that the issues here today--and it seems to me that we should for once limit this hearing to the issues--is to determine the MER for the Cliff pool. We are not talking about one well; we are talking about the Cliff pool, the whole thing.

You have a statutory duty to prohibit waste. Waste is defined by the statute to be the underground waste of oil, the wasteful or wrongful use of reservoir energy, and there is no ground for construction. The statute says 'gas, including gas energy, in the waste of oil.' There is no ground for construction in those definitions. They are very plain. So the question today is, What can the Cliff pool produce without waste, and that is the only question. We think--as I said before--that it is 200 barrels of oil per day, or less.

Now, let me digress just a moment on this recommendation that we limit only gas. Now, we all know that the common law as applied to oil and gas before any statutes were enacted was the law of capture. The state, under its police powers, and to conserve its natural

resources for the benefit of the entire state, has the constitutional authority to enact conservation laws--which Colorado has done, not to the extent some of us would like, possibly, but nevertheless we have some pretty good laws on the books. When those laws are introduced it gives the state control over private property for the state benefit. For the first time in the law of any state on oil and gas correlative rights come into play when the state enacts conservation laws. This Commission here, the Railroad Commission in Texas, the Corporation Commission in Oklahoma and Kansas, all by the various statutes are given certain authorities to regulate and control the production of oil and gas and the activities of the parties doing it.

The constitutional authority for it is the police power to protect the state's natural resources, but the minute those laws are enacted then certain restrictions on those laws come into play, not by the legislature, but by the vested rights of the parties about which this legislation is enacted, and that's where correlative rights come into play in the oil and gas game. You must prevent waste, and you have the authority to do it, and under the statute you are charged with the duty of doing it; and at the same time you must do it and you must exercise your authorities and your duties in such a manner as to not violate the vested

and constitutional rights of the parties involved; and that is the reason that in a pool such as the Cliff pool there is no one hundred percent possibility of equity under conservation in such a pool; but, we have adopted certain principles and certain formulas that the most learned engineers and mathematicians say are as near as being equitable as can be maintained. You cannot limit the production of gas without limiting the production of oil; and neither can you limit the production of oil without limiting the production of gas. If I owned a lease and am in the gas cap, and "A" owned a lease and is down structure in the oil, you cannot say to me, "You can't take your property; you have got to leave it in the ground and let him produce his oil well. You can't produce your property but he can go on and produce all he wants." That is completely wrong and would be completely unconstitutional. You are taking my property for his benefit without compensation.

But, what you can do, and what you have done in order 66-3, and with many other pools in other states, and what you should continue to do is to say, "Each of you have a right to a certain amount, a certain portion of the Cliff pool. If we let each of you produce it uncontrolled and wastefully the state's reservoirs are wasted, and that the legislature says we must not do." So we establish the

amount of oil per well per day from the Cliff pool, not on individual wells, not on the poor well over here that will only produce ten barrels a day, and not on the good well that will produce 800 barrels a day, but throughout the pool what is the figure that the wells will come the nearest to producing without any underground waste of oil. Then we apply engineering factors to it to accomplish the gas-oil ratio and let the men up here take it out, take out the amount of gas which will void a space equal in the reservoir to the amount of oil that the oil well can void from the reservoir.

True, there are holes in it. True, it is not exact; but, it is the nearest thing to being exact that the engineers can get today, and that is the only way that this limitation may be placed on this pool. It is what you have heretofore done in other pools and it is what you must do here today to protect the Cliff pool, and to get for the State, the producers, and the royalty owners the greatest amount of hydrocarbons that are down there that may be gotten out. But it is the pool and all the hydrocarbons in it that have to be considered, and not an isolated well or an isolated product.

Now, you can put your limitation on gas first, and then apply your gas-oil ratio, which automatically gives you

a limitation on oil; or you can go the other way around, but you cannot prohibit one man from producing out of the pool and turn around and give it to the other man. I cannot see how that can seriously be argued, and I submit that you have to make an order very similar to 66-3. You are charged under the statute to make an order to prohibit waste as defined in the Act; and our recommendation is that the MER for the Cliff pool be set at 200 barrels of oil per day per well, or less, and our testimony will support it when we put on our case.

COMMISSIONER BRETSCHNEIDER: Mr. Stockmar, do you desire now to proceed with your evidence?

MR. STOCKMAR: Yes, sir. Gentlemen, it is our ambition to build as complete and sound a record in this matter as we can. We therefore prepared in both large and small form most, if not all, of the exhibits that we will present. A number of these we will make only cursory reference to. They are submitted for your study and information because they are necessary to a total review of the picture (handing documents to the Commission).

JOHN STEIN, called as a witness on behalf of the British-American Oil Producing Company, being first duly sworn according to law, upon his oath testified as follows:

DIRECT EXAMINATION BY MR. STOCKMAR:

Q Mr. Stein, will you state your full name for the record?

A John Stein.

MR. STOCKMAR: Gentlemen, this is Mr. Stein's third time around. Will you accept him as a qualified expert?

COMMISSIONER BRETSCHNEIDER: Yes, sir; we know him.

Q Mr. Stein, the exhibits which we have numbered 1-3 through 12-3 and enclosed in our portfolio were prepared by you or under your supervision?

A Yes, sir, that's right.

MR. STOCKMAR: I might explain the numbering system. Since this is the third time around, and since there are some duplications for the record we will refer to these as Exhibit 1-3 and so on as the third hearing. All of our numbers have the three tacked onto them.

Q Now, Mr. Stein, Exhibit No. 1-3 shows basic geological data for every well presently drilled in the Cliff Field, whether producing or dry, is that correct?

A That is correct.

Q And the information with respect to the top of the

refer to Exhibit 7-3. As I understand this, Mr. Stein, it is a composite map which indicates the location of the gas zone, the oil zone, and the water zone found in this field?

A Yes, sir.

Q With a simplified cross-section on the bottom, cross-sections, showing an east-west and north-south cross-section?

A That is correct.

Q Now, will you hang up here at some spot certain of the exhibits 6-3 to which you might wish to make reference in your explanation of the type of reservoir which we have demonstrated by Exhibit 7-3?

A Yes, sir.

MR. STOCKMAR: Gentlemen, again, these things are so bulky and yet so necessary to the record that we have not included them here.

COMMISSIONER BRETSCHNEIDER: Are those the logs?

MR. STOCKMAR: Logs with cross-sections. We will try to keep the use of them to the minimum. Gentlemen, you will notice on each of the copies which you have there is shown at the extreme right end a small map which defines the---

COMMISSIONER BRETSCHNEIDER: Will you wait a minute until Mr. Eames returns?

MR. STOCKMAR: Oh, excuse me. Gentlemen, on this

map are marked the particular cross-sections, marked by the series of logs. Now, as we stated before Exhibit 7-3, which is to the left, is a composite map of water zone, oil zone and gas zone. We have three representative cross-sections on the wall.

Now, one of the most important features to be determined by the Commission is the type of reservoir which we have. Now, it is our objective here to demonstrate conclusively that we have a closed tightly sealed-in reservoir with barriers on all sides so that no effective water drive is possible.

Q Now, Mr. Stein, will you please refer to your Exhibit 11-3, which is a summary of information with respect to certain wells, and utilizing that exhibit, will you discuss the wells both as they appear on the map and as they might be reflected in the logs, if they are in these samples, and define the reservoir that we have here.

A We will start off at the extreme north end taking Gibraltar's No. 5, as shown on the cross-sections by this well (indicating on charts). This well had about ten feet of net permeable sand, of which eight feet was oil sand and two feet was water sand. Core analysis on that particular zone indicated a permeability of about 7.9 millidarcies. Drill stem tests recovered 380 feet of oil and gas-cut mud.

Now, this indicates the shale out to the north (indicating), and over here I think you can see it pretty well; this zone here is shaling out (indicating). You have a relatively thin "D" sand pay section with this part of the "D" sand very poorly developed.

Now, we will go on to the next well which will be Sinclair's No. 4. That is the well right here, and it is represented on the cross-sections by this well (indicating). No. 4 had a net permeable sand of eleven feet, of which nine feet was oil sand and two feet was water sand. Core analysis indicated an average permeability of about 15 millidarcies. The electric log again indicates rather poor sand development, large shale section in here (indicating), so here again we have another indication of a shale out toward the north.

The next well is the Sinclair No. 3. That is not shown on any of these cross-sections that we have on the wall. No drill stem tests were run on this well. It was cored, but the core was not analyzed, I understand, but the description and the microlog indicated tight sectioning here and it was plugged in the bank, so that indicates a shale out of permeability to the north--a permeability barrier to the northeast.

The next well we want to look at is the British-

American's Casement No. 1, which is this well right here (indicating), and that is on this cross-section and shown right here (indicating). Now, drill stem tests of each sand interval here had gas at five minutes at the rate of three and a half MCF per day; at the end of sixty minutes it was eighteen MCF per day. The electric log very definitely indicates the shaling out of this sand. The sand is almost gone; so we can say then that we have a definite shale out to the east (indicating).

The next well we wish to look at is the Thompson-Thompson Casement 3, which is this well right here (indicating). That is not shown on the cross-sections. It had a net permeable sand of about three feet, of which two feet was considered to be gas sand and one was oil sand. No drill stem tests were run. The sand was practically gone in this well, as indicated by the electric log, so that gives us a tight shale out toward the east again.

We will go on down to British-American's Casement No. 4, which is this well (indicating), and again it is not shown on these three cross-sections I have here. We ran a drill stem test in the "D" sand here and recovered three feet of mud and no water. Of course, the well was plugged and abandoned. Here again drill stem tests indicate no permeability, so we have another definite permeability

barrier toward the east.

Now, we will go on down to Casement B-6, which is this well right here (indicating). We had several drill stem tests on that. One up in the gas zone recovered gas at nineteen minutes at the rate of nineteen MCF per day, and recovered 140 feet of water-cut mud. Another drill stem test down in this area (indicating)--that, incidentally will show on the cross-section here; here it is right here (indicating)--down in this zone we recovered 330 feet of muddy water and 180 feet of clear water. This well is high structurally, but the oil section is practically shaled out. There is not too much permeability, so it gives us some indication of a shale out to the south, in a southerly direction.

Now, this is getting kind of far away from it, but it is a pretty good well for control, and that is our Griffith No. 1, which is an oil well in the "J" sand. We don't have a picture of the electric log here, but the "D" sand was completely gone, shaled out, so that ties in with our anticipated shale out from the south.

We go then to the British-American Casement A-6, which is this well (indicating), and it is not shown on these cross-sections (indicating charts) but it is in your portofolio. The drill stem tests of the "D" sand in this

well recovered fifty feet of oil-cut mud and 150 feet of water. According to the microlog we had about thirteen feet of sand in there which could be considered as permeable; but, the drill stem tests indicate it to be practically impermeable. There was no appreciable amount of fill up. So we had a permeability barrier to the southwest (indicating).

Now, we will go to Sinclair's Hitchcock No. 3, which is this well right here, and is shown on the cross-sections by this well (indicating). It had a net permeable sand of about twenty feet, of which twelve feet was considered to be oil-bearing, and the bottom eight feet was water-bearing. A drill stem test recovered three feet of oil-cut mud and 480 feet of water. A core analysis of this area gave a permeability of from two-tenths to 28 millidarcies. That is very definitely a low permeable well, and of course it was plugged and abandoned; so this tells us that we have a permeability barrier toward the west (indicating).

Now we go on up to Anderson-Prichard; they drilled a well in here recently (indicating), McCleary No. 1, and it had about ten and a half feet of very fine grade silky sand on a core. The core was not analyzed, I understand, and no drill stem tests were run, and the well was plugged

and abandoned, so that gives us some more idea of the permeability pinch out to the west (indicating).

So we come on up now to the Gibraltar-Ayres No. 4, which is this well (indicating). There is a net permeable sand of eight feet, no gas sand, and of course the eight feet was oil-bearing. Core analysis indicated an average permeability of about sixteen millidarcies. The drill stem tests recovered 120 feet of oil and 180 feet of oil and gas-cut water, so according to the electric log it has pretty poor sand development and the well had to be fractured initially to make it produce, so that gives us some indication of a permeability barrier of shale out forming to the northwest (indicating).

Q Mr. Stein, you have reviewed each and every well around the periphery of the field. What is your conclusion with respect to the type of reservoir system demonstrated by this information?

A The evidence indicates and it is my opinion that this is a closed reservoir.

Q Does that mean that there is no effective water drive which can serve as a mechanism for displacing oil available to you in this field?

A It does.

Q Now, Mr. Stein, will you please refer to your

Exhibit 10-3. You have a 10-3A and a 10-3B?

A Yes, sir.

Q And describe those for the Commission and explain their importance with respect to this existence or non-existence of a water drive?

A 10-3A is merely a tabulation of the oil and water which when added together--the water divided by the total gives you a water percentage for the field. This is fieldwide. And on Exhibit 10-3B we have shown this graphically. Since the inception of the field we can notice that there has been very little, in fact no appreciable increase in water percentages. There was some during the months of August and September, which was probably due to new wells being completed; but on the whole and on the average we could say that the water percentage has remained fairly constant at around five percent on the average. To me this indicates the absence of a water drive. Otherwise you should have an increase in water percentages as the field is produced.

Q Now, Mr. Stein, another way of determining whether or not you have had a water drive is to make what is called a material balance calculation to actually gauge the pressure drop against the fluids originally in the reservoir, and the fluids in the reservoir after the pressure

drop. That can disclose, as I understand it, the existence of any influx of water. Have you made such a material balance calculation, Mr. Stein?

A Yes, I have.

Q And what were the results of it?

A It indicated no water drive. In other words, there was no indication of water influx into the reservoir.

Q Can you find 17-3 very quickly on there, Mr. Stein?

A Yes.

MR. STOCKMAR: Gentlemen, in December additional well tests were made which have provided the basis for a new pressure map of the field. We have shown this largely for convenience as our Exhibit 17-3. At our first hearing we had presented a pressure map based on a September survey of the pressures.

Q Now, Mr. Stein, I gather that this is your interpretation of the pressure distribution in the field as of the December pressure survey?

A Yes, sir, except this is as of January--about the 6th, I think, when we concluded the survey.

Q Now, as I understand the effect of a water drive, an influx of water in any amount, but particularly in a substantial amount, will serve to retard the pressure decline in the reservoir, is that not true, sir?

A That is correct.

Q And if we find that there has not been any noticeable slowing down or retarding of the pressure decline, is that not a graphic representation of the material balance calculations which you have already made?

A Yes, it would be.

Q Will you refer to the next exhibit, 18-3, which I might explain is a pressure differential map, showing the difference in pressure at various parts in the field between the September survey and the December survey. Mr. Stein, does that not demonstrate the most substantial decline in pressure as taking place in the northern portion of the field?

A Yes, this is a differential pressure. From the last pressure survey to the present one--which was about four months difference--we have a drop in pressure of some 300 PSI in this particular area (indicating), and about 200 PSI in this particular area (indicating). Of course, as you go around the field, for instance, this is a 100 PSI drop (indicating), and so on out in here (indicating).

Q Mr. Stein, that production in the northern part of the field has been from an area which is oil zone only, is it not?

A No, there is some gas zone right in here, but

primarily it is oil productive; but, within the 300 pounds differential, that is all oil zone. There is some gas zone right in here (indicating).

Q As I read the statistics with respect to the well tests on those wells, they have produced oil in the last quarter at a very low gas-oil ratio, quite near the solution gas-oil ratio, is that correct, sir?

A That is correct, yes.

Q And yet we find a very substantial pressure drop in that area. Is that to you evidence that they are taking the oil out of a small enclosed system in that particular part of the reservoir?

A Well, yes, it could be that. You could have it closed in there, but it indicates to me that there has been considerable more drainage in this part of the field (indicating) than there has been in this part (indicating). For instance, there has been considerably more oil taken out per unit volume of sand.

Q Sticking with the water drive, is there any evidence to be gained from this map that any water drive is available to produce additional oil in this field?

A No, there is no evidence to show that we have any water drive.

Q Then from the geological and engineering data, from

your material balance calculations, from the observations of actual water production, you find no information which could lead you to suspect a water drive in this field, is that correct, sir?

A That is correct.

MR. STOCKMAR: Thank you. I would like to submit the exhibits--I have one more, Mr. Stein.

Q Mr. Stein, will you refer to your Exhibit 8-3. Now, is this an accumulation of the basic engineering data available in the field?

A It is.

Q And is it the information that you have used in making later calculations?

A It certainly is, yes, sir.

Q Is this not largely the same information that was agreed to by all of the operators, but which has simply been extended to date as to total field production and so forth?

A It has merely been revised; it was agreed to.

Q The revisions, however, are your own work and not the work of all the operators in the field?

A In some cases some of it has never changed from the initial or the first hearing which we had back in September.

Q Will you refer to Exhibit No. 9-3 and explain it for the Commission?

A This is the monthly oil, gas and water production since the inception of the field. We have tabulated it by months, as you can see, and as of January the 1st we have tabulated the cumulative oil, gas and water production for each lease in the field; and finally a field total, which is at the extreme bottom and on the last column.

Q Mr. Stein, will you now refer to your Exhibit 12-3 and explain its significance to the Commission?

A 12-3 is the net pay volume which underlies each developed lease, both in the oil zone and in the gas zone, and the combined volume of the oil and gas zone, with the percentages of each shown in the separate columns.

Q To take an example, Mr. Stein, what is British-American's percentage of the oil zone?

A Our percentage of the oil zone amounts to 34.8 percent.

Q And the percentage of the total gas zone?

A It would be about 59.7. Our percentage of the total volume of the field amounts to 40.5 percent.

Q Now, were these figures derived from the net oil and net gas isopachs, which we have shown as Exhibits 3-3 and 4-3?

A They were.

Q By standard and normal planimentering methods?

A Yes.

Q This represents the breakdown of the amount of oil zone and gas zone available to each operator in the field?

A It does, yes.

Q Thank you. Now, let me call your attention to Exhibit 13-3, Mr. Stein; will you explain the meaning of it?

A This is simply the actual volume tests that were run during December in accordance with the Commission's order.

Q Taking each of the four columns after the well number, would you tell the Commission what the column indicates?

A Well, under the first heading, of course, we have the lease and the well number; the next heading is the oil rate, which is the capacity of that well to produce in barrels of oil per day.

Q Now, is that the total amount that that well can produce without any restriction on its production at all?

A That's right, yes.

Q All right, sir.

A And, of course, the water is a test on the well

QUESTIONS BY MR. JERSIN:

Q You have made these material balance calculations, Mr. Stein. Do you have the notes for your calculations?

A Yes, I have a set of them in my briefcase. We did not enter them in here, but I do have some notes on it.

MR. JERSIN: There are various factors that are variable. I wonder if they might be submitted for examination, please?

MR. STOCKMAR: We certainly can. We can introduce them as an exhibit, if you wish. We didn't put these in, gentlemen, because they are engineering hieroglyphics.

THE WITNESS: We can call that Exhibit 20-3.

MR. STOCKMAR: Let's not enter that as an exhibit until Mr. Jersin finishes. Mr. Jersin, do you wish to examine Mr. Stein as to this?

MR. JERSIN: Not right now, Mr. Stockmar.

MR. STOCKMAR: We will have him here available for further questioning at any time you wish. Is there any cross examination of Mr. Stein?

MR. MC GOWAN: I would like to ask just a couple of questions.

CROSS EXAMINATION BY MR. MC GOWAN:

Q Mr. Stein, you testified that you thought this was

a completely closed reservoir. Now, in closing it to the north you have no well drilled there that has actually gone into shale or anything, have you?

A No, we are basing it, of course, on the Gibraltar-Ayres No. 5, which is the north extension, and does indicate some shale out. In other words, the sand is pinching out in that direction.

Q But it is just as logical to assume that it might go on another half a mile or so, is that correct?

A It is kind of hard to get the control, I will have to admit, but it indicates a definite pinch out in that direction.

Q But, you do not have definite well control, but are merely giving opinion or speculation control as to the north, is that correct, based upon these present wells that are producing that are showing a thinner layer of sand?

A That is my opinion, yes.

Q Now, you also testified concerning your Exhibit 17-3. The gas cap on this field is essentially on the east side, is it not?

A Yes, and through the center; that is, the eastern portion almost due north and south. It runs almost in line with that section line through there (indicating).

Q Now, generally speaking also during the last ninety

A That is correct.

Q Now, with respect to the pressure maintenance by the restricted production of gas, has that pressure maintenance arisen because of the restriction on the gas production or because of the restriction on the oil production?

A I think it is on both. I mean, you have had both of them restricted, so your pressure tends to try to equalize throughout the field; however, it didn't quite do that, as we can see. We have slightly more drawdown in the north end of the field than we have in the south end of the field.

Q Would not a limitation on gas production alone maintain gas cap pressure?

A Yes.

MR. STOCKMAR: Thank you, sir.

QUESTIONS BY MR. JERSIN:

Q Mr. Stein, while you are on the witness stand, do you believe you could determine whether or not you had effective water drive at a high rate of production from a reservoir?

A If all of your production data is correct and your pressure surveys are correct, it shouldn't make any difference whether you have a high rate or a low rate. Your material balance calculations should tell you whether

you have any influx of water or not.

Q Your influx of water is not a rapid influx usually, isn't that correct?

A Well, we don't measure the rate generally. We merely want to see if there is any water coming into the reservoir; then we can make more calculations and actually establish the rate. On this particular calculation that I made, it was merely to determine whether or not there was any influx of water into the reservoir, not the rate.

Q In other words, your exhibit, your testimony indicates that you did not recognize any water drive at the present time?

A That's right; as far as I am concerned, there is no water drive.

Q Well, there could be water drive. Your evidence indicates that there is no effective indication of a water drive right now?

A That's right; there is no water drive at the present time.

QUESTIONS BY MR. STOCKMAR:

Q As I understand it, Mr. Stein, no matter how small the influx of water it can now be detected?

A The material balance would show it if there were

an influx of water.

RE-CROSS EXAMINATION BY MR. MC GOWAN:

Q Mr. Stein, you are aware, are you not, that the wells to the northwest are increasing in their water production?

A I am not aware of individual wells, no; I didn't pay that much---

MR. STOCKMAR: You can refer to your exhibit.

A The exhibits probably show it; I merely took this on a fieldwide basis, because you can't take any one well, I don't think, actually--you might if you had a long enough history.

Q I was trying to get to the point that you state flatly that there is no water drive, and you seem to base that upon your material balance calculation. If the wells to the northwest are increasing in their water production, it is my understanding at least, that if the field was producing at too rapid a rate, that the water drive would not reflect itself, and therefore you couldn't disprove it by your material balance calculations. Am I correct in that?

A No, I wouldn't say that you were. The only thing that I have noticed is that those three latest wells that were drilled up there--and they have only been completed a couple of months now--made some water initially. I don't

A Back in April.

Q April of '55?

A That's right.

Q And actually isn't it true---

A Practically ten months ago.

Q ---isn't it true that you don't really have enough data as yet, and that you will not really know until more time elapses and more data is collected as to whether or not there actually is a water drive in this field?

A I feel that right now we have sufficient data that the material balance would show water influx, if there was any. It might be only a small amount, but it would show it.

Q Your testimony here today, of course, is completely consistent with Mr. Cavalier's testimony, who appeared for British-American before, isn't that right, concerning water drive?

A I don't even remember what he said; this is my own opinion, sir.

MR. SCOTT: Mr. Stockmar, I have two questions of the witness.

QUESTIONS BY MR. SCOTT:

Q Did your material balance study cover only a time interval to date, or did you attempt to predict the ultimate

recovery throughout the length of the field?

A No, it was as of this date.

Q I see. Do you have any opinion from your present study as to what the ultimate picture would be on the material balance?

A No.

Q In terms of recovery?

A I don't have any opinion on that. I feel right now that there is no water drive, and that the---

Q Yes, I understand that.

MR. SCOTT: Thank you.

MR. STOCKMAR: I would like to call Mr. Glenn Stearns as our second witness.

MR. JERSIN: Mr. Stockmar, we are all taking a shot at him in piecemeal fashion.

QUESTIONS BY MR. JERSIN:

Q Mr. Stein, just roughly what would you approximate the relative volume of the gas cap to be compared to the oil zone in the Cliff Field?

A About twenty-three percent.

Q About twenty-three percent. Is that large enough to protect--let me rephrase that. Do you think that an order that the Commission might issue should be such that would regulate that gas cap?

A I don't think the gas cap is too important in this issue except that it ought to be conserved.

Q Now, just to go to a hypothetical possibility of producing the field. If all of the wells except the wells in the gas cap were shut in and you produced all the wells to the gas cap wells, do you believe you would recover as much oil as you would if you shut the gas cap wells in and produced to the others?

A Would you mind stating that again? I don't believe I understood you.

Q If you produced all the wells to the gas cap wells and all of the wells except the gas cap wells were shut in, do you believe that you would recover as much oil--that is---

A Oh, if there was some oil zone under the gas cap?

Q Do you believe---

A You are talking about a well completed in the gas cap, but having an oil zone in it, are you not?

Q Yes, do you believe your ultimate recovery would be the same?

A I think all the wells would have to be produced in the field to get all of the recovery.

Q But, there could be a waste of oil by wetting gas sand if the production practices were not proper?

A I personally don't see how you can wet the gas cap.

MR. STOCKMAR: Mr. Stein, doesn't something have to drive oil to make it move upward?

THE WITNESS: Yes, that's what I was trying to bring out, that as long as you have the gas cap there, then there is nothing to make the oil go up into the gas cap.

MR. JERSIN: Unless you had a non-uniform pressure pattern throughout your reservoir which could be distorted by unequal withdrawals, isn't that correct?

A And you can have the unequal pressure pattern all right, but your gas cap would try to maintain itself as a gas cap and it would serve to expand and push oil, not push it away, but to hold its gas cap size, and if anything it would try to expand.

Q (By Mr. Jersin) You believe that no matter in what manner this reservoir is produced you will recover the same amount of oil ultimately?

A I don't believe I better answer that question. We have some more testimony here that might answer your question for you.

MR. STOCKMAR: I think we can say for the record very clearly, Art, that methods of operation of the reservoir will cause a greater or lesser recovery, but that they relate to the efficient utilization of the energy in all of the gas in the reservoir. I don't wish to testify

(Witness excused.)

MR. STOCKMAR: Mr. Stearns, will you please take the stand?

GLENN M. STEARNS, called as a witness on behalf of the British-American Oil Producing Company, being first duly sworn according to law, upon his oath testified as follows:

DIRECT EXAMINATION BY MR. STOCKMAR:

Q Glenn, will you please state your full name and your professional connection for the record?

A Glenn M. Stearns, chief engineer of British-American.

Q Do you have in your capacity as chief engineer for British-American a particular knowledge of the Cliff Field?

A Yes. I have followed the development since the beginning and have examined numerous electric logs, core and reservoir fluid analyses, and so forth.

Q Will you give a brief background of your professional and educational connections?

COMMISSIONER BRETSCHNEIDER: We will accept him as an expert witness.

Q All right, sir. Mr. Stearns, you have examined in detail the exhibits previously presented by Mr. Stein?

A Yes.

Q Do you concur with his conclusions that the "D" sand reservoir in the Cliff Field is a closed reservoir and that no effective water drive can be detected?

A Yes, I do concur. I might summarize the reasons. Based on the core analysis data, the drill stem test data, indicating fluid fill up, and the indications of thinning on the edges of the field, there is evidence of a closing off of the permeable section which would be a requirement for the movement of water into the reservoir; that is, displacing the oil, which is really what water drive means. In addition to that, Mr. Stein has presented the trend of the field water production, water percentage, which indicates no increase, indicating some fluctuation possibly because of differences in production of the wells, completion of new wells; but, certainly it indicates no trend upward which you would expect as water moved upward along the flanks of a field, as you would have in a water drive field.

In addition to that, as Mr. Stein has presented, we have the results of material balance calculations borne out by the pressure pattern, the material balance calculation of necessity being a method by which you would recognize the presence of water that had moved into the field since the beginning; and there was no indication of such water.

The pressure pattern presented by Mr. Stein indicates that the pressure drop has been just as severe along the flank of the field where we would expect water to come in as it has been--and even more severe in some spots--than it has been in portions of the field more remote from the flank. If there were water coming in the flank wells should show better pressure maintenance than wells more remote from the flank.

Q Well then, Mr. Stearns, if it is your opinion that we do not have a water drive reservoir, what kind of a reservoir do we have?

A Well, we have a reservoir that--as Mr. Stein has pointed out--consists of roughly twenty-three percent gas cap and seventy-seven percent oil zone. Due to the relatively small volume of the gas cap as compared to the total reservoir volume, I would say that the field is predominantly a solution gas drive field.

Q Well, in a closed reservoir of this nature with the relatively thin oil column and a relatively small gas cap, does the gas cap contribute materially to driving oil out of the reservoir?

A I would say that comparatively speaking, the mechanism of gas cap drive is rather small as compared to solution gas drive, and that is certainly true up to the

present time since there has been no segregation of solution gas into the gas cap, in my opinion, and since there has been relatively small expansion of the gas cap as of this date, even though there has been no contraction of the gas cap as of this date.

Q We have stated as part of our opening statement that it is valuable to preserve the gas cap and the energy in it. What function does the gas cap play in a reservoir of this nature?

A Well, in a sense the gas cap acts as a cushioning effect on pressure decline. By its expansion, with some withdrawal of oil it tends to minimize the amount that the pressure drops as a result of removing a given amount of oil from the oil zone, and thus with preservation of the gas cap you maintain the pressure in the entire reservoir to a greater degree, and also take advantage of the downward movement of the gas cap, when and if it expands, and it gives you a better displacement of the oil from the oil zone.

Q Then there is distinctly an advantage to keeping at a minimum the production of gas cap gas?

A That is true.

Q Nonetheless, in this type of reservoir can you escape the production of some gas cap gas with the oil?

Is the gas presently being produced, which is in addition to the solution gas, coming from gas cap?

A There has been gas cap gas produced almost since the beginning of the field, the production period. That is based on the fact that roughly three-fourths of the wells produce at ratios well in excess of solution ratio, and that excess gas represents primarily gas cap gas.

Q Could it be dissolved gas which is coming from barrels of oil not being produced?

A The excess gas later produced at some later time will represent a significant amount of gas that has come out of solution in the oil, but at the present time the withdrawals from the oil zone have amounted to roughly four and a half to five percent of the oil containing pore space in the oil zone. By knowledge of reservoir mechanics we know that you must void roughly ten percent, or somewhere approaching that figure, to create a sufficiently high gas saturation to allow the gas to flow as free gas to the well, or to bubble up into the gas cap; so the excess gas that we are producing now with that low voidage of the oil zone is primarily gas cap gas.

Q But, I gather from your statements that there has been a sufficient production of oil from the oil zone to nonetheless permit the expansion of the gas cap slightly.

Will you explain your thinking on the maintenance of the gas cap?

A Yes; that was a part of our material balance calculation, as a part of making the material balance calculations to which Mr. Stein referred and which was given to the Commission staff, that involved a consideration of the amount of gas withdrawals from the gas cap and the amount of expansion of the gas cap; and the expansion of the gas cap to date is indicated to exceed the withdrawals to date, in reservoir terms, so that you now have a somewhat larger gas cap than we had originally.

Q When you have reached the point in time when the segregation of gas in the reservoir will begin to occur, will gas filter up into the gas cap and aid in keeping it from contracting?

A Yes. As I indicated in my earlier estimate, there will come a time when the gas saturation due to the release of solution gas becomes high enough in the oil zone that there will be some percolation of that gas into the gas cap feeding it and enlarging it and maintaining it.

Q Well, if the excess gas since the beginning of the field has been coming from the gas cap, I gather that it is your conclusion that there is no way that a reservoir of this type could produce oil from the oil zone without

also producing gas from the gas cap, at least as to wells which are in association with the gas cap?

A There is no way of producing all the wells without producing some of the gas from the gas cap.

Q If it is valuable to maintain the gas cap to keep the pressure up and to keep the gas available, is not the best practice to so produce the reservoir that you are producing the oil at the lowest gas-oil ratio possible?

A That is true, yes.

Q Now, we have to balance this with economic factors and so forth so that all the companies can get ahead in the world, I gather?

A Yes, sir.

Q Do you believe, Mr. Stearns, that the gas cap, when segregation of gas in the reservoir begins, could be kept expanding solely by gas coming out of solution and being brought to the gas cap, even if at the same time some of the initial gas cap gas was being produced?

A Yes, I do.

Q What is your opinion, Mr. Stearns, with respect to the rate of production as a means of controlling the field, as compared with efficiently using the gas?

A The rate of oil production as such in this field will not be a factor that affects the ultimate recovery.

The ultimate recovery will be highest if we make the best use of the energy in the reservoir, which is primarily measured by gas. In other words, if we produce the least amount of gas with each barrel of oil we will be accomplishing the greatest efficiency possible.

Q Without respect to whether we completely drain the reservoir in one year or twenty-five years, is that correct?

A That's correct.

Q Mr. Stearns, would you please bring forth your Exhibit 14-3 and explain its purpose to the Commission, and you might at the same time wish to discuss 15-3 and 16-3.

COMMISSIONER BRETSCHNEIDER: How long will it take to finish this witness? We have a date right around 12:00 o'clock.

MR. STOCKMAR: If you are speaking about lunch, why---

COMMISSIONER BRETSCHNEIDER: It is lunch; we also have an appointment.

MR. STOCKMAR: I think Mr. Stearns will be done in less than ten minutes, will you not, sir?

THE WITNESS: As far as my presentation of it is concerned, yes, ten, fifteen minutes.

COMMISSIONER BRETSCHNEIDER: If we can recess when

he is through, is that all right?

MR. STOCKMAR: It is all right with me, yes.

COMMISSIONER BRETSCHNEIDER: All right; proceed.

Q (By Mr. Stockmar) Would you proceed to explain these three exhibits then, Mr. Stearns?

A All right. It seems that there are two principal---

COMMISSIONER BRETSCHNEIDER: Pardon me just a minute. Mr. Eames thinks we ought to stop now and come back after lunch.

COMMISSIONER EAMES: I am afraid we wouldn't give it the attention that we should give to it.

MR. STOCKMAR: That is perfectly all right with me, sir.

COMMISSIONER BRETSCHNEIDER: Before anyone leaves, how long will it require after lunch, a couple of hours for the other side? Do you feel that we will get to any other cases this afternoon?

MR. STOCKMAR: Our testimony with respect to Mr. Hogan can be done in three minutes, and it is strictly explanatory of the gas marketing situation.

MR. MC GOWAN: It looks as if our side of the case will equal at least two hours.

COMMISSIONER BRETSCHNEIDER: You would like that much time?

MR. MC GOWAN: I think the total time will have elapsed this afternoon of two hours before we are through.

COMMISSIONER BRETSCHEIDER: We will try to clear the rest up this afternoon even if we have to stay late. We will recess at this time until 1:30.

(Whereupon, at 12:00 o'clock noon, January 24, 1956, the Commission recessed.)

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AFTERNOON SESSION, JANUARY 24, 1956, 1:30 o'clock p.m.

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COMMISSIONER BRETSCHNEIDER: Mr. Stockmar, are you ready to proceed?

MR. STOCKMAR: Yes, sir.

GLENN M. STEARNS, called as a witness on behalf of the British-American Oil Producing Company, having been previously duly sworn according to law, resumed the stand and testified further as follows:

DIRECT EXAMINATION BY MR. STOCKMAR: (Continued)

Q Mr. Stearns, I understand that you have prepared three additional exhibits which we have numbered as 14-3, 15-3 and 16-3. Will you explain these in such order as you might wish and with such comments as you might wish to the Commission?

A Yes; to give background to the purpose of these exhibits I want to make a few statements preliminary to the showing of the details on the exhibits. Mr. McGowan brought out in his talk awhile ago some points with which I agree, indicating that the principal points at issue here are prevention of waste, which includes surface waste and underground waste. I think the matter of surface waste can be handled by indications in our later testimony which will bring out the fact that we are selling the gas from the

in detail the figures that went into the preparation of the graphs, and the graphs permitting much better visualization of the various factors, I will deal mainly with the graphs.

On the first graph, which is on the left there on the wall, and is Exhibit No. 15-3, I have chosen, as indicated by the previous exhibit, 14-3, four separate bases for comparison of the various factors involved, and those bases are: Basis 1, unrestricted production; basis 2 is the proposal that was presented by Sinclair and others at the hearing on September 8th 1955, and involved the placement of a limit of 150 barrels of oil per well per day and 300 MCF of gas per well per day on a lease basis. Basis 3 is the present Commission Order No. 66-3, which has a top oil limit of 200 barrels per well per day, and as gas limit of 300 MCF per well per day on a lease basis. Now, what I have designated as Basis 4 is the British-American proposal, which involves no oil limit, and involves a gas limit of 300 MCF per well per day on a lease basis.

Now, I might clarify and emphasize one point there. I don't want you to misinterpret that "no oil limit." Actually there is an oil limit as imposed by the gas. The placement of a limit on the gas automatically places a limit on the oil, but by the words "no oil limit" we mean no additional oil limit other than that permitted by the

maximum permissible gas production.

Now, this Exhibit 15-3 compares the amount of hydrocarbon fluids withdrawn from each acre feet of sand each day for each of the four bases. If we consider basis one you will note that British-American under the condition of unrestricted production would be withdrawing the highest amount from each acre foot each day, if it was based on the December well tests. The minor operator would be Gibraltar, and referring to the lower right-hand chart, that green band indicates that British-American, the maximum in that case, basis one, would be voiding approximately five times as much as Gibraltar.

Now, considering basis two, which has already been defined, under this condition T&T would be voiding the maximum amount per acre foot per day, and Gibraltar would be voiding a minimum from each acre foot each day, and the ratio of those two, the maximum to the minimum, would be in the range of 3.7, as indicated by the yellow band on the lower right-hand chart of this exhibit. Notice that the ratio of the maximum voidage to the minimum voidage drops off.

Then considering basis three, which is the present Commission order, in a similar way the ratio of maximum to minimum would be roughly about 3.3.

Considering basis four, which is the British-American proposal, you will note that the deviation of each of those voided values from a weighted field average is less than under any of the other conditions, and that is indicated by the gray band, the right-hand side of the lower right-hand graph. The ratio of maximum to minimum is about 2.5, or in other words, there is less spread between the amount of voidage of the various operators. They are coming more closely to an even rate of withdrawal from each part of the field.

Now, an ideal condition of perfection would be "one," everybody being perfectly equal. Well, we know that from a practical standpoint that cannot be exactly accomplished.

Q Mr. Stearns, to give a little background to the ratio of "one" being ideal, would you explain to the Commission what the effect of exactly equal or proportionate voidage would be in terms of prohibiting drainage from one property to another?

A Well, if I understand your question, Mr. Stockmar, if you assume two blocks of sand, let one of them be the block of sand that is under one lease, and the other a block of sand that is under an adjoining lease. We know that there is no wall there at that property line, beneath the

property line, that there is freedom, permeable channels for fluid to move from one block to the other if given the proper conditions to permit it; but, the condition that will permit that movement of fluid is a difference in pressure between those two blocks. The thing that creates a lower pressure is withdrawal of fluid, and a lower pressure in one block than in the other would permit fluid to flow toward that lower pressure. But, if we take equal volumes of oil and gas, this hydrocarbon material that we are all wanting to get out, if we take equal volumes from the two there will be a lowering of pressure in both of them, but it will be the same amount of lowering of pressure and there will be no migration from one to the other; and that is what we are approaching here in trying to remove from each unit volume an equal amount of fluid, and this chart is for the purpose of showing that we get closer to an equal volume of fluid than these other plans.

Q Mr. Stearns, is not a scheme of production based on a gas limitation a close approximation of an equal reservoir voidage order?

A It is, automatically, because when you place a gas limit on the production naturally the operator has the incentive of wanting to produce all the oil he can within the limits prescribed; if you place the gas limit only he will

naturally want to produce as much oil as he can within that limit, which will mean that he will want to produce at the lowest possible ratio, which would mean the lowest possible voidage, and automatically by putting a top only on the gas, thus encouraging the operator to produce the most oil possible with that gas, you are encouraging him to produce most efficiently, which I can elaborate on more by referring to the other charts.

Q Will you, please?

A Now, I want to repeat again what Mr. McGowan said in his talk, for emphasis. He referred to the definition of waste that was in the statute, and I interpreted him as placing particular emphasis on one of the portions of that definition which stated that prevention of waste included--or, that waste, the definition of waste, that waste included the inefficient use of energy including gas energy.

Now, I want to agree wholeheartedly with that definition and emphasize the importance of conserving the gas energy in the reservoir in the form of the gas that is down there under pressure. To preserve and conserve that energy we want to produce or dissipate the least amount of it from the reservoir in getting out a barrel of oil, so we want to produce with the lowest possible ratio.

Now, I have compared these same four bases that I defined awhile ago on this chart, 16-3, with regard to total gas production that would be permitted, with regard to the oil production per well that would be permitted along in producing that total gas production, and I have also compared the ratio that would result, gas-oil ratio, and in turn the reservoir voidage that would result from the production of one barrel of oil.

Now, you will note that under basis one, unrestrictive production, the ratio would be approaching 2,000 cubic feet per barrel, as shown by the third chart near the top, the right-hand top chart. If you place into effect the Sinclair plan, basis two, you would cut the oil production in half, at least as it appears from this graph. You wouldn't proportionately reduce the oil production, but your ratio would be in the neighborhood of slightly above 1500 cubic feet per barrel.

Now, with the Commission order you have a lower oil production rate for the field than under unrestricted production, but a little higher than with Sinclair's suggested limit, and the gas-oil ratio would be roughly the same, or under the order the resulting ratio is essentially the same, slightly higher than under the Sinclair plan.

With the British-American proposed plan you will

note that the production per well is higher, but you are more efficiently producing the total amount of oil produced, as indicated by the gas-oil ratio which is, I believe the exact figure was 1372, yes, 1372, which compares to 1574, the resulting ratio under the present Commission order.

Q Mr. Stearns, can you state the benefits of producing the oil more efficiently in terms of ultimate recovery of oil from the field?

A Yes, sir. We all know that the best we can do with a field, even the best we can do with a field we are going to leave a lot of oil underground. That oil will be left down there because it is dead oil with no energy to move it, and the retentive forces, the capillarity and the other retentive forces in the sand exceed any energy forces that are available to drive it out.

Now, if in producing our earlier barrels we don't look ahead and take out an excess of gas with some of those earlier barrels, we are in effect robbing those remaining barrels of energy and gas drive that can bring them out. So we, by using less efficient methods and producing with a higher ratio in the earlier stages, will lose ultimate recovery, which certainly represents waste.

Q Do you have any further comments with respect to

Exhibit 16-3, Mr. Stearns?

A I do want to make one other comment which I may have made in one form or another, but I do want to emphasize that our plan results in a higher rate of oil production per well, which we don't think is damaging, primarily because each barrel of oil is produced more efficiently with less gas, and it ties in with our earlier stated conclusion that this is not a rate sensitive reservoir. The amount of ultimate recovery that you get is not a function of how long it will take to produce it, but is a function of how efficiently you produce it, and you can most efficiently produce it by producing the least gas with each barrel of oil.

MR. STOCKMAR: Do you have a question, Mr. Jersin?

QUESTIONS BY MR. JERSIN:

Q Mr. Stearns, just for clarification, as I understand it, your suggested order is based on the thought that we would have a more uniform pressure pattern than we would if we had a oil restriction with a gas restriction, is that correct?

A That is true. The left-hand chart, which is 15-3, I believe, indicates that we will under our plan be taking more nearly equal amounts of reservoir fluids from the various tracts under our plan than under any of the

other three plans.

Q So your aim is to keep the pressure pattern as uniform as possible?

A That would tend to make the pressure pattern as uniform as possible, which according to my little example I tried to explain a little while ago, would prevent migration from one part of the reservoir to another.

MR. JERSIN: Ted, excuse me for interrupting.

MR. STOCKMAR: Feel free to do so, Art. Do you have any further questions?

MR. JERSIN: Yes, I do.

Q Your suggested order deals with gas only, Mr. Stearns. You realize that it is rather difficult to measure that hydrocarbon accurately unless all of it is measured. Do you have any suggestion on how the Commission could keep track of production of gas from leases?

A Of course, I---

MR. STOCKMAR: May I inject that we are not presently seeking any change in the method of measuring and testing these wells, and the approach which we are suggesting here includes a carrying-forward of the quarterly gas-oil ratio tests and other actual volume tests as well as pressure measurements, and at such intervals the gas-oil ratio can be determined and the quantities of oil available

for production under our proposal can be then calculated just as you calculate allowables presently, and so as far as keeping track of the situation we would end up by measuring the oil, or living within a prescribed oil allowable for each quarter.

Q (By Mr. Jersin) With the restriction on the gas alone, Mr. Stearns, do you think a test every three months would be an accurate gas production figure for each well?

A I think that within practical limits a quarterly test would keep fairly close check on the trend of the ratios. Now, I base that on the fact that since our hearing in November, if I recall the figures our ratio has increased by only an average, something like a hundred cubic feet per barrel, which is really not a sharp increase in gas-oil ratio.

QUESTIONS BY COMMISSIONER VAN TUYL:

Q Can you separate the figures from the gas cap area from the oil area?

A Can I separate what?

Q Is the ratio higher in the gas cap area? Is the increase more rapid in the gas cap area than it is in the oil area?

A You are talking about produced gas-oil ratio and the increase for the gas cap wells as compared to the lower

structure wells?

Q Yes.

A I haven't examined them to make such a comparison. I think actually that--now, this has to be very rough--it could be checked exactly; but, I believe a great part of our increase has been additional wells showing a ratio above solution ratio. In other words, certainly a large part of our increase has been on wells that originally had solution ratio and are now a thousand or more cubic feet per barrel above solution ratio. But now, as to just how it would compare, I just haven't made such a comparison.

QUESTIONS BY MR. STOCKMAR:

Q Mr. Stearns, isn't it your testimony that the gas cap gas must inevitably be produced to get the oil from this reservoir?

A Yes, sir, that is certainly true in this reservoir. It has a relatively thin oil column; it has a relatively low structural relief, and the practical methods by which you can segregate the two are restricted very much by the fact of having that real thin oil column and very low structural relief. You just don't have room for control to keep from producing some gas cap gas, but I do think that you have enough control that can be exercised to--as demonstrated here--to keep that gas production to a minimum,

and even with that much control, in a closed reservoir I believe we are insured of a continued expansion of the gas cap.

Q Mr. Stearns, in a reservoir of this kind doesn't it follow that we cannot escape increase in gas-oil ratios as the cumulative production is taken from the reservoir?

A That's true.

Q And that the problem is simply one of constantly trying to keep the gas-oil ratios to the lowest possible figure?

A In this reservoir there are going to be two factors that tend to cause this situation; one of them is that as you withdraw the oil you gradually thin the oil column which makes the gas more nearly adjacent to the perforation so that more and more of it can be produced. In addition to that the gas saturation in the oil zone itself will increase with time and you will be producing more and more solution gas from oil that remains underground; and the goal is merely to keep it to the minimum of that amount of gas.

Q Mr. Stearns---

COMMISSIONER VAN TUYL: Pardon me for interrupting.

Are your perforations in the lower part of the oil sand, or

do they run up close to the oil-gas contact?

A They vary, Mr. Van Tuyl. In the main where we have permeable sand far enough away from gas to give us proper drainage for the oil, we certainly stay as far as we can from the gas; but, on many of the wells--I believe Mr. Stein pointed out one or two of them--where the portion of the section that should have had the oil in it was essentially shaled out--you may have two or three or four feet of oil zone before you get into shale, and naturally to get the oil you have to perforate those permeable sections, and in some of those wells you just don't have much room to play in as far as that goes.

Q (By Mr. Stockmar) Mr. Stearns, in answer to Mr. Jersin's question if all or substantially all of the gas produced is marketed, does that not provide us with a means of measuring the gas production?

A Yes, I think that would give the Commission a very good check on it. In addition to their ratio tests they could obtain the figures, the measurements of gas volumes that were sold from each lease, which would, in effect, give them an audit on the gas production.

QUESTIONS BY MR. JERSIN:

Q In other words, if the Commission requested that all produced gas be measured it would impose no additional

expense to British-American?

A It would impose no hardship on British-American to measure the gas that was produced in excess of that used on the lease.

Q And the amount of gas used on the lease can be estimated with a degree of accuracy, isn't that correct?

A A fair degree of accuracy, yes, sir; with an engine of a given size and heaters of a given size you can get within practical limits of the amount.

Q Mr. Stearns, when you were discussing this gas cap gas with Mr. Van Tuyl, you mentioned a degree of control. Did I get the implication that it is your opinion that the less gas from the gas cap you produce prior to oil production that you obtained, the more ultimate recovery you might obtain? In other words, if you produce your oil before you produce most of your gas cap gas, would that tend toward greater ultimate recovery?

A I think so. I made the statement that if you produce the least possible amount of gas, whether it is from the gas cap or whether it represents excess solution gas that has come out of solution, you have accomplished the purpose of waste prevention the best you can. So that ties in with your statement that you want to produce the least possible amount of gas cap gas consistent with

property rights; I mean, you are at the same time giving each operator the right to withdraw an equal quantity of total hydrocarbon fluids from his unit volume of sand as compared to another owner.

Q Control of gas cap gas then would indicate possibly an increased ultimate recovery of oil if this control took into recognition correlative rights?

A Art, I missed the first part of your sentence. Would you repeat it?

Q All right, we will ask that again; it is just a restatement, Mr. Stearns. The control of the gas cap gas, good control of the gas cap gas, would possibly increase ultimate recovery of oil?

A Yes.

Q I just wanted to be sure I got that implication.

A That's correct.

QUESTIONS BY MR. STOCKMAR:

Q Mr. Stearns, in this type of reservoir hasn't it been your testimony that the control of that gas cap gas is really a question of completion practices and so forth rather than the particular rate at which production might be taken from the reservoir?

A Yes; and I might say that this order which encourages or gives a premium or a bonus, you might say, to



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the operator that is able to produce his oil with a lower ratio, encourages workovers or placement of a perforation lower, or reworking of a well to put it in better shape to produce a lesser quantity of gas. The type of order we are proposing I think would encourage not only juggling our proper selection of wells to produce from, but even improvement by some of the wells by workover.

MR. STOCKMAR: We seem to have half-way worked into cross examination here, but I would like to submit Mr. Stearns to any further questioning by the Commission or staff.

QUESTIONS BY MR. FREEMAN:

Q Mr. Stearns, what is the basis of your recommendation of 300,000 cubic feet?

A Well, primarily that is based on earlier indications by the Commission of what it thought the gas limits should be. I might say that I recall the Kimball Gas Products Company made the statement essentially to the effect that they would be able to handle the field gas if that limit were imposed, and British-American has made an installation of compressor equipment to handle the surface-produced gas if that limit applies; and at the same time I might say that there has to be some top or limit placed on production from an operations and profitability

lease basis; I mean the principle of selectivity on a lease, to be able to select the lowest ratio well on that lease to produce a maximum amount of oil is what results in this benefit of a lower ratio. You can select the lowest ratio well on that lease without hurting any owner; but, you can't necessarily select the lowest ratio well in the field for production without hurting the owners, or some of the owners, because they wouldn't get to produce any.

QUESTIONS BY MR. STOCKMAR:

Q Mr. Stearns, in view of the certainty, which I believe is in everyone's mind that gas-oil ratios must increase, if a substantial reduction of the limitation on gas was now applied, would we not find that in the not too distant future the oil which could be produced, even though we say there is no oil limit, the oil which could be produced under that limitation would constantly reduce, and that the net effect of what you are doing is simply to stretch out the time within which you get your recovery and not substantially increase the ultimate recovery?

A Yes, and that is what I meant by bringing in the economic aspects of it. I think the principal thing that influenced the choice of this particular limit was the placing of faith in the Commission's indication that this was a proper limit, and the design of our compressor and gas

handling facilities is based on this limit. Actually, I don't think that any lower limit than this would be fair to the operators since they have all made arrangements for facilities to handle this much gas per day.

QUESTIONS BY MR. JERSIN:

Q There is a little bit of flaring in the Cliff Field now, Mr. Stearns. To increase this limit would require the operators to increase their gas handling capacity or flare more gas?

A To increase this limit?

Q Yes.

A Yes, if the limit were actually restrictive.

Now, I might say that because of the vagaries of the various wells, that this limit is not now actually produced. You see, there are thirty wells in the field---

Q By "limit" you mean "gas limit"?

A Yes, sir.

Q All right.

A The limit of 300,000 per well per day amounts to 9,000,000 limit for the field; but, because of the fact that some of the wells are limited in their capacity for producing oil, and some of the leases could not actually produce the gas limit, produce to capacity at the present time, the effective gas limit is actually--well, I believe

somebody--well, it is actually lower than that 9,000,000. As indicated by Exhibit 14-3 the production of the leases according to the methods used in this basis three would result in a field gas production of about 6,350,000.

Q Does British-American have compressor capacity to handle their portion of the nine million maximum?

A Yes; Mr. Hogan is going to put on some testimony in that regard, but when you take off lease use, our present compressor capacity will essentially handle what is left over.

MR. STOCKMAR: Are there any further questions by the Commission or the staff? (No response.) Cross examine, then, please.

CROSS EXAMINATION BY MR. MC GOWAN:

Q I have just one or two questions, sir. As I understand your suggested order, it would either result in a different oil allowable for every well in the field, would it not, or essentially, if two wells happened to have exactly the same gas-oil ratio, it might be the same?

A Our order would place a limit only on the gas production for the lease.

Q And you would then---

A We wouldn't treat it on a per well basis.

Q But you would be allowed to produce then all the

well oil from each well that you could produce within that gas limit, is that your suggestion?

A No, we would produce all of the oil from a given lease.

Q Well, put it on a lease basis. If you have four wells on there you would have four times 300,000 cubic feet of limitation?

A Yes, sir.

Q And your suggestion is under your allowable that that well, or one well could produce all that it can produce so long as it doesn't produce more than the 1,200,000 MCF of gas?

A That is correct.

Q Under that then, under your formula, if we have two operators and one of them has a well or a lease in the high gas-oil ratio area and the other one has a lease in the low gas-oil ratio area of the field and they are both limited by the gas limitations, that would then let the wells in the lower gas-oil ratio area of the field produce substantially more oil than those wells in the higher gas-oil ratio area, would it not?

A They would be producing more oil, but essentially approaching as nearly as we can approach it from the practical standpoint the equal reservoir withdrawals of gas

and oil.

Q Well now, would---

A ---so as to minimize drainage and keep equal pressure patterns.

Q Would not the result, though, be that the low gas-oil ratio leases will be producing just as much gas as the high gas-oil ratio leases, but a greater quantity of oil?

A No, I don't know--I don't think that is exactly true, if I understand your question.

Q Let's take two leases. Each lease has four wells on it. One lease is in the low gas-oil ratio area and the other lease is in the high gas-oil ratio area. Each lease under your suggestion would be limited to 1,200,000 cubic feet of gas, would it not?

A Yes, sir.

Q And each lease would be allowed to produce all the oil it could produce so long as it produced no more gas than that?

A Yes.

Q Then the low gas-oil ratio lease would be producing the same amount of gas and a greater amount of oil than the high gas-oil ratio lease, would it not?

A Yes.

Q Then the low gas-oil ratio lease would be, under

order of the Commission, authorized and allowed daily to void a greater space in the reservoir than the high gas-oil ratio lease, would it not?

A Not significantly greater, Mr. McGowan, within limits.

Q Wouldn't it be directly proportionate upon the amount of gas that was produced?

A Not exactly; within limits of calculations the reservoir voidage of the oil as compared to free gas--I mean a barrel of oil as compared to several thousand cubic feet of gas is very small, and the voidage that you would get would be roughly equal in those two cases; that is, the amount of fluid withdrawn from the reservoir would be roughly equal. The two owners would be getting what they deserve because the first owner of the gas cap has all the gas under his property. The other owner over here in the oil column has only oil with solution gas under his property, and if you are approaching more nearly equal withdrawal from those properties they are getting what they deserve. You are trying to give them roughly the same amount,---

Q But, Mr. Stearns, my question is---

A ---of reservoir voidage per day.

Q ---if the high gas-oil ratio lease produces 1,200,000 cubic feet of gas, and because it is a high gas-oil

ratio lease it can only produce 400 barrels of oil a day, and the low gas-oil ratio lease also produces 1,200,000 cubic feet of gas a day, but produces a thousand barrels of oil a day instead of 400 barrels of oil a day, then the low gas-oil ratio lease is obviously voiding a much larger space in the reservoir than is the high gas-oil ratio lease, isn't that right?

A Some greater, that is true.

Q That would not be an order which would give to each owner in the field the right to daily void an equal space in the reservoir, would it?

A It would be approaching it more nearly than without this type of regulation; I mean, other factors would cause greater variations in voidage than this particular factor that you mentioned, this particular feature of the regulation.

Q But would the effect of that order not be that the Commission would be saying to the man who owned the high gas-oil ratio lease, "You cannot dissipate the reservoir as much as you can produce; you must conserve your gas so that the man with the low gas-oil ratio lease can produce all the oil he can get"?

A Well, it is a matter of somewhat of a balance between, as I see it, between property rights and waste or

ultimate recovery.

Q Well, isn't it---

A We are in a sense trying to balance the withdrawals between properties, but at the same time we are trying to do another thing, and that is to get a maximum amount from the field as a whole, and the two are to some degree in opposition to each other.

Q Isn't it pretty generally accepted that to base the limitations on gas-oil ratios is about as good a method as you can get unless you go into a very complicated volumetric withdrawal formula, or field unitization?

A I got all that but the first part of your question. If you will repeat that--

Q Isn't it fairly well accepted that about as good or an equitable a withdrawal from a given source of supply as can be obtained is the gas-oil ratio of the field, unless you go into a very complicated volumetric withdrawal formula, which has been used in some areas, or else go into field unitization? You have got to have some basis of deciding how many cubic feet of gas will void an equal space in the reservoir to a barrel of oil, do you not?

A Yes. Well now, when you say the placement of a limiting gas-oil ratio, you have got to be a little more specific than that. I don't favor the normal means of

factor will have the opposite effect, and we can never get exact perfection, but---

Q But when you do this---

A ---I think ours is an approach to it.

Q Go back to my original example where you limit this man up here to this 1,200,000 cubic feet of gas, and with that he can only get 400 barrels of oil a day on the high gas-oil ratio lease, and this other fellow with the low gas-oil ratio lease is producing 1,000 barrels of oil every day; and this man down here is voiding a much greater space in the reservoir than this man with the high gas-oil ratio lease because this is in the gas cap and the products from this lease will flow to and be drained from his well, but it will not reverse itself, is that true?

A If he is withdrawing in excess of 600 barrels per day, why, he is withdrawing the volume of that in relation to 1,200,000 cubic feet of gas; I think that will answer your question. As I stated awhile ago, that is rather insignificant compared to the total volume of 1,200,000 cubic feet of gas.

Q There is one other factor, too, that seems to me to result from your suggested plan, Mr. Stearns. In the gas cap area you have a high pressure area, don't you, generally speaking?

A I don't think that is necessarily true. Yes, the highest pressure is toward the east side.

Q Which is near the gas cap? And the low pressure area then is generally speaking where the thicker columns of oil are and the low oil-gas ratio oil then?

A The low pressure area also has some gas cap extending out over the---

Q But, the man that is in the low pressure area and in the low gas-oil ratio area draws out 600 barrels of oil and the same amount of gas--draws out the same amount of gas and 600 barrels of oil more from the same sized lease than the man in the high pressure area. Aren't you every day driving what oil lies under the high pressure area to the low pressure area?

A That one feature trends in that direction, yes, sir.

Q Just one other thing, when you computed this data did you use gas-oil ratio tests or well capacity tests?

A I used the gas-oil ratio tests--I mean, I used the gas-oil ratio and the well capacity tests, yes.

MR. MC GOWAN: That's all I have.

QUESTIONS BY MR. FREEMAN:

Q Mr. Stearns, you said that your plan more nearly approaches a uniform withdrawal, as I understood it?

A Yes, sir.

Q Isn't it true that with an oil limitation that the drainage that was indicated, or the possibility of drainage that was indicated by your previous answers to Mr. McGowan's questions, would be further eliminated by an oil top limitation on, say, a lease basis? In other words, taking the example that was presented, 1,200,000 cubic feet of gas and 400 barrels of oil as against a thousand barrels; say if you had a 200 barrel limitation per well, and it was an equal four well lease, wouldn't you have less of a disproportionate withdrawal?

A No, Mr. Freeman. My charts actually show the effect of the variation in the voidage on the various leases under this plan and under the Commission order, which is no different at all, except for the placement of an oil limit; and under what I call the Sinclair plan, it is no different at all except for a placement of a lower oil limit.

Now, this could be measured in different ways, but I have chosen to measure the disproportionate character of the relative volumes by reason of a ratio of maximum to minimum. The variation of the ratio of maximum to minimum voidage on each owner's property is indicated to be less with this plan than for the Commission order, which differs

in no other respect, except for this top on the oil per well.

MR. STOCKMAR: Sam, may I interrupt? I think something is so obvious to Mr. Stearns that he is not making it clear to the rest of you here.

REDIRECT EXAMINATION BY MR. STOCKMAR:

Q Mr. McGowan has raised the point that if a man here is permitted to produce 1,200,000 cubic feet of gas and 400 barrels of oil, and another man over here having better gas-oil ratios is permitted to produce 1,200,000 cubic feet of gas and 1,000 barrels of oil, his point is that that additional 600 barrels of oil constitutes such a volume that there is a great disproportion in the reservoir voidage. As I understand, a barrel of oil contains approximately six and a half cubic feet, is that approximate, or five and a half cubic feet?

A A barrel is 5.6 cubic feet.

Q A hundred barrels of oil then will contain 560 cubic feet. That compared with the 1,200,000 cubic feet of gas is a negligible feature, isn't it?

A This 1,200,000 must be corrected to reservoir conditions. One MCF under the present well conditions, one MCF is equal to 2.6 barrels, or about that, 2.7.

Q Aren't we measuring the surface gas produced and stock tank barrels of oil produced?

A Yes, but the question is whether you are taking equal voidage in the reservoir from these two leases that he is speaking of, and it is true that the volume of the oil is rather insignificant as compared to the volume of the gas when reduced back to reservoir conditions. Insofar as causing migration of fluids it is relatively small.

QUESTIONS BY MR. JERSIN:

Q Mr. Stearns, could you suggest an oil limitation that would reduce that negligible amount?

A Could I suggest an oil limitation?

Q Would an oil limitation reduce this negligible amount?

A No; any limitation on the oil would tend to nullify--I mean, any limitation on the oil over and above that that is imposed by the limit of the gas would tend to nullify the very benefits we are talking about, because you would automatically be required, the various operators, to produce less oil with a given volume of gas, and thus produce that oil less efficiently.

QUESTIONS BY MR. STOCKMAR:

Q Now, Mr. Stearns, with respect to---

A So in actuality we are trying to attain a balance between prevention of waste, which means most efficient production, and a balancing of the withdrawals, which means

distribution to the various owners.

Q Mr. Stearns, with respect to the comment that our approach might benefit owners that did not hold land over the gas cap, do our statistics not show that British-American owns sixty percent of the gas cap zone, and if there is any negligible suffering on that account we will be bearing sixty percent of it?

A Yes, sir.

RE-CROSS EXAMINATION BY MR. SCOTT:

Q Mr. Stearns, I have just two questions here. What percentage of the recovery of the original oil in place would you expect to obtain from a reservoir such as we have in the Cliff Field?

A Well, actually I made no exact estimate of the recovery. The amount of recoverable oil will certainly only be a fraction of the amount that is in place.

Q You have no figure on how much was originally in place?

A No, I don't have an exact figure. These set of exhibits would furnish a very good basis for calculating it. I don't have it in terms of barrels, but if you took the number of acre feet of oil zone as indicated on Exhibit 12-3 and converted it, took that times the porosity, which is roughly 18.5 percent, times the one minus connate water,

which would be approximately .83--that is, the one minus connate water would be .83--you would obtain the indicated amount of oil originally in place.

MR. STOCKMAR: Are there any further questions of this witness (no response)?

(Witness excused.)

COMMISSIONER BRETSCHNEIDER: How many more witnesses have you?

MR. STOCKMAR: This gentleman will be our last witness unless someone wants to explore the oil marketing situation.

COMMISSIONER BRETSCHNEIDER: All right; go ahead. THOMAS HOGAN, called as a witness on behalf of the British-American Oil Producing Company, being first duly sworn according to law, upon his oath testified as follows:

DIRECT EXAMINATION BY MR. STOCKMAR:

Q Would you please state your name and your position with the company for the record?

A Thomas Hogan, district superintendent of production.

Q Are you acquainted with the gas sale program of your company in this area?

A Yes.

Q Would you---

COMMISSIONER BRETSCHNEIDER: We will accept him

as an expert witness, if that is what you are trying to establish.

MR. STOCKMAR: We are limiting his testimony to knowledge of this gas situation, and that's all.

COMMISSIONER BRETSCHNEIDER: All right.

Q Would you briefly detail for the record the basis of the gas sale contract under which gas, your gas from the Cliff Field is being sold?

A In June of 1953 British-American entered into a contract with Kansas and Nebraska Gas Company of Hastings, Nebraska, in which it is stipulated that certain lands then undrilled would have their gas production dedicated to Kansas-Nebraska at a premium price. Kansas-Nebraska, under the contract, was obligated to take our casinghead gas, if it is economically feasible. We have the alternative, in case they don't wish to take it, of putting in our own compression equipment, if necessary, and supplying it to them. The Cliff Field leases, the Casement leases to be exact, are among those lands dedicated to Kansas-Nebraska.

Q Then at the time of the discovery of the Cliff Field you had an existing gas sale contract set up in anticipation of discoveries in Logan County?

A Yes, we did.

Q Then, I gather you promptly started an analysis

and install a third compressor?

A They ordered a third compressor and it was installed November the 16th. We now have three compression units handling all of the gas that we are producing on the Casement leases in the Cliff Field.

Q Will these compressors permit you to handle all of the gas that might be produced under an order adopted in accordance with British-American's proposal?

A They will handle it.

Q Do you have any substantial knowledge with respect to what the other operators in the field are doing about their gas?

A The only knowledge I have regarding the other operators' disposition of gas is that on or about January the 9th of this year Kimball Gas Products completed a line to Nebraska and commenced taking gas at field pressures. By that I mean at separator or treater pressures; however, they do not have compressors in the field as yet, as I understand it.

Q During all of this period have the other operators in the field had the same opportunity to sell gas to Kansas-Nebraska that British-American has had?

A Yes, the opportunity has existed for sometime, and in support of that statement I will refer you to

Exhibit 19-3, which is a letter from Kansas-Nebraska Natural Gas Company of Hastings, Nebraska to British-American Oil Producing Company. The letter is dated 8 November 1955. In the second paragraph of the letter I will quote:

"With respect to your inquiry concerning our ability to handle casinghead gas of other producers than B.A. in the Cliff Field in Logan County, Colorado, this will confirm my statement to you that we are able to handle all of the casinghead gas presently being produced in this field. It is always our intention when we enter any field that we will provide a market for all the gas being produced in that field which needs a market. Under this plan we would be glad to contract with the other producers in the Cliff Field to take their outputs of casinghead gas on terms no less favorable to Kansas-Nebraska than those included in the contract we have with your company. We understand, however, that all of the remaining gas in the field is under contract presently to a group which proposes to gather, compress and extract the liquids from it. We have a contract with that group to buy their residue gas, which we now understand is to be delivered to us at the outlet of the Kimball Gas Plant in Kimball County, Nebraska. Through this means a market will have been provided for all

the gas produced from the Cliff Field; but, should any gas happen to be left out of this arrangement or should any future gas discovery be unable to find a market, we should be anxious to prevent its waste." Signed, S. D. Whiteman.

MR. STOCKMAR: Are there any other questions that the Commission might wish to ask of Mr. Hogan?

MR. JERSIN: Yes.

QUESTIONS BY MR. JERSIN:

Q Mr. Hogan, in the month of November British-American flared 21,458,000 cubic feet of gas. Do you have the capacity for all the gas you produce?

A We have the capacity, but because of mechanical difficulties and because of hydrate formations in Kansas-Nebraska's lines during November, which you will recall was rather cold--there were days when we put practically no gas in the line. It was not because we didn't have the compressor capacity; I will state it that way.

MR. STOCKMAR: It was no fault of your company?

A It was no fault of ours.

MR. STOCKMAR: Is that situation being remedied by Kansas-Nebraska?

A They are taking steps to counteract it in the future.

MR. JERSIN: Is this all wet gas being delivered?

A It is wet gas, but as usual it has drips in it; at low places it collects condensates and they form.

COMMISSIONER BRETSCHEIDER: What did you say was the matter with the pipeline at that time?

A Hydrate formations.

Q (By Mr. Jersin) The difficulty that was had in November, Mr. Hogan, do you think that steps can be taken now that will offset these difficulties?

A Well, I can quote you some very recent figures. During the past week or ten days we have averaged compressing and selling to Kansas-Nebraska 2,850,000 cubic feet per day. There is no gas being flared now or during that period. In the event of mechanical breakdowns or further pipeline trouble there will be gas flared; I don't know how you would get around it.

Q I was wondering whether the difficulties might have arisen from the fact that it was wet gas going through this pipeline.

A That accounts for part of it.

Q And possibly we could expect those difficulties to continue?

A No; if Kansas-Nebraska installs the proper type of dehydrating equipment, which is up to them, it shouldn't

continue. They have done it in other parts of their system.

MR. STOCKMAR: You say it is up to them. Does not your contract with them require them to provide facilities to take your gas without such interruption?

A It requires them to install facilities when necessary, but at the outset you couldn't expect them to put everything in until it is proven necessary.

MR. STOCKMAR: Any further questions?

MR. JERSIN: No.

MR. STOCKMAR: Any cross examination of this witness? (No response)

COMMISSIONER BRETSCHNEIDER: You are excused.

(Witness excused.)

MR. STOCKMAR: Gentlemen, that concludes our side of the case.

MR. MCGOWAN: Before I put a witness on, the Kimball Products Gas man is here, and the other operators are present; however, in the interests of saving time, unless somebody questions it I will state for the record that the gas from the leases of all other operators in the field is being taken by Kimball Products Company, put through a gasoline plant, and the residue is being sold to Kansas-Nebraska. That is the situation. If anybody

questions if we can, if necessary, put on sworn testimony.

We have four exhibits, and so that the record may be as clear as possible we will continue with the same numbering system they used, starting with 21-3, 22-3 and so on.

MR. STOCKMAR: May I back up long enough to ask that our exhibits be introduced and accepted in evidence? They end with 19-3.

COMMISSIONER BRETSCHEIDER: Yes, they will be received.

MR. FREEMAN: Mr. Chairman, I have one request I would like to make first of the various interests that are represented in this hearing. As you know the chairman of the Commission, Mr. Downing, has disqualified himself from acting. We have at present four commissioners with the vice-chairman, Mr. Bretschneider, presiding. Is there any objection to having these four commissioners, one of whom is Mr. Bretschneider, participating in the deliberation of this case?

MR. STOCKMAR: Not on the part of British-American.

MR. FREEMAN: Are you aware of the fact that there is some slight interest that Mr. Bretschneider has in some portion of this field?

MR. MC GOWAN: Sinclair has no objection.

MR. SHAW: The T&T Oil Company will be very happy to have Mr. Bretschneider participate.

MR. SCOTT: There is no objection on the part of Anderson-Prichard.

MR. FREEMAN: Then it is agreeable that these four commissioners will participate in the case.

G. L. WEGER, called as a witness on behalf of Sinclair Oil & Gas Company, being first duly sworn according to law, upon his oath testified as follows:

DIRECT EXAMINATION BY MR. MC GOWAN:

Q Will you state your name, please?

A G. L. Weger.

Q And by whom are you employed?

A Sinclair Oil and Gas.

Q And you are familiar with this case and its development and history and have testified heretofore in this hearing?

A I have.

MR. MC GOWAN: First we will briefly identify the exhibits and mark them for the clerk and then Mr. Weger will testify concerning them.

The first exhibit is a gas-oil ratio map identical with the exhibit introduced at the first hearing. It is being used merely for comparison purposes and is not a new

exhibit. This one will be 20-3, which is a gas-oil ratio map of the field drawn November 14th 1955. 21-3 is a gas-oil ratio map of the field drawn December 21, 1955. This next one is the pressure map that again is an exhibit in the hearing and will be used only for comparison purposes. This will be 22-3. 23-3--and that is a monthly reservoir performance chart made through October '55, drawn January 18, 1956.

Q Mr. Weger, were these exhibits all prepared by you or under your direction?

A They were.

Q Will you without any further prompting from me advise the Commission what these exhibits depict and your conclusions therefrom in connection with their effect upon the Cliff pool production since its beginning?

A As you all well know, the Commission asked for the MER of this field in the early life of this field; and it was determined on the first hearing that there wasn't enough information to determine the MER at that particular time, and that we would like to have a test period set for a period not to exceed ninety days in order to gain some information so that we may come up with an MER for this particular field.

Now, these exhibits as presented here is the

information which was found from testing the wells through gas-oil ratio and bottom hole pressure during this ninety-day period. The first test, of course, was at the very beginning of the test period and was entered into the testimony previously; and these exhibits now are to show the improvement in the field conditions over that which existed before the 66-3 order went into effect.

Now, before we go into this I would like to dwell on these colors just a little bit just to make sure everybody understands. This orange color is carried through on all of the ratio maps to show the same ratio range. All colors have been carried through from one map to the other so that the improvement in ratio can be brought out pictorially on these ratio maps. The yellow is the 500-1,000. The orange, of course, is zero to 500; the yellow 500-1,000. The brown is 1,000 to 1,500, and the green is 1,500 to 2,000; and the greenish-blue is above 2,000 ratio.

In the very beginning the first pressure of the field showed deep depletions of pressure in the field around certain wells and areas, and at that particular time the gas-oil ratio map indicated that possibly the gas from the other side or the gas cap side was migrating down structure into those low pressure areas there, as depicted on the first two that have already been introduced into evidence.

Now, the next gas-oil ratio map which was run in-- I have October the 15th here--shows considerable improvement in the ratios of the field. The deep depletion well, which was indicated on the pressure map and which shows the brown cutting across the field there in the first ratio map, has been considerably wiped out. As you can see, the ratios in the 500-1,000 range very definitely improved all over the field; and the higher ratios have subsided back to the side of the reservoir, as you would normally expect.

The orange areas that were in the original map have changed around somewhat, but on the overall basis this was a definite improvement in ratio of the field. The last ratio that was taken shows a continued improvement in the field with considerable amount of zero to 500 ratio showing up all across the down structure side of the field, which you would normally expect, and the map as a whole shows definite improvement in ratios of the field, which is at this particular time the main driving force of the field; that is, the gas.

At the same time during the period that the second ratio map was drawn there was no pressure survey in that particular interval, but a pressure survey, by order 66-3, which made arrangements for that ratio to be run near the

end of the ninety-day test period, or the end of this period--and that is the exhibit on the extreme right-hand side (indicating)--and we can see from that map--I think British American's map differed from that a little bit by closing contours within the field---

Q It is the second from the right.

A Oh, yes, it is the second one from the right, the extreme right. I think the main differences in those two maps are that they close contours in the south end within the field limits, and this particular map does not close contours in the field limits; and possibly there is another pressure in the north end of the field there that British-American does not have on their map. But, this depicts our interpretation of the isobaric map as it now exists; and you can see that the low depression areas have been wiped out and this map, I might say, also is contoured on the same contour interval that the original map was contoured on, so there won't be any changing of the contour intervals. They are all down on the same basis. They are on a forty-pound contour interval, so that the change and improvement in reservoir pressure throughout the entire field can be observed.

It will be noticed that the gas cap side of the field contains high pressures, which you would normally

expect, and that is the way the field pressure exists at this particular time, cutting out all the low depression areas that once existed in the field.

Q What, in your opinion, Mr. Weger, caused those low depression areas in the beginning?

A Well, in the very beginning the field was produced wide open and without any restrictions whatsoever, and we believe that this indicates where most of the hydrocarbons were, the area where most of the production of the hydrocarbons was at that particular time.

Q And under the controlled production under order 66-3 those low depression areas have been now eliminated, is that correct?

A That is right; we have conditions here that we would more nearly expect in fields of this type rather than having erratic pressure conditions and erratic ratio conditions, especially since the ratio maps in the beginning had low structure wells, which you would not expect to produce much gas, producing higher ratios, and since the cut back it definitely shows an improvement. Even the well that the pressure map indicates as the worst offender is now in the range of zero to 500 cubic feet per barrel, according to the last tests that were run. That is our opinion.

Q Do you think that has resulted in the field coming back into its normal balance before it was drilled into?

A As it should have looked before in the original condition.

Q Well now, is it your opinion, Mr. Weger, based upon this information that is available and your continuing study and knowledge of the field throughout, that underground waste in the form of the channeling and dissipation of gas pressure and the trapping of oil that never would have been recovered that now will be recovered was occurring prior to the effective date of order 66-3?

A That is true, but the most important part of this, as we see it, is the fact that you were pulling extraneous gas in the low structural wells by overproducing that well causing the ratio of the whole field to be higher at the time this study was started than it is at this particular time. At the controlled rates you are now balancing the field out to look like it should have looked in the very beginning. You wouldn't expect a low structure well to produce at ratios as are exhibited here, and certainly it shows that extraneous gas coming into that particular well; due to cutting it back over a period of time it is now one of the lowest ratio wells in the field.

Q And then the result of the controlled production

for this period of ninety days or so under order 66-3 has resulted in reversing the original trend, which certainly created underground waste, and bringing the field back into the balance that you would expect to find it in?

A That is true.

Q Now, Mr. Weger, simply for the record, it has been mentioned here today concerning a water drive. Do you have any opinion about whether one exists now or whether one will exist or whether there is a possibility of it?

A On the water drive issue, we will say at this particular time that it has not shown anywhere in the field pressure decline curves or anything that would indicate it coming into the field, other than the extreme northwest wells have been gaining in water production right along. In these fields that we have in Colorado, it has been our experience in producing them that a lot of times the water drive does not show up--I am talking about to show any effect--until the reservoir pressure gets down into the range of 400 to 600 pounds. Up until that time we feel that we possibly have outrun any small drive that might be there; but, we have any number of little pools that we operate in that now since their reservoir pressure has been depleted somewhat has now begun to show an effect or a hold

or to maintain a level, even with the ratios going over the hill, so to speak, as we would expect in solution drive, and holding the oil production up, which would be entirely due to the water drive or the little drive that we considered insignificant at first. We haven't ruled that out in this field, however I will say again that so far the mechanics of the reservoir has indicated only a solution type drive with the help of the gas cap. Of course, we know that exists, and we feel that in this particular field that that gas cap is quite an item and should be protected more than some of the other testimony has given indications. According to our figures the gas cap is about thirty percent of the field, and that is based on the acre foot of the gas cap against the total acre foot of the field, and we feel that that is a considerable amount and will lead definitely to the recovery of additional oil if protected.

Q Well now, without considering the possibility of any water drive force--which as you have testified at this time is not known--but, taking the reservoir solely as a gas-oil solution reservoir with an approximately thirty percent gas cap, do you think the available information today indicates an approximate MER for this field?

A We believe that this information shows definitely

that the MER of the field should be set at no more than 200 barrels per day.

Q And what is the approximate average gas-oil ratio in the field?

A The average ratio in the field right now is about 1500 to 72 cubic feet per barrel--that is, 1500 to 1572 cubic feet per barrel.

Q Is it your recommendation to the Commission then that in order to prevent underground waste of both gas and oil in this reservoir that they determine an MER of not more than 200 barrels of oil per day per well on a lease basis with a limiting gas-oil ratio of 1500 to 1, which results in 300,000 cubic feet of gas per day per well on a lease basis?

A That is true, and I might add that we believe that the original order of 66-3 hit awfully close, since it was more or less taken from the air we might say-- that we have information now that shows that that was awfully close to the MER. It definitely was the maximum efficient rate.

Q Is there anything else that you wish to add?

A Nothing other than this production curve; I didn't dwell on that; the performance curve on the end down there (indicating). Under this cutback in production of

oil and gas there is definitely shown an improvement in the ratio. All the rest of it is, I believe, entered in testimony by everyone concerned--British-American, Sinclair--which I think we all have about the same data on this; but, that shows the picture graphically rather than just in tabulated figures, and you can definitely see that since September the 1st the ratio has declined, as in this middle curve (indicating). That definitely improved during this period and we believe that any improvement in the ratio of the field at all will lead to additional recovery of oil from that field.

Q Do you think then that these exhibits and the information that they represent indicate that under a production program similar to or identical with 66-3, that that will result in the avoidance of close to the minimum amount of waste that is possible?

A That is right; it definitely shows improvement throughout the field, and all the mechanics that we watch in producing the field. The lowering of the ratio over what it had been before, which is now the driving force or the main driving force, we feel is definitely proof that we probably recovered additional oil already from the cutback over that which would have been recovered had the field been left untouched as it was in the very beginning.

MR. MC GOWAN: Does the Commission or the staff have any questions?

QUESTIONS BY MR. JERSIN:

Q Mr. Weger, you have some type of a field weighted average, bottom hole pressure?

A Yes, I believe we do have that figure. It is planimetered from that map; I believe that is 1,006 pounds.

Q 1,006?

A Yes.

Q You indicated that there has been an improvement over the field conditions as the result of the order the Commission has issued. Do you feel there would have been the same amount of improvement had an oil restriction not been imposed?

A I do not.

Q Why is that, Mr. Weger?

A Because if we had only a gas allowable restriction on it with no oil allowable, and under the same ruling, we will say like the field is now without this oil allowable and the operators that had the low structure well which permitted them to produce the oil on the downstructure side, then that would continue to cause a lower pressure area on the downstructure side, which we still have existing somewhat even in our improved maps, and this particular well

would cause the gas in the upper structure to maintain its high pressure and the gas in it at the same time would expand and drive what oil that may be there--if they were restricted only to gas--to the lower structure wells, driving it off of their property, because the differential will be toward the low pressure side of the field, and those people that have the high structure wells will be more or less sitting there with just a good gas well, and the people on the low structure side of the reservoir would necessarily get more oil coming from their property.

Q We have seen some exhibits from British-American that indicate that it would be more efficient to have an order restricting only the gas and not oil and gas. Would you care to make a discussion on that point?

A I would say that--I don't know where Mr. Stearns got all of his information--but I would say most of his information came from ratio tests in the field. Those were not capacity tests, and in order to get a clear picture of what that particular thing would be it would seem to me that those would have to be capacity tests rather than gas-oil ratio tests. If we went back to some higher rate of production than this we would tend to go back to the original conditions that we had before, as depicted in these other ratio maps, and we would be



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CROSS EXAMINATION BY MR. STOCKMAR:

Q Mr. Weger, I can't gain a foot by cross examining you on the basis of the presentations which you have made, because you have done no more than to confirm the testimony which we put on with respect to the effect of the existing order 66-3.

Now, there is a difference between the present order and the proposal we are requesting, and that is that we are asking that the arbitrary oil limitation per well be removed and that the natural limitation of the production activity of the well be substituted. Now, if that is the only difference in our positions, then it seems to me that it behooves you to overcome our testimony that the reservoir can be produced more efficiently under our scheme. Now, since that is the crux of this case, I would like to ask you to tell me why the inclusion of an oil limitation is going to permit more efficient production of the field, why it is going to increase ultimate recovery. That is the issue that is here today. You have confirmed our testimony---

MR. MC GOWAN: I would like to object for just a moment, if I may, please. This is cross examination of this witness on his direct evidence. We have no duty whatsoever to rebut, reply to, or take any cognizance of British-American's testimony. We are here in response to a

request of the Commission today to recommend an MER, and the witness may be cross examined on his testimony, but we have no duty to rebut, reply to, or take any cognizance whatsoever of the testimony of British-American, and I ask that cross examination be restricted to his direct testimony, and not---

COMMISSIONER BRETSCHNEIDER: And not to what his opinion is concerning British-American.

MR. MC GOWAN: That's right; he has expressed no opinion concerning that testimony.

COMMISSIONER BRETSCHNEIDER: I think that is proper, don't you?

MR. STOCKMAR: All right, sir.

Q (By Mr. Stockmar) You have testified that waste can be prevented and ultimate recoveries increased by leaving in the existing order the limitation on oil of 200 barrels per day. Now, in what way does that increase ultimate recovery and permit more efficient gas-oil ratios? That is within the scope of his testimony?

MR. MC GOWAN: That's right.

A I would be glad to answer that. I think the pictures on the wall there bring that forth without saying very many words. It very easily can be seen that there is in the beginning a channeling of gas through the field.

That is not just one well; that is that whole string of wells through there (indicating), which indicates that the gas is coming from the upper structure or the gas cap area and migrating downstructure into the low structure wells and is producing gas cap material. Since that well has been cut back that has been stopped. We feel that the gas cap plays an important part in the recovery of hydrocarbons from that field. Since the restriction has been put on the field you can see very well that effect, and these are the tests submitted to the Commission showing that that condition has been erased, that the high ratios are where they should be and in line with where the gas cap is, and that even the well or the wells that are indicated by the low depression area and the pressure map is now one of the low gas-oil ratio wells. To me that right there shows the higher ultimate recovery of the hydrocarbons from that field.

Q You are saying in effect that the pressure has equalized somewhat?

A It has equalized a great deal.

Q On account of order 66-3?

A It sure has.

Q Did the placing of a limitation on the gas which could be produced play any part in the equalization of that

pressure?

A It did.

Q Did the limitation on the oil play any part in the equalization?

A It sure did.

Q In what way?

A Because you are limited to each lease on a well basis of the amount of hydrocarbons that can be produced from that field both in oil and gas, and they go hand in hand in a solution type of reservoir in the production of those hydrocarbons.

Q Is there without a gas limitation a natural limitation on the oil?

A There is.

Q Then a gas limitation includes an oil limitation, does it not?

A That is right, it does, but not to the extent that we want to see in this particular field. We feel in this case that the gas cap gain plays a good part, and we feel that if you do not have oil restriction on those boys on the downstructure side, that they producing excessive amounts of oil--we won't say "excessive"--but, being able to produce more oil will cause a low pressure area on the downstructure side even more than it is now, and the gas will

migrate to the downstructure just like it did in the first case.

Q Is it your testimony, Mr. Weger, that the production of oil from this field at the lowest possible gas-oil ratio will lead toward the highest ultimate recovery?

A There is no doubt about that at all.

Q Is it your opinion, Mr. Weger, that a limitation on gas alone will closely approximate an equivalent reservoir voidage formula?

A Well, no, I think there could be a better one worked out than that by just putting a haphazard figure of anything on it, but surely we would want it on a different basis than was submitted by your company.

Q If there is a better way than that submitted by our company, would you tell us what it is?

A Well, it would be based on the gas voidage in the reservoir itself; calculated, not picked out of the air. We would calculate exactly how many cubic feet a barrel of oil displaces and try to balance it out in that respect. If you want to go to a reservoir voidage deal, which would cut it even more than either one of us is talking about, it could be done on that basis. It has been done in several places and is a workable formula.

Q Well, it is your opinion that the distribution of

the oil in the reservoir is best accomplished by an equivalent reservoir voidage formula?

A That's right.

Q One further question, or set of questions here, Mr. Weger. You have given as your opinion that the MER of the field should be 200 barrels per well per day. I would like to know how you arrived at that as a firm figure.

A We said 200 barrels more or less, and that was based upon the performance and the improved performance of the field, which is an exhibit, and you have the same figures as we do. We feel that even yet at the rate that we are going at 200 barrels per day and with the gas limit that has been set on it, that improvement of this field will still continue to a certain point. Of course, we all know that sometime in the life of the field the gas is going to again go up, because that is the way the gas solution drive field works; but, as long as we can keep that ratio down to a very minimum--I don't mean uneconomical minimum, but I mean to a minimum production--then we are going to recover additional hydrocarbons from that reservoir; so, based upon what we have found out in this ninety-day period we have concluded that the 200 barrels that was arbitrarily set with a 300,000 ratio has definitely

caused the performance of that reservoir to improve, and we see no reason for it not to continue to improve until such time that we get down to the point that the ratio or the whole field goes up, and at that particular rate it would do it, because that's the normal behavior of a solution gas type reservoir.

MR. STOCKMAR: I don't believe that we have any more questions, Mr. McGowan.

MR. MC GOWAN: For redirect just let me ask you a few questions.

MR. FREEMAN: Mr. McGowan, before you go into redirect may I ask him a few questions?

MR. MC GOWAN: Yes, sir.

QUESTIONS BY MR. FREEMAN:

Q There are two proposals; one, of course, with an oil limit, and that's really what we are fighting over, as I understand it. The proposal of both companies--do we understand that you are both proposing 300,000 cubic feet per well on a lease basis, is that correct?

MR. STOCKMAR: Yes, sir.

MR. MC GOWAN: Yes; the effect is that we are basing it upon an oil limitation and the gas-oil ratio.

Q (By Mr. Freeman) Now, Mr. Weger, is it true that if you had no oil limitation and 300,000 cubic feet of gas

produced, wouldn't you produce at a more efficient gas-oil ratio? Wouldn't your gas-oil ratio be more efficient? In other words, wouldn't you get more oil for the amount of gas you produce?

A We do not believe so for this reason: Because if you have one well under the setup--I will have to digress from your question in order to answer it a little better-- If you have a good well on the downstructure side, and say it will produce the allowable for four wells and it is a low ratio well, then under the order with no oil allowable set on it, no oil limit, whatever that well can produce in oil and get to the limit set on those four wells will be what this lease is allowed to produce.

Q Correct.

A Then it would be possible for that one well to produce an allowable for four wells to get the 1,200,000 cubic feet of gas and whatever amount of oil possible; that is what that boy could produce from that one well.

Q Right.

A When you do that you are creating an extremely low pressure area around that well, which we had in the very beginning, and it would go back to the same picture as we have in the beginning of these maps; with a low pressure area around this well it is producing all the oil,

and that would tend to pull the excess gas from the upside of the structure--which we would call the gas cap--into that well, dissipating that energy. For that reason we would want an oil limitation placed on those wells in order to keep some well from producing an excessive amount of oil from one particular lease, thereby causing that low pressure area. Without an oil limitation we go back to the original conditions similar to what we had in the very beginning. Of course, everybody under those conditions would try to produce those low pressure wells as much as possible, and you would be getting back into the original deal that you had before.

If you tried to balance it out among the wells and had an oil limitation on it some wells wouldn't produce 1,500 barrels a day or 1,000 barrels, or whatever it turned out to be. Under the limit at that particular time, then he would not be so apt to pull a low pressure area across the field and it would balance out and look more like the pressure pattern that we have now.

Q If we did this on a well basis, would it be better?

A Rather than on a lease basis?

Q Yes.

A Well, of course, anything we can do to keep the

gas in the ground would certainly improve the performance of the reservoir.

Q Wouldn't we, in effect, if we had it on a well basis, as we can probably do, be penalizing the high gas-oil ratio wells in favor of the low gas-oil ratio wells? Would there be a need of having a specific limitation on a well?

A You mean each well standing on its own feet, not on a lease basis?

Q That's right.

A You still have an inequity there; we are getting back into reservoir voidage again.

Q It wouldn't be nearly as serious as on a lease basis?

A It would still be an inequity.

Q Wouldn't it be true that the wells that were producing oil as opposed to gas would be voiding less space?

A No, not necessarily because they would be producing the gas plus the oil, if you want to get real technical about it.

CROSS EXAMINATION BY MR. STOCKMAR (Continued):

Q Mr. Weger, isn't the condition that you described as being what would occur under a no-oil limitation just

exactly what is occurring under the present order?

A Not at all; if we had that condition we would probably have some clearing up, balancing of the reservoir; but, we would not have the effect that we have now, because you have both oil and gas in balance together.

Q Aren't you seeking to take substantial quantities of production from your low gas-oil ratio wells at the present time?

A We sure are, but at the same time you have a limit on what you can take from that particular lease.

Q Is there any limit on what you can take from a particular well at the present time?

A There is.

Q What is it?

A 200 barrels a day.

Q I don't understand.

A On a lease basis; of course, it goes back to your original test. You test it on a well basis; it is allocated by a lease.

Q If you have a well capable of producing 500 barrels of oil now can you not produce 500 barrels of oil?

A Yes; but by the same token if you took the limitation off you could take all the production from one well, creating a low pressure area--if you had a well that

could produce that much.

Q Is there such a well in this field?

A I don't know.

Q You say that the imposition of the oil allowable balances the gas allowable among the wells, and yet you can still take all the production you want from any well. How do you reconcile that?

A Up to what the oil allowable for those wells are.

Q If we had no limitation on oil allowable and took all of the production from a single well, you say that would create an area of low pressure there?

A It would.

Q Would the gas-oil ratio of that well increase?

A It would.

Q In the next quarter it wouldn't look like such a good well anymore, would it?

A Probably not.

Q It would go to some other well?

A Yes.

Q Isn't there also a balancing of production under that kind of system?

A Of course---

Q Even if an operator tried to take all his production from a single well?

A If that were the case it would show up on our pressure maps that we have now.

REDIRECT EXAMINATION BY MR. MC GOWAN:

Q Mr. Weger, to clear up possibly a few not too clear points here in discussing this voidage formula, now, a voidage formula requires both an oil and gas limitation, does it not?

A It does.

Q Is not a true voidage formula in a reservoir based upon this premise: that so many cubic feet of gas under the pressure and at the temperature in the reservoir, being 8,000 feet or 15,000 feet below the ground, which has to be calculated; but, you calculate that the cubic feet of space that contains one barrel of oil in a reservoir contains so many cubic feet of gas based upon the depth, temperature, pressure and what other factors the engineers may use in making the calculation; so that a true voidage formula would be figured upon that basis?

A It would.

Q And then to carry out the voidage formula for each barrel of oil that was produced from the reservoir there would have to be that many feet of gas produced from the reservoir, so you would have to have a limitation on oil and gas on each well to retain the voidage formula basis

of the reservoir and to let each operator each day void an equal space in the reservoir?

A That's the only way it can be done.

Q Now, you testified again here, I believe, in response to Mr. Freeman's question that the waste would be serious, or is in effect serious without the oil limit in respect to draining it all from the low pressure well. Will you clarify again what your views are in relation to excessive--or again maybe that is a bad word--but, unprorated or uncontrolled or unlimited oil production on a well basis, or on a lease basis, even though it be a low pressure or a low gas-oil ratio well?

A Whenever you start to produce a well at an excessive rate you create an extremely low pressure area around that well, and all of the high pressure material around that well will come in there, whether it be oil or gas, and the high pressure will tend to move toward the low pressure area, and the gas in the high pressure side of the field is driving the oil from those leases to the low pressure areas. And should you start a well like that, it may be a low pressure well in the very beginning, but the longer you produce that well at that rate, then that ratio is going to start to climb, and it will climb fast for two reasons: due to the fact that you are creating a gas cap

area around this particular well because of its low pressure, and due to the fact in this particular field you will be pulling gas cap material from the upper structures into that well also. So if you produced a well like that it wouldn't be very long until that ratio would be out of sight again.

Q Is that not the condition we had in the field prior to order 66-3?

A That is the condition we had and it is depicted on the board (indicating charts).

Q Is not the result of such production of a field, and was not the result of that type of production in this field, to allow the wasting of reservoir energy and the trapping of oil that could have been recovered under good practices?

A That is true.

Q And has not that situation been substantially corrected in the ninety days that order 66-3 has been in effect?

A It has been remarkably improved.

Q In your opinion will it continue to improve under a similar type of restriction on oil and gas, restricting oil and gas production under the EMR you have recommended?

A We feel it will.

MR. MC GOWAN: That is all.

COMMISSIONER BRETSCHNEIDER: Is there anymore cross examination or questions of the witness? If not, the witness is excused.

(Witness excused.)

MR. MC GOWAN: That closes Sinclair's case.

COMMISSIONER BRETSCHNEIDER: If any other operators wish to make an appearance now, will you please come forward?

MR. SCOTT: We are having placed on the board now an exhibit, 24-3, which will be the only exhibit on behalf of Anderson-Prichard Oil Corporation. I have called Mr. Duncan Patty.

DUNCAN PATTY, called as a witness on behalf of the Anderson-Prichard Oil Corporation, being first duly sworn according to law, upon his oath testified as follows:

DIRECT EXAMINATION BY MR. SCOTT:

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

A Duncan D. Patty of Oklahoma City. I am reservoir engineer for Anderson-Prichard Oil Corporation.

Q Mr. Patty, were you qualified as an expert witness and did you testify at the former hearing, the

original hearing held in the Cliff Field?

A I did.

Q As reservoir engineer for Anderson-Prichard do you not have available to you the results of the tests required by the rules and orders of the Commission as well as the other information submitted to the Commission on this field?

A Yes, sir.

Q Have you made, either personally or under your supervision and direction, any engineering studies of such field test data resulting in the preparation of any engineering reports?

A We have made what we call a reservoir performance study. In essence I have tried not to concern myself with the matter of correlative rights or with the matter of production and performance of individual wells, but the performance of the reservoir as a whole. Might I just go ahead and explain this?

Q One thing I want to bring out, this particular exhibit is not repetitious of any of the exhibits heretofore introduced by Sinclair, is that correct?

A That is correct.

Q All right, sir; now, if you will explain to the Commission the graph which you have prepared explaining the

scales, the curves and so forth?

A All right. With these curves we have compared actual performance in the Cliff Field in so far as gas-oil ratio and pressure is concerned, and we have plotted this data versus recovery and percent of the original oil in place. This could be plotted versus time or versus cumulative oil; it would still have the same general configuration. The reservoir pressure scale is on the left-hand side of the page. The gas-oil ratio scale is on the right side of the page. The long curve starting at the upper left-hand side of the page and slanting downward to the lower right side is the predicted reservoir pressure decline plotted versus percent of recovery of original oil in place. That is to say, initially the pressure was about 1350 pounds. We would anticipate with our knowledge of the oil in place and the characteristics of it, that recovery to a bottom hole pressure of 100 pounds would be about 15.5 percent of the oil in place. The other long curve which starts at the lower left corner of the page and starts upward and then swoops back down again on the right side is the predicted gas-oil ratio from this field.

In computing that curve we have taken into account two factors: one, the gas-oil ratio from the oil zone itself, and we have added to that the gas which would be

produced from the gas cap, assuming that the gas cap had no influence whatsoever on the oil horizon, that it was just depleted at the same rate pressure that the oil zone was depleted. In effect we are saying then that for the purposes of these predictions we assumed that the gas cap would neither help nor hinder production from the oil zone.

We then have plotted the two little short lines on the left side of the page which represent actual bottom hole pressure performance and gas-oil ratio performance to date. Now, the bottom hole pressures are based on simply three points, since that is all the data that we have on hand: the original static bottom hole pressure in the field, and the--I used just simply arithmetic averages of the pressures obtained on the two surveys; those are the two subsequent points on that curve, and it was interesting to note that we were about twelve pounds different--I mean, my arithmetic average was twelve pounds lower than the weighted average which Sinclair took from their isobaric map.

The gas-oil ratio figures as plotted were taken from the data which is in the Commission files and which was reported by the operators as the volumes of gas produced during this period. The thing which we would specifically like to point out is this: that under the methods of operation--

at least until the date that this order was entered, order No. 66-3--our recoveries from this field were approximately one-half what we would ordinarily expect to recover from a reservoir of this type. My personal opinion is that the balance of that oil which should have been produced has gone into the gas cap and has wet that dry gas sand and will probably never be recovered.

Q What is that in barrels, Mr. Patty, approximately?

A This is, in percent of recovery to January 1st we have recovered approximately 4.25 percent of the oil which was in place originally, or a little over 900,000 barrels, as I recall it. We have probably produced something on the order of another 4.25 percent, or another 900,000 barrels into the gas cap, and that is lost irrecoverably.

Now, I do not anticipate that this curve will continue to be so steep; in fact, it has probably already flattened, but since the order became effective, between the last two pressure points it is impossible to state with any certainty what the performance has been between those two points, and we will have to wait until the next pressure survey to see. My personal opinion is that the pressure, actual pressure in the reservoir, probably was above this line which we have drawn as actual pressure up to the time of the first survey, and that it swooped considerably below

this line in between these two points and then was flattening, or had already flattened considerably at the time that this last pressure survey was taken the 1st of January, and that henceforth this curve will probably more or less parallel our predicted curve; it may even approach it a little.

Q Mr. Patty, have you had an opportunity to examine in detail the exhibits prepared by Sinclair?

A I would say not in detail, no.

Q But, you have examined those exhibits?

A I have seen them, yes.

Q And you concur with the matters reflected by them and the opinions reached by Mr. Weger?

A In general, yes.

Q In other words, you would concur in the recommendations made by Mr. Weger on establishing at least a 200-barrel oil allowable, or less, and a 300,000 MCF of gas?

A Yes, sir, it is my opinion that the Commission's order as issued under order No. 66-3, I believe it was, has gone a long way toward preventing waste in this reservoir, and that it is a good workable order and that it should be continued.

I would like to go further, however, and state

that as an engineer I think probably the only way to reduce waste to an absolute minimum is, of course, unitization and selective production from the very low ratio wells. At the present time that is obviously impossible, and the Commission has to choose some intermediate compromise route whereby they would keep waste to a reasonable level and yet protect the correlative rights of all the parties involved.

MR. SCOTT: Any questions from the Commission?

QUESTIONS BY COMMISSIONER VAN TUYL:

Q Why do you think it is impossible for us to have unitization in this field?

A I would put it this way: I believe it would be to every operator's advantage to step in and unitize the pool. There has been sufficient difference of opinion between the operators represented here today that I don't believe we could get together at the present time.

Q There is a difference on the participation formula?

A Oh, no, that has never been discussed. It's a difference as to whether the present method of operation is wasteful. British-American apparently feels that essentially the present method of operation, or wide open oil production, is suitable; and I believe that most of the rest of us feel

to the contrary.

MR. SCOTT: Any further questions from the Commission?

Q (By Commissioner Van Tuyl) You mentioned the possibility that substantial amounts of oil had moved into the gas cap. Have you any definite evidence of that?

A None other than this curve which we have entered in evidence. In other words, we have computed predicted performance from this field using, I grant you, an estimated but a reasonable KGKO curve of a reasonable estimate of the oil in place, and I think any engineering group which got together and predicted performance such as this would probably be within ten percent of that curve, higher or lower. I mean, I couldn't guarantee they would get the same figures that I have, because as you know reservoir performance predictions are peculiar in that everybody sees them in just a little different light; but, this is a field where we have a great deal more basic engineering data to work with than you have in most fields on which studies of this type are made, and consequently I feel that this is a very reasonable prediction of the performance.

The pressure data to date indicates that somewhere out of that oil reservoir a great deal more oil has been produced than we have recovered at the surface of the

ground. The only other place that it could have gone is into what we term the gas cap area. It has been my experience in other fields--and I don't say this to the detriment of any operator at all--but, probably the actual volumes of gas reported were greater--I mean, the volumes of gas produced were probably a little greater than those actually produced. It is difficult to determine those things. I think, though, that when we are actually selling the gas and metering it we will begin to get some accurate gas production figures and we can use this sort of thing with greater assurance.

QUESTIONS BY MR. JERSIN:

Q Mr. Patty, have you taken capacity tests of your wells?

A No, sir, we have not. We have information of five our wells that will produce well in excess of 200 barrels a day, but the tests we took were simply gas-oil ratio tests. I don't know what the capacities are.

Q Then you don't know what effect an order with a gas restriction only would result in?

A Well, knowing the character of our wells, I am reasonably sure that Anderson-Prichard would be benefitted by such an order. In other words, our wells are relatively low ratio wells, and on the whole we have information out of

five wells which are capable of producing well in excess of 200 barrels a day. I am sure that the operators in the field as a whole don't have anywhere near that many wells, proportionately speaking, that are capable of producing over 200 barrels a day.

Q You stated that generally you agreed with Mr. Weger's statements.

A Yes, that the production from this field should be limited probably on both; limitation on the oil and on the gas.

Q What is your reason for the limitation on the oil?

A Very much in line with the statements that Mr. Weger made, to prevent the excessive withdrawal of oil from any one well and the consequent reduction of pressure in that area. That is inevitably going to lead--if you can visualize it in the third dimension rather than in just two--you have a gas cap overlying most of the oil zone in this reservoir. If over on this low side you withdraw the pressure considerably around a well which you are going to produce, say, 800 barrels of oil a day from, you are going to have migration of the less viscous of the two fluids in the reservoir; that is, the gas. It will move easier than the oil for a given pressure differential. It is going to move over the top and down into that area. Then

you are going to reduce the pressure in the gas cap area and you are going to have migration of oil up vertically into that gas cap area from the area which we called the easterly side of the field. It is better to keep your oil takes balanced, so to speak, and relatively uniform if you are going to prevent migration of gas.

MR. SCOTT: Any further questions from the staff or the Commission?

COMMISSIONER BRETSCHNEIDER: If there are no further questions, you may be excused.

MR. SCOTT: We haven't given them the opportunity to cross examine the witness.

MR. STOCKMAR: I don't believe we have any questions.

(Witness excused.)

MR. MC GOWAN: May I, sir, as a formality, move the introduction of Sinclair's Exhibits?

COMMISSIONER BRETSCHNEIDER: Yes.

(Sinclair's Exhibits 20-3 through 23-3, inclusive, were received in evidence.)

MR. SHAW: Mr. Bretschneider, we have one witness that won't take over about three or four minutes, I don't think.

H. T. OLSON, called as a witness on behalf of the T&T Oil Company, being first duly sworn according to law, upon his oath testified as follows:

DIRECT EXAMINATION BY MR. SHAW:

Q Will you state your name, please, sir?

A H. T. Olson.

Q And you are a consulting petroleum engineer?

A I am.

Q With how many years' experience?

A I would have to subtract from --1936 from 1956;

twenty years now.

Q All right. I believe he is known to the members-- the people that are employed by the various companies representative. If there is no objection, I will not ask for his qualifications.

COMMISSIONER BRETSCHNEIDER: Yes, sir.

Q Mr. Olson, have you made a study of the data which has been prepared from various tests and so forth that have been taken in connection with this Cliff Field?

A I have.

Q And you have made that study on behalf of the T&T Oil Company?

A That is right.

Q That is, in considering the entire field, you

were asked by the T&T Oil Company to make such a study?

A That is right.

Q I don't want to ask you any questions that are repetitious or merely corroboration of other things, but in connection with some testimony by Mr. Stearns of the British-American, part of his testimony was to the effect that the-- or, he gave an opinion that in an unrestricted production of the oil, that the replacement of the gas cap by the gas released from the solution with the oil, that that replacement of the gas cap from the released--or bubbling up of the gas released from solution was sufficient to maintain the gas cap. Now, that is under the condition of an unrestricted production of oil, as has been advocated here by British-American. Will you state your opinion on that, please, sir?

A I believe that that is the way he answered in his testimony, and I am of the definite opinion that the gas will not percolate up through the oil zone and into the gas cap at a fast enough rate to replace the gas that is being withdrawn from the gas cap, so therefore you could not maintain your gas cap volume.

Q And by not maintaining the gas cap volume, you are dissipating right there, are you not, part of the driving energy of your field?

A That is true.

Q Now, with respect to I believe also Mr. Stearn's testimony and also the testimony of Mr. Stein for British-American, what other results occur that are detrimental, for instance, to this field if you do not pay any heed to the rate of recovery of the oil? In other words, if you have an unrestricted recovery of the oil, but with a gas restriction, what are some of the possible detrimental effects of that with respect to this Cliff Field?

A I don't really understand your question.

Q Well, with respect to coning and fingering of gas, for instance, I believe it already has been touched upon on to some extent by Mr. Weger and Mr. Patty.

A Well, using Sinclair's exhibits you will note that the wells that are essentially just in the oil band without much gas cap connected onto them, the gas-oil ratios have reduced considerably between the last two gas-oil ratio surveys, and I am of the opinion that the major portion of that has resulted from a reduction of the coning and fingering of the gas cap into the well bores, which is definitely caused by pressure drawdown in the wells and by the restriction of the wells to 200 barrels per day, or actually less, depending upon their gas-oil ratio. You have reduced the pressure drawdown within the well bore of

Q Does that mean that that oil is going somewhere else?

A Well, it would have to go someplace else, and that would really result from oil being drawn to the lower pressure areas, and also by the expansion of the gas cap and the lowering of the gas-oil interface with time, and T&T being in probably one of the worst positions of all the operators, having their wells where they go out of the "D" sand actually above the water table, and their productive life is going to be shorter, their oil productive life is going to be shorter than that of other operators who are going to be able to produce just slightly lower structurally.

Q And, of course, the ultimate recovery, for instance, from the T&T lease would be lessened, as you have already pointed out; it would have a much shorter life if there is unrestricted production of oil, is that correct, because of the obvious migration of the oil from the T&T lease?

A That would be one answer, and another answer would be also that, well, the ultimate life of the field is going to be less, too.

Q Because of unrestricted production of oil?

A Because of unrestricted oil production.

MR. SHAW: I believe that's all the questions I
have for you today. Thank you very much for your
testimony. I will see you again in a few days.

want to ask. Are there any questions by the Commission or the staff?

QUESTIONS BY MR. JERSIN:

Q Mr. Olson, I have just one question: Have you taken capacity tests or do you know of capacity tests of T&T wells in the Cliff Field?

A There have not been any real capacity tests; there have been just straight gas-oil ratio tests.

Q Then you don't have available the capacity of the wells operated by T&T?

A No, I don't.

MR. SHAW: Any other questions?

MR. FREEMAN: Yes; there is just one question that I have.

QUESTIONS BY MR. FREEMAN:

Q You said that the life of the field would be shorter; would the ultimate recovery of oil be less?

A I would have to say 'yes' for this reason: that if you can maintain the gas cap to where it is doing work for the recovery of the oil by its expansion, then you would have a possible increase in ultimate recovery, and-- Am I digressing from your question there? The ultimate recovery, I believe--I am going to have to put it this way: the ultimate recovery actually could be more by having a

longer life to the pool. Now, I think that answers your question, doesn't it?

Q Why?

A All right, that goes over into another factor of it, that to maintain the gas cap you are going to have to have a restricted oil production to minimize the coning and fingering of the gas cap into those wells that could produce at a low gas-oil ratio with a very small pressure drawdown.

MR. SHAW: Does that answer your question, Mr. Freeman?

MR. FREEMAN: Yes.

MR. SHAW: Mr. Stockmar?

CROSS EXAMINATION BY MR. STOCKMAR:

Q Mr. Olson, do you subscribe to the general premise that the field can be most efficiently produced if produced at the lowest possible gas-oil ratio?

A I think any engineer would, and I would, too.

Q So operating the field at the lowest possible gas-oil ratio would then lead to a greater ultimate recovery?

A I think that is right.

Q And the production of the minimum amount of gas will longer maintain the gas cap?

A That is true.

MR. STOCKMAR: That is all.

REDIRECT EXAMINATION BY MR. SHAW:

Q Of course, that ideal situation would be best accomplished by a unitization plan, isn't that right?

A That is entirely true.

Q We are talking, of course, are we not, Mr. Olson, of measures for the best possible MER in this field short of an actual unitization field, isn't that correct?

A I hadn't heard unitization interjected into this hearing until the Anderson-Prichard man mentioned it.

Q And that is correct, isn't it, that we are just talking about measures that are the best under the circumstances?

A Without unitization.

Q In the absence of unitization?

A That's right.

Q You subscribe, as I understand it, to the general proposals made by the Sinclair Oil Company through its witness, Mr. Weger, isn't that correct, sir?

A That's right; that's true.

MR. SHAW: Thank you; that's all we have of this witness.

COMMISSIONER BRETSCHNEIDER: Does anyone else wish to cross examine the witness? (No response) You are excused, sir.

(Witness excused.)

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COMMISSIONER BRETSCHNEIDER: Does anyone else wish to appear?

MR. STOCKMAR: Mr. Bretschneider, can we establish whether or not our oil marketing man is going to be needed? If not, we would like to release him to meet a plane.

COMMISSIONER BRETSCHNEIDER: I don't think we will call for him, Mr. Stockmar. Mr. Jersin wants to ask Mr. Stearns a question.

GLENN M. STEARNS, recalled as a witness on behalf of the British-American Oil Producing Company, having been previously duly sworn, resumed the stand and testified further as follows:

DIRECT EXAMINATION BY MR. JERSIN:

Q You submitted some testimony which reflected efficiency in the operation of the reservoir. If I remember that testimony correctly, you based that partially on capacity tests?

A It was based on the results of the December tests which I understand from statements of some of the other witnesses didn't in all cases represent capacity tests of the given well.

Q But, apparently they weren't capacity tests?

A I gather from what some of the other witnesses say

that they didn't necessarily represent the capacity of the well, as long as they demonstrated the gas-oil ratio at which the well would produce, and also its ability to produce above the prescribed limit under the present order; in other words, 200 barrels of oil per day.

Q Would you like to discuss whether or not that would make a difference in what you submitted as efficiency?

A Yes, it would make some difference. Now, if there were a low gas-oil ratio well on that tabulation that actually had a higher capacity for producing oil than was indicated by the test, the benefits demonstrated by the gas limit alone would be enhanced; in other words, indicated to be greater even than my charts indicated.

Q But that possibly would indicate or prescribe to a greater sink in pressure and we would get away from the uniform pressure pattern throughout the field, possibly, is that correct?

A No, I don't think we would, because the very premise on which my calculations are made, to compare the effect of a gas limit alone upon equality of voidage as compared to the effect of a gas limit with an oil limit upon equality of voidage, using the same random test data, shows up that the gas limit alone results in more equal voidage; and with regard to the efficiency of production,

I think you can boil that down to just these simple terms to demonstrate that an oil limit in addition to a gas limit has to result in less efficient production, if that oil limit is such as to actually be operative; or, in other words, if the oil limit is low enough that it actually applies to wells--if it is not a fictitious limit that doesn't really control, for this reason: if you have a gas limit alone you are going to produce, be permitted to produce a certain quantity of oil from a given lease, and naturally the operator will so select his wells to produce a maximum quantity of oil within that gas limit; but, now, in addition, if you come along and place an oil ceiling somewhat below what that gas limit alone would permit, you are in effect reducing the number of barrels of oil that that operator can produce with the same quantity of gas. So you do nothing more than require that he produce his oil less efficiently because you require him--by reducing the amount of oil that he can produce with a given quantity of gas, you require him to produce it at a higher ratio, and therefore you are requiring him to produce it less efficiently by arbitrarily pushing the oil limit down below what the gas limit establishes the oil limit to be.

Q Would you be increasing the possibility of channeling without an oil limitation?

A I would say 'no', still based on my testimony and my exhibits, because as my exhibits showed, I believe, conclusively, the equality of voidage was more nearly reached with the gas limit alone than with the gas limit and the oil limit combined.

QUESTIONS BY MR. FREEMAN:

Q Have you made any capacity tests of your wells?

A This is subject to check with Mr. Hogan and Mr. Stein, but I believe our tests represented capacity tests.

COMMISSIONER BRETSCHNEIDER: I think we have had testimony on that before by two witnesses.

MR. JERSIN: Not for British-American.

A They indicate that they confirm that statement.

MR. JERSIN: I believe that that is all I had, Mr. Stearns.

COMMISSIONER BRETSCHNEIDER: You may be excused.

(Witness excused.)

COMMISSIONER BRETSCHNEIDER: Are there any more parties interested in this?

MR. GENGLER: Mr. Bretschneider, you have heard the testimony of British-American and Sinclair. Now, I represent Sanford Production Company and Murfin & Sutton, and Gibraltar Oil Company, and Don M. Rounds Drilling Company, who are four other operators in the field, and

instead of introducing or in lieu of introducing additional testimony, why, we wish to state that we are entirely in accord with the testimony of Sinclair and Anderson-Prichard and T&T which has been introduced up to this point.

Now, one important feature I wish to also state is that D. M. Rounds is a mineral owner as well as an operator in this field, and has an interest in some sixteen wells, and his interests are overlying quite a bit of the field, probably to at least as much acreage as any other person in this controversy--maybe not as much as in the amount--but, at least some interest in all of these different areas, and he feels that his interests are best supported by the testimony and best preserved by the testimony of Sinclair and Anderson-Prichard.

COMMISSIONER BRETSCHNEIDER: Does anyone else wish to speak?

MR. STOCKMAR: I have a very short final statement, gentlemen. It seems to me very clear that British-American has carried the burden of proof with respect to its proposal covering the efficiency of the production of the reservoir, the extension, the enlargement of the ultimate recovery possible, and the more equitable distribution of the oil in place. All of the other testimony has confirmed what our testimony stated; that is, that order 66-3 has achieved to some degree, some of those things.

MR. MC GOWAN: If it please the Commission, a brief closing statement for Sinclair.

I think the testimony shows this: that all of the testimony of both sides of this controversy today has certainly shown that waste did exist in the reservoir prior to order 66-3, that it has gone a long ways already in this short ninety-day period of eliminating that waste; that a similar order is certainly necessary to continue that elimination of waste; therefore, it seems agreed by all the operators that the waste that the Commission is authorized and charged with the duty to prevent did exist and will again exist without such an order; that the Commission, therefore, must under its statutory mandate to conserve the natural resources of this state enter such an order as will prevent that waste from reoccurring, but in doing so must enter such an order as does not violate the correlative rights and the property rights of the operators and the royalty owners in the field; that the accepted basis of doing that is the voidage formula, which has been used by this state and is being used by practically all of the other states that have oil and gas conservation, which has been recommended here by the vast majority of the operators and which has proved very satisfactory in eliminating waste that existed in this pool, and I think

that only such an order based upon both a limitation of oil and gas, based upon a voidage of the reservoir basis by that equal volume of oil and gas from each well can be entered by this Commission if they are to protect the correlative rights and the vested property rights of the various parties involved. Therefore, I urge upon you to either continue order 66-3, or a similar order amended as the Commission may desire.

COMMISSIONER BRETSCHNEIDER: Does anyone else wish to have anything to say now?

MR. SHAW: The only thing I want to add to that is that we want to emphasize, if the Commission please, that the voidage formula--in other words, we ask that a similar order be entered or this one be continued. We are talking about the restriction of 200 barrels per day per well or less, and the same gas-oil ratios now as are in the order.

COMMISSIONER BRETSCHNEIDER: I think we understand that. This is quite a complicated case, and I am sure everyone will appreciate that our engineering department and the rest of us will have to take the case under advisement and study it for awhile. I don't know how long we will have to study it, but I am sure we will go into it very thoroughly, and we will let you know in due time.

We will, therefore, close the Cliff case at this time, and we will now take up the next case in order.

(Whereupon the hearing in Cause No. 66, Cliff Field, adjourned at 4:00 o'clock p.m., January 24, 1956.)

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C E R T I F I C A T E

I, Keith Watson, do hereby certify that the foregoing pages, numbered 1 through 162, constitute a true, complete and correct transcript of my stenotype notes of the proceedings had in the foregoing matter, and that the same were thereafter reduced to typewriting under my direction.

To all of which I certify this 2nd day of February, A. D. 1956.

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