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BEFORE THE OIL AND GAS CONSERVATION COMMISSION

OF THE STATE OF COLORADO

THE PURE OIL COMPANY, AS UNIT OPERATOR OF THE ADENA "J" SAND UNIT AREA, APPLICATION FOR AMENDMENT OF FIELD RULES FOR THE "J" SAND, ADENA FIELD, ESTABLISHED IN ORDER NO. 26-27.	CAUSE NO. 26

PURSUANT TO NOTICE TO ALL PARTIES IN INTEREST, the above-entitled matter came duly on for hearing at the State Capitol, Room 243, Denver, Colorado, at the hour of 10:00 o'clock a.m., July 2, 1956.

BEFORE:

Mr. Warwick Downing, Chairman
Mr. H. C. Bretschneider, Commissioner
Mr. F. M. Van Tuyl, Commissioner
Mr. Prescott Eames, Commissioner

APPEARANCES:

Messrs. Ted Stockmar and W. T. Butler, Attorneys at law, for the Pure Oil Co.;
Frederic L. Kirgis, Esq., Denver, Colorado, for Petroleum Inc.;
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: I think Mr. Bretschneider will soon be here. In the meantime let's enter appearances. Will you enter appearances?

MR. KIRGIS: Same appearance for this next matter.

CHAIRMAN DOWNING: This is a hearing in case No. 26, Adena, the Pure Oil Company, as Unit Operator of the Adena J Sand Unit Area, application for amendment of field rules for the J sand, Adena Field, established in order No. 26-27.

MR. KIRGIS: Is Mr. Bretschneider coming?

CHAIRMAN DOWNING: Go ahead with your appearances.

MR. KIRGIS: Frederic L. Kirgis appearing on behalf of Petroleum Incorporated.

CHAIRMAN DOWNING: You are appearing for Petroleum Incorporated?

MR. KIRGIS: Yes.

MR. STOCKMAR: Ted Stockmar appearing for Pure Oil Company as unit operator and Mr. William T. Butler, counsel for Pure Oil Company, also is appearing.

CHAIRMAN DOWNING: Just the two of you appearing?

MR. STOCKMAR: Yes.

CHAIRMAN DOWNING: Is anyone else appearing in this matter? (No response.) Is there anyone else that wants to be heard? (No response.)

Pure Oil Company will start out. You are the proponent here?

MR. STOCKMAR: Yes, sir.

CHAIRMAN DOWNING: How long will you take?

MR. STOCKMAR: We expect that our direct testimony will take at least an hour, sir, possibly more.

CHAIRMAN DOWNING: An hour?

MR. STOCKMAR: Yes, sir.

CHAIRMAN DOWNING: How long will yours take?

MR. KIRGIS: We believe that ours will take an hour, perhaps a little more depending upon the cross examination.

CHAIRMAN DOWNING: We always like to finish at noon if we can. Do you want to swear your witnesses?

MR. STOCKMAR: Yes, I think we could swear witnesses. If Mr. Bretschneider is coming, I would certainly like to wait for him.

MR. KIRGIS: Do you want our witnesses sworn at the same time?

CHAIRMAN DOWNING: Yes.

(Messrs. Horner, Weyler and Kavaler were duly

sworn.)

(Discussion off the record.)

CHAIRMAN DOWNING: Mr. Bretschneider is here and you may now present your case. We want facts, but we don't want a lot of repetition. All right, proceed, Mr. Stockmar.

COMMISSIONER BRETSCHNEIDER: Before you proceed I would like to ask whether or not anyone objects to the new rule we have which permits the Commission to hold a hearing with one or two, or less than a quorum of commissioners? Is that the reason you couldn't proceed?

CHAIRMAN DOWNING: Well, it has always been our policy if we could to have a quorum on important matters.

MR. KIRGIS: Mr. Chairman, we certainly prefer to have a quorum here for the purposes of this hearing.

COMMISSIONER BRETSCHNEIDER: You would prefer a quorum?

MR. STOCKMAR: Yes, sir.

COMMISSIONER BRETSCHNEIDER: I just wanted to ask the question because we tried it out and it went along all right, and I wanted to know if anybody objected to it to see if the rule is any good or not.

CHAIRMAN DOWNING: Proceed.

MR. STOCKMAR: Mr. Bretschneider, in awaiting your arrival---

CHAIRMAN DOWNING: Tell us what it is about.

MR. STOCKMAR: ---we have sworn in the witnesses and done some of the preliminary matters already.

COMMISSIONER BRETSCHNEIDER: All right.

MR. STOCKMAR: Gentlemen, as I stated, I am here in behalf of the Pure Oil Company as unit operator representing all but one of the eighty-some working interest owners in the Adena Field. We are here today to seek a revision of Rule 4 of your existing order 26-27, which you will recall was promulgated simultaneously with the order adopting and approving the "J" sand unit area.

You will also recall that at the unit hearing we agreed to the present Rule 4 only tentatively and voiced our objection for the record to the long term continuity of that rule. We are here today to propose a substitute rule which we believe to be much sounder and to accomplish the two important things of waste prevention and protection of correlative rights.

It has been obvious throughout this entire proceeding---

CHAIRMAN DOWNING: First may I ask what change in the present rule, what change do you want?

MR. STOCKMAR: I will come to that, sir. It has been obvious throughout this entire proceeding that the ultimate benefit to the state and the operators could be achieved only under complete unitization.

FFor that reason on June 29th we again extended to Petroleum Incorporated an invitation to join the unit. We are expecting to proceed with water flooding on some basis in the near future. To make it attractive to Petroleum Inc. we offered them a participating percentage which was the equivalent of all that we might hope to gain by unit-wide water flooding as against partial unitized water flooding.

Now, that offer, that invitation, has not been accepted and we must now for the record withdraw it on the terms made. We again extend, however, the invitation at any time for Petroleum Inc. to apply in accordance with the unit agreement and seek admission.

The existing Rule 4 provides for a limitation on production of 125 barrels per day or 150,000 cubic feet of gas, whichever is produced first. It also provides for a rather restricted method of allocating or transferring the allowables to the more efficient wells.

These rules were a carryover from the rules

which existed prior to unitization and the change in the mode of operation and the general fact situation of the field is such that these rules are becoming increasingly less applicable to the type of operation which we have.

The rules which we are proposing require the calculation in great detail, which we have done, of the oil and gas, the hydrocarbons originally in place in the reservoir. We seek a limitation on the production on a field-wide basis. We seek a division and an allocation of the daily production of oil and gas in relationship to the original gas and oil in place in the reservoir. You may hear as a rebuttal to our proposal that this is a unique and new type of order. We, however, feel that you have a unique opportunity here and that this particular field has had a unique history. From the earliest stages of development here there was complete cooperation on the part of all of the interested parties in moving toward unitization and unit operations. The oil and gas in place calculations were mutual efforts. We do not deny the right of the others to now attack them, but from the beginning this field has been developed and operated in a constant movement toward a division on the basis of oil and gas in place.

You may also hear the charge that the rules are extremely complicated and difficult to administer. We will admit that the calculations and determinations that go into the rule are difficult and we have worked on them for six months--if not for two years--but, the rule itself is as simple or simpler than the existing rules.

The rules which we have to offer and the testimony which you will hear is entirely consistent with the approach and the testimony that we used at the unit hearing. We again will bring back the same two witnesses that spoke then and incorporate a substantial amount of their prior testimony in this matter without unnecessary duplication. I would like to make one point clear with respect to the two witnesses. In the enormous amount of work that has been done it has been necessary over the past several years to divide that work, and I will limit the direct testimony of each of the witnesses to particular phases, and I would like also to limit the cross examination of those witnesses to the work which they have done.

Now, without more I would like to call Mr. W. L. Horner as our first witness.

CHAIRMAN DOWNING: You haven't a copy of the

proposal?

MR. STOCKMAR: The copy of the proposed rule was submitted to you gentlemen as a supplement to our application and each of you should have a copy. Do each of you gentlemen have a copy of our proposed application with the rules?

CHAIRMAN DOWNING: I don't seem to have it. Well now, do you want to make a statement?

MR. KIRGIS: Mr. Chairman, I would like to inquire whether it is the pleasure of the Commission that I make an opening statement or whether you prefer that I reserve it until the time for our case to be presented.

CHAIRMAN DOWNING: I think we would like to hear from you now so we will know the issues.

MR. KIRGIS: As has been stated by Mr. Stockmar the present order provides for 125 barrels per well limitation, and a limitation of 150,000 cubic feet of gas per well. Presumably in a given day the well would have to be shut in when it reaches either of those limitations. Basically it is the same type of order not only as existed in Adena prior to unitization, but it is also basically, I think, the same type of order which has been commonly accepted and applied by the

Commission in the entire Denver-Julesburg Basin.

Actually, under the formula which is now proposed, which is based on original oil in place, as I understand it, and results in a formula which must be applied by calculation to determine the amount of production which may be allowed to any given well or any given operator, though the application itself does not put pencil to it and turn up with a figure, if my mathematics are right, and I believe they are, at least I have checked them, in this instance adoption of the proposed rule would result in reducing Petroleum Incorporated's percentage of total field production from a current approximately 15% down to 7.2%. In other words, under the rule which exists today Petroleum Inc. is permitted to receive a little over twice the amount of production which it could receive under the proposed rule.

Now, that to Petroleum Incorporated is obviously an important thing according to our calculations, and the testimony, of course, will go into these matters. We are talking of something in excess of a thousand barrels a day of Petroleum Incorporated's production, which under this order would be removed from Petroleum Incorporated and given to the unit; and

in that connection it is our position that the problem which you have here is merely the problem of a two-lease field. In other words, the unit, despite the fact that it has so many working interest owners admitted to it and so and so many royalty owners admitted to it, is for purposes of operation of its pool merely one lease, and the non-unitized tracts all under a common operating arrangement are a second lease, so that actually our practical problem here is just as simple as I stated it, that it amounts to taking a little over 1,000 barrels of production from one lease and transferring it to another.

As we see it, the problem of this Commission is to determine whether waste exists, and if one of these systems results in waste, then I take it that the Commission has the authority and the responsibility to deny that particular system or that particular order, and it will be for this Commission to determine whether that order which must be denied is the one which is now proposed or, on the other hand, the one which is currently in force and effect, and which the unit operator wants to displace.

Now, as I see it, Pure has as unit operator--I speak of Pure and I do it in its collective capacity as unit operator--Pure has, as I see it, the duty of

proving that the present order does not prevent waste. Perhaps it has even the duty of proving that the present order does create waste in order to justify the adoption of a new order. I think also that they must have a duty to prove that the present order affirmatively does not protect correlative rights, if there be waste.

We believe that they cannot prove that the present order creates waste. We believe they cannot prove that their proposed order would be effective in preventing any waste. We just don't think there is waste, and we certainly don't think that the proposed order would tend to cure any waste which may exist under the existing order.

This, as the testimony will show, is basically--at least our testimony will show--that it is basically a reservoir operated through a gas cap mechanism. That is important in the analysis of the operation of the pool and the effect on the pool of the two orders under consideration, the current order and the proposed order. In effect, the proposed order will limit the production of oil from certain properties which we may generally speak of as edge properties, down structure properties, in any event. They will do that by transferring an oil allowable to, generally speaking, properties that are up

structure properties.

We believe the testimony then will show that from a technical standpoint that is exactly the wrong thing to do in a field where you have a gas cap mechanism if your own objective is--as this Commission's is, of course--to secure the greatest ultimate recovery and to prevent waste. We believe that Pure will not be able to meet these various requirements. We want to emphasize that the order which is proposed by Pure is contrary to all former orders of this Commission not only in this field but anyone in the Denver-Julesburg Basin.

We wish to point out that it is unique; so far as we know, even outside the State of Colorado we don't think an order of this type has ever been entered anywhere, and we also want to point out that various proposals which have been made in connection with negotiations for the unitization and so on have never been so stringent as to insist upon one factor only for determining participation in production, that one factor, as in this instance, being original oil in place, without reference whatsoever to position on structure or capability to produce of any given well or property, and our case will be directed toward these points.

MR. STOCKMAR: Do each of you gentlemen have

a copy of our proposed application? I do have some extra copies here. A considerable amount of work has been done, engineering work, since the submission of this proposal. It has been in your hands for approximately a month as well as in the hands of Petroleum Inc. I would like now to call your attention before we proceed with Mr. Horner to Rule 4 appearing on page 3 of the proposed order. This is the rule which permits the transfer of allowables between wells within any of the tracts. The additional work which we have done since submitting this now compels us to withdraw the proviso which appears as the latter part of the proposed Rule 4. It places a restriction on the transferability; as our witnesses will show, it may prevent the proper operation of the unit tract and the most efficient gas-oil ratioes.

Beginning on the fifth line with the word "provided" we are now deleting the remainder of that paragraph from our proposal.

COMMISSIONER BRETSCHNEIDER: The fifth line of the old rule?

MR. STOCKMAR: The fifth line of the proposed rule.

COMMISSIONER BRETSCHNEIDER: You are doing

what now?

MR. STOCKMAR: Deleting from "provided" to the end of the rule. Gentlemen, we have put some of our exhibits into book form for your convenience here and we will introduce them as they come along.

Mr. Horner, our first witness has appeared before you. I would like to call him and have him qualified, or his qualifications accepted, whichever is suitable here.

MR. KIRGIS: There is no need to qualify the witness as far as Petroleum Incorporated is concerned.

MR. STOCKMAR: Before asking Mr. Horner for any testimony I would like to introduce Exhibits 1, 2 and 3. Exhibit 1 is the Core Laboratories Incorporated report of October 8th 1954. Exhibit 2 is the large connate water curve which we have mounted on the left on the board (indicating). Exhibit 3 is the solution gas-oil ratio curve. These are respectively Exhibits 1, 2 and 3 that were submitted at the unit hearing, and we have in effect brought them back for your convenience and for use by Mr. Horner.

MR. KIRGIS: I am sorry to interrupt, but I think we can just concede the admissibility of those if I ask this question: They are the same exhibits which

were introduced at the unitization hearings, is that correct?

MR. STOCKMAR: Yes.

MR. KIRGIS: Without alteration in any way?

MR. STOCKMAR: I note that the Exhibit No. 3 has been updated.

MR. KIRGIS: If it is the same one there is no objection.

MR. STOCKMAR: Excuse me; it is dated. Those are the same exhibits.

MR. KIRGIS: There is no objection.

WILLIAM L. HORNER

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

DIRECT EXAMINATION

BY MR. STOCKMAR:

Q Mr. Horner, will you please make a general statement with respect to the nature of the reservoir which we are talking of here today?

CHAIRMAN DOWNING: I think the witness ought to come up here.

MR. STOCKMAR: Pardon me.

A Gentlemen, if you will refer to the map that

you may have of the field, we can describe the field very briefly with respect to the rules applied for. You should note that the Adena "J" sand pool is of a general shape oval north and south and the oil and gas is confined by the pinching out of the sand in all directions around the field with the exception that water is found underlying the oil on the northwest.

The entire eastern one-third of the pool is flanked by gas. The entire oil and gas pool is featured by a gentle tilt of the top of the sand from the east down to the west at a slope of forty feet per mile. That's about a quarter of an inch per yard gentle slope.

Under the original method of production the body of gas lying to the east of the oil in contact with the oil would have been produced without driving much of the oil; however, under unit operation we have an opportunity for the best use of each well to attempt to obtain ten million barrels more oil than could have been produced without a unit operation.

The original gas area would be utilized to drive as much oil as possible to wells that are selected and periodically re-selected and sometimes reworked, all of it controlled on an ideal engineering basis.

Q Mr. Horner, in our proposal we have asked for a limitation on oil production of not in excess of 15,000 barrels per day. What are the considerations that are proper for the Commission to make in arriving at and justifying such a limitation?

A Well, first you should consider I believe the upper limit of a pool rate. The upper limit ought to be so that no gas is unnecessarily flared. This field is produced as an oil pool and therefore the most practical way to regulate and control gas waste is through an oil allowable for the entire pool.

Now, also, you should consider a lower limit, and the lower limit should, of course, be sufficiently high so that each operator should have an opportunity to pay his operating costs and a reasonable return of investment and profit.

Now, the engineer's job is to help pinpoint where in between that upper and lower limit the MER should be set. This field is suited for an MER determination. The amount of oil from this pool is influenced by the amount of allowable set. Moderate oil producing rates favor the opportunity to obtain as much as possible of this ten million barrels of oil. At present this opportunity would be hurt by high or excessive producing

rates. At lower rates you could have a more even sweep and more efficient drainage in the area swept. At higher rates the pockets developed as they are now of low pressure that will become more gassy and interfere with the efficient sweep. This unit was formed for the purpose of promoting conditions to obtain displacement of oil by an efficient sweep of either gas or water. Reasonable limitations as to the producing rate are implied by adopting such a plan of operation as we have.

Q Mr. Horner, those are general considerations. Have you been able to make any engineering calculations to pinpoint the MER or the range of the limit on production of oil?

A We have tried to determine an exact MER. We feel that sufficient performance data are not available at this time. We made material balance calculations based on presently available data, found no water drive; therefore, with no water drive you couldn't allocate the production for the field as a whole on the basis of the water drive, like they do in East Texas.

The influence of gravity is likewise difficult to evaluate. The problem is complex, but these trends and factors are evidenced in field performance. We feel that the performance in the last six months shows

serious defects in the rules. Under new rules observation should be made of the performance of the pool to see whether any rate that we select as a result of this hearing is the proper rate. We feel that is probably the proper way to determine the real MER for this field.

Now, to be more specific, we can say that we have gone a little further. The field is featured by severe hampering towards its objective of providing a good frontal drive, and that is, it is hampered by the fact that there are nineteen non-unitized wells and there are twenty-two direct offset wells that are not available at this time, a total of forty-one wells not available for maximum and best engineering use.

Some of those forty-one wells are required to produce more oil than they should, and some of them are required to produce less oil than they should if the entire pool was operated on this ideal basis.

We would suggest that the twenty-two offset wells to the non-unit wells, those twenty-two wells belonging to the unit, should be given an opportunity to produce their engineering best without transfer limitations. The Commission can evaluate the effect of the new rules if there is any hardship or difficulties that are developed.

Q Mr. Horner, since you cannot compute an exact MER, what from your review of the field performance can you state ought to be the range or the area within which we establish the field limitation on oil?

A Well, something like this is happening in this field (marking on board). There is waste that increases as the gas-oil ratio goes up, whereas as the rate of production goes up (indicating)--and it appears from the observations that I have made that someplace in here (indicating) around 15,000, maybe as low as 12,000, in that range the curve starts to break up and waste begins to increase.

Now, that MER would--or this point of waste would change. Obviously if you delay any action towards adopting proper field rules another six months, then this curve would probably assume a different shape and the waste would begin to break off more sharply at a lower rate. At present the indications are that a lower rate than the present rate would be better than the present rate, which is something around 15,000.

Q What is your specific recommendation with respect to the limit on oil production on a pool or field-wide basis, Mr. Horner?

A Well, it would depend on the rules that are

adopted really. Under the present rules I should think it would be well under 12,000 barrels per day to be on the safe side to prevent waste. Under the proposed rules with unlimited transfers I think that the 15,000 rate could be reasonably attempted.

Q Are these figures justified by the work which you did many months ago with respect to Exhibit 1?

A Yes, in Exhibit 1, that's the big blue report, we made some calculations there that show what would happen to the field without any unit or without any new rules, the same rules that were in effect in the latter part of '54. Under those rules the pressure was dropping rapidly and would continue to drop. In another curve in that same report we showed how we would calculate the unit to perform if we had an entire fieldwide unit operated on a completely scientific basis, and there would be less pressure decline and more recovery of oil per pound drop.

Observing the behavior in the last six months, it looks like the field is producing someplace in between what would happen if you had no restrictions, no unit formed--strike that "restrictions"--no unit formed, and only part way toward what the field would be producing if you had had a complete fieldwide unit. In other

words, you are getting about half the benefit of a field-wide unit, or a fraction of it.

Specifically we notice that, for instance, as pressure decline is one of the measurements that you can look upon as a measure of efficiency, from that standpoint pressures fell about forty-two pounds so far this year, which is about 61,000 barrels per pound drop. If you had an ideal unit and it started on unit operation at the first of 1955 you would be getting about 100,000 barrels per pound drop. Without a unit at all under the old rules you would be getting about a 51,000 barrels per pound drop, so you have got a gain here of something like twenty percent toward an ideal unit operation. It might be a little more than that because you should take into account that the field has declined since those calculations were made. In fact, there has been eighteen months of production since the date of that forecast, and that forecast then should be reduced downward. We think that downward reduction to the order of 15,000 barrels of oil per day is just about the maximum, and that careful study of the report will reveal that to be a reasonable upper limit under the best rules that can be devised at this time.

MR. JERSIN: Mr. Horner, will you repeat what

the 50,000 barrels per pound drop was?

A Yes, sir. 51,000 barrels per pound was about what was forecast in the absence of a unit using rules that were in existence in the last half of '54, whereas actually in the last six months 61,000 barrels were produced per pound drop and under an ideal unit more likely around 100,000 barrels.

MR. FREEMAN: 61,000 is under the present rules for the unit?

A Yes, sir, that is an approximate observation.

Q (By Mr. Stockmar) Now, Mr. Horner, we will leave to Mr. Weyler testimony with respect to contemplated water injection, but if water injection is accomplished in the field, do you see in that any additional reason for presently limiting the oil production from the field?

A Why, certainly; this unit was formed ultimately for water injection. All the operators had that in mind and have had it in mind for a year and a half, in fact for two years, and there is no need to hide from that fact in considering regulations for this field. An opportunity to obtain another seventeen million barrels on top of that ten million opportunity that is slipping by, that seventeen million barrel opportunity will also

slip by if something isn't done to prevent dissipation of the field conditions.

Q Mr. Horner, at the hearing on unitization you testified with respect to the suitability of this particular reservoir for water injection. Without going into detailed testimony, can you still confirm the testimony which you gave at that time?

A Yes, in spite of the continued decline in pressure this reservoir remains highly suitable for increased recovery by water injection. The damage has not been very severe. It is occurring daily. Actually there is 6,700 barrels lost to the water flood operation for every pound of pressure drop in the field.

Q Do you mean an irrecoverable loss of 6,700 barrels per day per pound pressure drop?

A Yes, about that, just due to the shrinkage factor alone. There are other factors that can be considered, but that is enough to provide incentive for all haste and good caution.

Q And it seems important to slow down the rate of pressure decline in the field, does it not, sir?

A Yes, sir.

Q How can that best be accomplished, or let me reframe that. Will the proposed limitation on oil production

aid in accomplishing that?

A Yes, it would. It would tend to reduce the amount of pressure decline and reduce the amount of shrinkage and non-recoverable loss that would occur prior to the time water injection started.

Q This is hypothetical to some extent when we talk about water injection, Mr. Horner, but I gather that you can recommend a limitation on production even though the field is operated only as a gas cap drive?

A Oh, yes, without considering the water injection, the field is being operated as a gas cap drive and is sensitive to high rate of production.

Q Although we planned to have Mr. Weyler explain the derivation of the gas allowable limitation which we have sought here, Mr. Horner, I would like to have you justify the existence of some express limit on the amount of gas that can be produced from the field.

A Well, the unit proposes and proposed in December before the Commission as a part of its plan of operation to use the gas sector--that's this eastern third of the field--to drive more oil out of the reservoir. That gas sector can be just as effective as if a tremendous amount of gas would be injected. We are talking about some forty billion cubic feet of gas originally occupying

that gas sector. The unit proposes to conserve that gas and to not produce its high ratio wells that are underlain by oil.

Now, the unit agreement awards production to these gas-producing tracts; that is, the oil that the unit is awarded to produce, they give and turn part of that to owners of gas-producing tracts. The right to produce equitable shares of that oil should be extended to those gas sector gas owners, the owners of gas in the gas cap, because they have really contributed to conservation by joining the unit. Mr. Weyler will develop the mechanism by which the gas allowable proposed would tend to protect the correlative rights and assist in dividing the gas and oil among the owners of the entire reservoir.

Q You are saying, Mr. Horner, that the owners of the gas cap as such unitized or non-unitized, have a right to produce gas, is that correct?

A Yes, sir.

Q And if they choose to first move oil with their gas and then produce it through oil wells, that is also their right but they should be given due credit for it, is that your testimony?

A Yes, sir; actually---

Q Does the proposed, the rules which we are proposing accomplish that?

A Well, to an important extent. They don't give as much credit to the gas cap owner, however, as the unit is required to pay under its contract with the gas cap owner.

Q Is there any other advantage in establishing a separate gas allowable for the field?

A Well, by ordering a separate gas allowable the Commission can regulate gas production separately, possibly police the field to the extent that they could reduce the total gas allowable if it becomes necessary at any time to prevent possible waste. With a separate allocation of gas, as has been proposed in these rules, gas allowable could be altered without disturbing the oil allowable.

Q Is the imposition of a gas allowable also valuable in allocating oil and gas to the various tracts?

A Yes, it provides a means to properly allocate to each unit or tract on a uniform basis so as to control excessive gas production from local spots in the field where excessive production of gas might be done in an effort to obtain drainage of more oil without regard to

gas waste, or without regard to uniform gas drainage. In other words, the gas allowable would serve on a lease, by lease by tract or unit, by a unit basis, so to serve as an added precaution to prevent waste.

Q Then, summing up your testimony with respect to allowables, do you recommend a pool oil allowable in the range of 12,000 to 15,000 barrels per day and you recommend that some gas allowable be separately imposed with respect to gas production from the field?

A Yes, sir.

Q Now, Mr. Horner, at the hearing on unitization you testified at some length with respect to three of the factors which the engineers must have to determine hydrocarbons in place. The first of those was the question of the limiting permeability. Without repeating all of your testimony, will you summarize your opinions with respect to the proper limiting permeability to be applied?

A Yes. Throughstudy of all of the information on this field, which was exceptionally complete, some 3,400 samples of rock were examined, it was determined that rock with permeability of 2.5 millidarcies or less could be classified as non-pay material. That's one of the points that was stressed at the December hearing.

Q That any particular section of rock with a permeability of 2.5 millidarcies or less was in your thinking not considered as pay sand?

A Yes, sir.

Q You also testified with respect to the gas-oil contact or the plane which exists or did exist originally between the gas cap and the oil zone. Will you refresh our memory as to what that was?

A Yes. A study of the fourteen wells that penetrated the gas-oil contact found it at quite a uniform plane. Other determinations made in the field confirmed that, so that there was no question about a gas-oil contact being at 1063 feet subsea. We understand that the engineering committee adopted that figure in its calculations after considerable additional study.

Q Mr. Horner, you also testified with respect to the percentage of connate or formation water which might be found at any particular section of sand and its relationship to its height above the water table. Will you briefly bring us up-to-date on that again?

A Yes. Now, this rock that has permeability of more than 2.6 millidarcies and which lies between the gas-oil contact and the water table, is the rock that contains the oil; but, it also contains water, and

to determine how much water it contains a chart of this kind (indicating), customary in the industry, was constructed.

Q You are referring to Exhibit 2?

A Exhibit 2 was constructed. This shows that for a rock at a given permeability and a given position above the water table the percentage of the pore space occupied by water could be estimated with reasonable accuracy. That was done, I understand, by the Engineering Committee in its work of determining oil in place throughout the field.

Q In determining hydrocarbons in place you must first find the rock that you are talking about, then find how much space there is for fluid, and then determine how much of that fluid is oil and how much is water?

A Yes.

Q That is the reason for your preparation of these curves?

A Yes, sir.

MR. STOCKMAR: Now, gentlemen, that concludes Mr. Horner's testimony. We offer him for questioning by the Commission or cross examination, and in deference to Mr. Kirgis' reservation of six months ago, Mr. Horner is also available for cross examination on these matters

which he discussed at that time.

CROSS EXAMINATION

BY MR. KIRGIS:

Q Mr. Horner, am I correct in my understanding that in your preparation of this proposed order you worked on a basis of a field allowable as distinguished from individual well allowables?

A Yes, sir.

Q Did you take into account in the development of the formula which is included in your proposal, did you make any study of the results of your proposal from the standpoint of individual well allowables?

A Yes, I took that into account.

Q In what way?

A We viewed that necessarily with high allowables for the field as a whole, production of wells not suited for high production would be required in order to prevent drainage or to reduce drainage to a minimum, so there would be a tendency with a high allowable to overproduce single individual wells. That was taken into account, for one thing.

Q Did you make a study of the effect on that situation of the 125 barrel allowable under the now existing order?

A Yes. With respect to that order there are some wells not capable of producing the 125 barrels allowable efficiently.

Q Under the proposed order is there any fixed limitation upon the production from one of these inefficient wells to which you refer?

A I don't think so.

Q In other words, the situation is the same under the proposed order or the existing order in that regard, is that right?

A Not exactly, but almost. You might say that there is another feature of the proposed rules, and that is that transfers of allowables on any tract or unit would be permitted to the more efficient wells with less restraint than under the existing rules so that wells that are capable of producing efficiently at higher rates would be permitted to do so, but now a large number of them are restricted and not permitted to produce at the more efficient rate that they could produce at.

Q A rate in excess of the present 125 barrel limitation, is that right?

A Oh, yes, sir, there are many wells capable of producing efficiently in excess of the 125 barrels per day.

Q Now, the order which you have proposed--I say "you have proposed," I presume that you are a part of the group which has studied and proposed this order--the order which you have proposed would leave it entirely to the operators, would it not, to determine what wells should be produced at, let us say, in excess of 125 barrels, and what wells should be produced at something less than that?

A I think they would have the initiative, yes, sir, but not the control since it is my understanding that these proposed rules would be administered by the Commission and I have recommended that if it is possible, that these rules, that the effect of these rules on the performance of the pool and its individual wells should be a continuing matter under the jurisdiction of the Commission and a responsibility of the operators.

Q Is there anything in this proposed rule which gives to it, or reserves to the Commission the authority to control the rate of production from individual wells?

A I think it is implied, but I don't know of any specific determination; under the police power it has that power.

Q In other words, you are saying that this proposed rule could be implemented by the Commission at

its own initiative by controlling individual wells even though the order itself gives it complete discretion to transfer allowables to the operator any place he wants to?

A I think both the operators and the Commission would jointly bear the responsibility of any rules promulgated.

Q Is it at least the substance of your testimony here at this point that in whatever manner it might come about, no matter how a rule might be written, that under this type of formula the Commission would have to exercise a power to control variant production rates in each individual well in the field?

A I didn't understand that.

Q Let me restate it; it was somewhat complex.

A Please, sir.

Q Is it your testimony then that under a rule of the type proposed it would be necessary for the Commission to reserve the authority and to exercise the authority to control variant rates of production for each individual well in this field?

A I think that was more or less implied, but it would be not recommended that individual well production be controlled as a part of the proposed rules.

Q But someone would have to control it, is that right?

A Yes.

Q Did you not say a moment ago that the Commission would have to retain the authority to supervise and police that control?

A I think they would have that, should have that in this way: the responsibility would be that of the Commission and the operators with the initiative of either to be utilized, but the selection of the wells and the amount to be produced from each one should be the responsibility under the initiative of the operators.

Q In the first instance?

A In the first instance.

Q But suppose that one operator, let us say, Petroleum Inc., did not believe that a well which offset it on unit property was being produced at what you term the efficient rate; would it then not be the function of this Commission every time Petroleum Inc. thought that to determine whether that particular well was being produced in relationship to this entire pool at its most efficient rate?

A I should think the Commission should have that power at any time, and if either party would bring it to

the attention of the Commission action should be forthcoming.

Q And that would be contemplated then under the type of formula which you propose in this present hearing, is that right?

A Oh, certainly, that power should be there at all times.

Q I am not sure that I followed completely your theory--and I, of course, am not an engineer, and therefore I am apt to not follow many of these theories--as to water drive and gas drive. Am I right that you stated that there is currently no appreciable water drive in the field?

A Water is appearing in some wells, I understand, in an increasing amount. As to being a dominant factor of importance in setting an MER, calculations that were made under my direction and control did not reveal that to be the case.

Q And I believe you stated then that in determining an efficient MER you could not take into account water drive as a present factor, isn't that right, sir?

A Not as a factor in setting a rate of production equal to the amount of an injection, for instance.

Q Yes. Now, I am not sure what you said about

gas drive, but I believe you said---and if you did not please correct me---that there is a gas drive which could be evaluated, is that right?

A Yes, sir.

Q Can you tell us how that has been evaluated in this proposed formula?

A Well, it really hasn't been evaluated very accurately at this time by myself; I don't know that anybody else has.

Q But it is an important factor in determining efficient operation of this pool, is it not?

A Yes, a precise engineering evaluation hasn't been made to my knowledge, but recognizing it as a factor and knowing how those factors operate, it is certain that excessive rates of production to the field as a whole would be detrimental toward the chances of obtaining any of this ten million barrels of oil recoverable by the gas movement.

Q Now, you have said that an excessive rate would be harmful and I presume that as a generality that could be applied to any field quite aside from Adena. Can you determine accurately what is an excessive rate for one field--that might be one figure--and for another field it might be another figure?

A Oh, yes, sir.

Q Can you determine what is an excessive rate for this field if you have not evaluated the gas drive?

A Yes, I think so; you can name what relatively excessive would be. Certainly the upper limits should not be above the rate at which you can handle efficiently the gas without waste.

Q Well now, what does that mean?

A Well, you shouldn't trouble to calculate the effect of a rate above that rate which would cause waste of gas.

Q But, can you determine what causes a waste of gas without having evaluated the gas drive in this field?

A Well, it is, as I said, somewhat complex, Mr. Kirgis, and you can only make an approximation, and we have made no attempt at a definite specific engineering valuation of it. We did make an attempt in 1954 based on the then available voluminous geological and engineering data, more or less of a scower nature measurement was made of permeability and porosity and the size of the field, but sufficient observations of performance were not available then and in my opinion are not really available now to make a thorough determination.

Q Well then, isn't it true and doesn't it necessarily

follow from what you have said that your determination that 15,000 barrels for this field is a proper amount is not based upon an examination of all data which might appropriately be examined with the available, that it is instead based upon certain estimates instead of scientific fact?

A Both estimates based on judgment that I have attempted to exercise, and scientific fact revealed in the Exhibit 1 report where when we had all of the data before pool performance and it really began to unfold, forecasts were made to show that with production from the field opportunity to maintain a high rate of production would diminish and that lower rates would have to be the most efficient rates as the field began to produce. In other words, by starting earlier in the life of the field you can peel off the decline curve of the rate of all production at a higher rate, and if you start down lower you would have to peel off the MER rate at a lower rate sucessively. We could have had maybe 1,500 barrels a day more production from the field a year ago with the same amount of waste than we can have now, and a month from now the MER should be lowered again, possibly.

Q Now, that is a matter of principle rather than

a matter of determining an actual MER, is it not?

A No, sir; this is pretty well determined here and then it is a matter of extrapolation, interpolation, to estimate how you could peel it off. That is just one of the criteria that you should consider, I should think.

Q Isn't the gas drive one of the factors to be taken into account in determining these things?

A Oh, yes.

Q And yet you do not have and have not calculated the gas drive, if I understood you correctly?

A That's right; we did not make a complete determination. We made a determination based partly upon the thorough studies made a year and a half ago and the knowledge of existing conditions in this field at this time.

Q Do you have a basis for determining whether water injection actually would be a more efficient method of recovery here than gas drive?

A Yes.

Q On what basis?

A Well, we wrote quite a book there about it.

Q I don't want that. What I am getting at is this: Can you make that determination without having

an evaluation of the gas drive which has not been made?

A It might be related to it. We haven't faced that question yet, but waste of the gas cap at this time, of course, or waste of the reservoir pressure would certainly affect the MER on a water drive basis just like it affects the MER on the gas drive basis.

Q Now, I---

COMMISSIONER BRETSCHNEIDER: Now, may I ask a question, Mr. Kirgis?

MR. KIRGIS: Yes.

COMMISSIONER BRETSCHNEIDER: What do you mean by evaluation of gas drive?

MR. KIRGIS: To determine what its basis will be for purposes of recovery of oil. Has the witness been understanding me in that same sense?

A I think so, Mr. Kirgis.

Q As my notes go chronologically here in relation to your testimony, it was shortly after your discussion of this point that you mentioned the removal of the proviso in originally proposed Rule 4 and stated that there were twenty-two--if I understood you correctly--offset wells--meaning offset wells on the unit but offsetting Petroleum Incorporated property--which should be free to produce at whatever their efficient rate might

be. Did I understand you correctly?

A Yes, sir.

Q Are those then what you would deem to be your more efficient wells, those offsets?

A Some of them are more efficient; I examined a list of them and as I recall some of them are above average in efficiency and so are probably less, just as they are on both sides of the unit line.

Q You think there is no generalization that those wells offsetting the Petroleum Incorporated properties may generally be more efficient than wells in the balance of the unit?

A They may be a little more or less, but I suppose they are typical oil wells for that general portion of the field in which they are found.

Q Well, that portion of the field, is that the more efficient portion?

A Well, it varies; there are two general groups of Petroleum--what's the name of the company?

Q Petroleum Incorporated.

A Petroleum Incorporated; Pet Inc. is better.

Q Commonly called Pet Inc.

A May I use that?

Q Surely.

A There are two general groups, one the group in the north, as I recall, and one group near the south, and they have widely different characteristics and the Pet Inc. wells, like the rest of the field, have quite a range of productivities and efficiencies and perhaps they are no better or no worse than the average. I don't think that had anything to do with my recommendation as to these transfers.

Q Do you think that it is in promotion of the proper and the conservation-wise practice of production in this field to allow a line fight between different leases to see who can produce the most?

A No, it just wouldn't be fair.

Q Well, doesn't the elimination of the proviso in originally proposed Rule 4 create just that situation?

A I don't know who would win the fight.

Q I don't either, but irrespective of who wins, wouldn't the elimination of that proviso create a line fight on production?

A It might be that inclusion of that would promote a line fight, inclusion of that restriction would tend to promote a line fight.

Q In what way would that happen?

A That it certainly could be in recognition of that possibility and removal of it means that the operators would take the initiative in good faith to do the best they can for promotion of efficiency.

Q The proviso, as I understand it, limits the production that would be had from a direct offset well, does it not?

A Yes.

Q Are you saying that the removal of a limitation on that would promote or discourage a line fight?

A I don't know what it would do to a line fight. I think it would look a lot better to have it off. I don't see that it does much good if there is anybody talking about a drainage fight. I see no evidence of it in my perusal of all the data in the field, and yet I think the Commission and Pet Inc. could agree that under the existing rules that the unit would be in a very powerful and advantageous position if it chose to exercise its strength to do more than an ordinary line fight could do, and so far it hasn't done anything like that.

Q There is a limitation of 125 barrels per well currently, is there not?

A That's just on the offset well.

Q Under the current rule? We may disagree on that.

A Under the current rules there is a limitation of 125.

Q I don't believe it is only on the offset wells, but irrespective if that is the present rule, that is a protection against a line fight, so you cannot look, can you, to past history to determine whether there will be one in the future when there is no such limitation?

A No, I suppose not; we have, therefore, the continuing jurisdiction of the Commission on that matter and we have the fact that the unit, and I am sure Pet Inc. are in this field to get the most efficient operation out of it. Certainly the unit is, and I---

Q Let me state a hypothetical situation.

A A line fight might deviate then from any high aims that they certainly have evidenced.

Q Suppose that either the unit or Pet Inc.--it could be either one of them--would start producing 200 barrels out of one of these offset wells. If you were advising the other party wouldn't you certainly advise

him to increase his production in the offset well, the 200 barrels at least?

A Not necessarily, no, sir.

Q Why not?

A You might do more damage if you want to really damage your opponent by getting back three locations and hitting them with a well that would do something else to him.

Q But you would at least see that your client set up a counterdrainage someplace where you thought it would do the most good, would you not?

A Oh, not necessarily. You see, the drainage to the Pet Inc. lease currently they are draining oil from adjacent leases in my opinion from viewing the exhibits that Mr. Weyler showed me. Now, if those leases would be operated in such a fashion as to contain more water or more gas than they do oil at present, then the drainage to Pet Inc. would be the undesirable fluids of water or gas, and that might be more effective than retarding the oil flow. So there are many alternatives.

Q Well, Mr. Horner, can't we agree on that, that any order which leaves the situation open for the parties on either side of a common boundary line to produce as they see fit on either side of that common boundary line

is going to be controlled probably by economic considerations and not by conservation considerations and considerations of the proper way to operate this pool?

A Leaving that limitation of 125 barrels to offset wells in would be more or less accusing people of that before they actually do it.

Q I am not worried about accusations. Can you answer my question?

A It is such an involved way that I must answer it; I can see no reason why that should be--why there should be any limitation on the offset wells. I can see many conservation reasons why there should be no limitation.

Q Do you--- Still, Mr. Horner, I think you have not addressed yourself to my question, which is; whether or not--let us shorten it by saying the possibility of a line fight creates a situation in which a wasteful production may result?

A I had difficulty conceiving of a line fight in the first place, and I don't---

Q Will you assume my facts and answer my question?

A The answer to your question is probably "no," if it has to be yes or no, I suppose. I am an engineer

and I see no advantage to be gained by a line fight. There are other ways to fight without fighting on a line, and the paramount interest, of course, of the unit is not questioned at all, is it? It is conservation.

Q You are asking me a question and I don't understand it, so I shan't try to answer it.

A Well, if I have answered your question improperly.

Q Your answer is "no," that a line fight or the possibility of a line fight would not affect the conservational development of this pool, is that right?

A Of this pool, yes, sir; we are talking about this one pool right here?

Q Yes, sir, we are talking only about this pool.

A Now, this is a special case.

Q And your reason for your answer is that you as an engineer would not advise anybody to get into a line fight, is that right?

A I don't advise people on those matters. I certainly wouldn't advise them if it was going to reduce the recovery in the field as a whole.

Q Do you advise them on economic matters?

A With regard to such matters, I haven't had any request for such---

Q I understood you to say, Mr. Horner, that every day of pressure decline reduces the amount of oil that ultimately can be recovered from this pool through a water flood. Did I understand you correctly?

A Yes, sir.

Q Have you looked at this particular order from the standpoint of determining what effect it would have if adopted by this Commission on gas-oil ratioes within the unit?

A Not in detail.

Q Well, as a matter of simple computation isn't it correct that this proposed order would actually increase gas-oil--or permit an increase; it would not necessarily increase them--but permit an increase in gas-oil ratioes within the unit from 1,200 to one to 1,800 to one?

A I don't know.

Q Can you look at the order and give me an answer to that?

MR. STOCKMAR: Mr. Kirgis, I don't want to interrupt your testimony, but I did reserve the right to try to confine the questions to the work that the witnesses has presented and Mr. Weyler will go into

substantial detail on the operation and effect of the order and the results to the various parties.

MR. KIRGIS: The witness has testified, as I asked him a moment ago, that every day of pressure decline is going to have some horrendous effect. I am merely pointing out that under this proposed order I would think the pressure declines would be increased since the unit is allowed a 1,800 to one gas-oil ratio instead of the present 1,200 to one.

Q Do you deny that that is so?

A Is that a question to me, sir?

Q Yes, or to counsel.

CHAIRMAN DOWNING: Any further questions?

Q Let me ask you this question then; counsel does not respond. If this order has the effect of increasing the unit's gas-oil ratio from 1,200 to one to 1,800 to one, aren't you then going to increase this pressure decline now and decrease the ultimate amount of oil you get?

A Yes, sir, but I can't accept the premise.

Q That's a matter of computation and mathematics, isn't it, the premise?

A It's a matter of opinion.

Q But if my premise is right then you agree with

me that it is injurious to ultimate recovery, do you not?

A Yes, but I can't understand the premise.

Q Now, you also testified regarding the operation of the gas cap here and stated as I understood you that the existence of this gas cap with some forty thousand million cubic feet of gas originally is of value in the production of the field. Am I right in that?

A Yes, sir.

Q Now, will that not be adversely affected by any increase in gas-oil ratioes?

A I would think so, however increase must come as the field is depleted without water injection.

Q All right. Now, you also said that this proposed rule was intended to accomplish a reimbursement, if I may use my term---that isn't your term---to the owners of the gas cap properties for the reason of the fact that their gas is useful? Did I understand you correctly or am I paraphrasing your testimony correctly?

A I thought I indicated that it would be fitting and proper to compensate gas cap tract owners for their contribution of that gas cap to the useful purpose of the unit.

Q Do you say that this proposal has that result?

A I think it leans in that direction, partially rewarding the unit for that contribution.

Q And how does that come about, just briefly?

A I don't really understand how it comes about; I just know it appears to be in that direction. For instance, it allows an upper limit of gas production; if it is necessary to produce that much it can be produced.

MR. STOCKMER: Mr. Kirgis, I see the advantage to you of cross examining Mr. Horner on Mr. Weyler's testimony which he hasn't given yet, but I would like to object to this line of questioning on the effect of the rule which has not yet been explained and derived here for the Commission.

MR. KIRGIS: Well, Mr. Stockmar, I believe that this witness testified on the point. I just asked him and he said yes, he did, so I am asking him how he arrives at that conclusion and that would seem to me to be quite germane. I have very little more.

Q Mr. Horner, let me ask you this:n You state that you have not worked it out but that you believe that this formula would tend to compensate the gas cap owner for the value of the pressure which his gas provides. Does that mean when we look then at the Petroleum Incorporated position, the Pet Inc. situation,

that Pet Inc. under this formula is requested to trade its barrels of oils for the gas cap owners' barrels of gas?

A I am not sure the formula does any such thing with regard to gas cap gas penalty applied to Pet Inc.

Q You are in effect saying that you don't think the formula really does provide this compensation to the gas cap owner?

A I really don't think the gas cap owner is fully compensated by this rule at all. I think it is a deficiency in the proposed rule, Mr. Kirgis.

Q Mr. Horner---

A I don't want to appear the least bit evasive. I feel that I am among friends.

Q I am sure of that; I know that these are difficult things.

A If you have reference to anything I said and would care to take the time to have it read back to me I will surely attempt to answer it properly.

Q I think we have ccvered it. I don't think we need take more time. There may be just one more subject here. I want to ask just a few questions in aid of my understanding of your testimony regarding connate water. At the conclusion of your testimony it was pointed out

that there are three factors which were used to determine the oil originally in place; one was the limiting permeability; one was the gas-oil contact, and one was an analysis of the connate water situation. Am I right in that?

A Yes, sir.

Q Now, on the connate water problem, which is the problem with which I am concerned---

A Those are among the factors; porosity should be another one.

Q I am concerned only with the connate water problem.

A Yes, sir.

Q As I understand your Exhibit No. 2 shows the amount of connate water--I presume it is percentagewise--in relationship to the elevation of a particular point above the water table. Am I right in that?

A Yes, sir.

Q Now, does the amount of connate water increase or decrease as you move upward from the water table?

A It decreases.

Q That means then that, say, the first ten feet above the water table has the greater amount of connate water, is that right?

A Yes, sir.

Q Now, does the amount of connate water ever disappear entirely in this field--let's limit ourselves--as you proceed further up from the water table?

A No, sir.

Q Does it become a relatively small factor as you reach the top of the sand, or that is, the highest point above the water table?

A No, sir.

Q It is still an important factor, is that right?

A Yes, sir.

Q Now, is there any relationship between the amount of connate water at a given elevation and the recoverability of the oil from that same elevation?

MR. STOCKMAR: I will give Mr. Horner his option on answering that, but I want to again point out that Mr. Horner prepared these curves to show the amount of water existing at any particular section in the reservoir. Mr. Weyler and the entire Engineering and Geological Committee utilized these charts to measure the recoverability factor. Mr. Horner's prior testimony and his testimony here has only gone to the creation of this chart, not its use.

MR. KIRGIS: Will I have the opportunity to

cross examine Mr. Weyler then on the point which I am now raising?

MR. STOCKMAR: Certainly.

MR. KIRGIS: All right.

MR. STOCKMAR: And on most of these other matters.

MR. KIRGIS: No further cross examination.

CHAIRMAN DOWNING: Any further questions?

MR. STOCKMAR: I just have two in the nature of redirect examination.

MR. FREEMAN: May I ask one question?

MR. STOCKMAR: Yes, excuse me.

BY MR. FREEMAN:

Q Mr. Horner, what is the benefit of starting your water drive now rather than at a later date?

A The reservoir is deteriorating; although it is producing, it is deteriorating in that the recovery, ultimate recovery by the eventual water injection becomes less and less; for every day decline in pressure, the opportunity diminishes. The opportunity is less now than it was a year ago.

Q Then does the presence of gas pressure in a reservoir or a greater amount of gas pressure in a reservoir aid in the recovery you will obtain from a

water drive?

A Yes, sir.

REDIRECT EXAMINATION

BY MR. STOCKMAR:

Q With respect to two things only, Mr. Horner. As I understood your testimony it was that you have made a very complete and thorough study of all of the facts and factors involved in predicting a limitation on oil in this reservoir, but that there is not presently available to you enough information to make a firm mathematical computation of an MER, but only that your experience and observation of field performance permits you to select the range within which you would expect such a calculation to fall. In other words, you do have a sound basis for your opinion that the range of 12,000-15,000 is the proper one?

A Yes, sir.

Q Now, secondly, will the granting of the order which we seek permit the unit operator to immediately reduce the producing gas-oil ratioes of its wells?

A Yes, sir.

MR. STOCKMAR: That's all.

CHAIRMAN DOWNING: Any further questions? If not, the witness is excused.

(Witness excused.)

CHAIRMAN DOWNING: Next witness.

MR. STOCKMAR: All right, I would like to call Mr. Weyler next.

JOHN R. WEYLER

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

DIRECT EXAMINATION

BY MR. STOCKMAR:

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

A J. R. Weyler. I am assistant chief production engineer for Pure Oil Company in the Tulsa Division Office.

Q Would you gentlemen like me to qualify him again?

COMMISSIONER BRETSCHNEIDER: No.

MR. KIRGIS: No.

COMMISSIONER BRETSCHNEIDER: There are no objections; he is qualified.

Q Mr. Weyler, you have heard Mr. Horner's testimony with respect to the imposition of a maximum limitation on oil production of 15,000 barrels a day.

Do you confirm his opinion in that regard?

A Yes, sir, I do. I have done a certain amount of independent study. We have certainly been interested in the rate of production that should be produced out of Adena, more so since we have become the unit operator we have had that responsibility. My independent study confirms that certainly more than 15,000 barrels should not be produced out of the Adena Field in one day with the rules as they are proposed, and in that sense this limitation, this restriction on transferability which Mr. Stockmar has asked be stricken from the rules, is certainly important.

You can't even have an MER in the Adena Field if you are not going to allow the operator of those wells to produce oil from them if they are more efficient than other wells. You might go a shade further. It is quite difficult to have a true field MER with Petroleum Incorporated out of the unit, but you can have what is called a maximum efficient rate of production, with the fact that Petroleum Incorporated has nineteen wells that aren't in the unit, and the unit has the rest. With that assumption then you can determine the maximum efficient rate.

That transferability clause that is in those

rules certainly does not allow, in my opinion, even a 15,000 barrel a day allowable. It is down in that lower range of possibly 12,000 barrels a day.

Q Having flexibility of transferability then gives tc you the benefit which you seek in terms of selective production?

A Yes, that is absolutely right. We have twenty-one wells--twenty-two wells actually--offsetting Petroleum Incorporated. The unit could produce at a much lower ratio if it was able to utilize those wells.

Q By "selective production" we are stating another way, operating the wells which have the lowest gas-oil ratioes, are we not?

A That is correct.

Q And operating such wells permits you to maintain the higher reservoir pressure, does it not?

A Yes.

Q And that the ultimate recovery from the field is related to the amount of oil which you can get to come out for every drop, every unit or pound pressure drop, does it not?

A Yes, there is, I don't believe, any question that if you produce a certain amount of oil at one ratio and then are able to produce that same amount of oil at

a lower ratio in this particular field that you will increase the ultimate recovery of oil.

Q Because of the means of water injection is there any additional reason for limiting oil and gas withdrawals?

A Yes. I did some work over a year ago on that factor and did some work recently on the last pressure survey which shows a forty-two pound drop in six months and came up with substantially the same thing Mr. Horner gave you; it was slightly different. He had a longer range of pressure drop and a little bit different amount of production per pound. The last six months I calculate that if water--let us assume these two, make these two assumptions--if water injection had been started on January 1st of this year oron June the 1st of this year, if it had been started January 1st you would have saved 6,400 barrels of oil each day rather than going ahead and producing under the present rules.

Q Is that each day?

A That's per pound drop, or 1,500 barrels per day would be your loss by waiting the six months. That is going tocontinue on. Every day that this field is produced and pressure is allowed to drop before we start water injection we are losing oil that we are never going

to recover due to the shrinkage of the oil alone, and for that reason, that's just an additional reason to restrict the production not only down to the MER, but this water injection is imminent and we certainly don't want to continue to experience that lost oil until we can inject water.

We are certain that if the field had been 100% unitized January 1st the Commission would already have had a plan for water injection submitted by the unit. Since Petroleum Incorporated didn't come in we have had to modify our thinking and design alternate rules or alternate pressure maintenance programs and we certainly expect in the near future to submit a plan for pressure maintenance regardless of whether or not Petroleum Incorporated comes into the unit.

Q To take this out of the hypothetical, Mr. Weyler, will you give the Commission a status report on the progress toward water injection?

A Yes; soon after the Pure Oil Company took over the unit from the recommendation of some of the other companies and our own feeling, we put three petroleum engineers in the Adena Field to work primarily on a design of pressure maintenance programs. The personnel in the Tulsa Pure Oil Division office have

devoted a considerable amount of personnel and time toward the design of these programs and this problem of correct pressure maintenance for Adena.

The Pure Oil Company's laboratory, prior and since the unitization, has confirmed the suitability of the reservoir rock to water flooding. Our own laboratory is now engaged in further studies confirming recoveries. We have hired--since unitization we have hired one of the leading model consultants in the United States, Dr. Alexander Wolff, to assist us in determining what the best plan of injection would be. The Adena unit Engineering Committee has met periodically. Their prime interest, of course, is the pressure maintenance program. They have made recommendations which sub-committees have worked on and are working on, and also they have made recommendations which the Pure Oil Company's engineering personnel have taken on as an additional duty to work out this program.

Q I gather that these studies will proceed with diligence without respect to whether or not full unitization is accomplished?

A That is right.

Q Mr. Meyler, regardless of the gas allowable which might be established here for the field, what will

be the intention of the unit operator with respect to gas production?

A It would be very little different than it is right now. We have 150,000 barrels a day allowable on every well and we are certainly not taking it. We have allowables on gas wells and we are not taking it.

Q In other words, you are not presently producing all of the permitted gas allowable?

A No, absolutely not. We are producing only the minimum amount of gas that is possible under the existing rules, and to keep some semblance of a frontal drive in operation in the Adena Field. We are certainly considerably hampered by the present rules and by the non-transferability especially. The only oil that we would take under any set of rules would be the minimum amount of oil necessary to produce the oil allowable.

Q The minimum amount of gas, Mr. Weyler---

A The minimum amount of gas necessary to produce the oil allowable as we have in the past. We spent quite a bit of money the first few months of unitization in building larger tank batteries on low ratio leases so we could transfer certain allowables from high ratio wells to lower ratio wells.

Q In determining the amount of gas which you will

produce from the field, will you take into account the capacity of the Adena gas plant?

A Yes. Certainly the Adena gas plant has a maximum gas capacity. If we produce over that it is going to result in flaring of gas which we certainly want to keep to a minimum. That's a valuable product. The manufacturer's rated capacity of the gasline plant is thirteen million cubic feet a day in the summertime. In the wintertime this rate increases to fifteen and a half million cubic feet due to temperature differences. Right now, and I think ever since unitization, the plant is operating at overloaded capacity of eighteen to nineteen million cubic feet. They are doing a pretty good job operating that plant up there. They are having intermittent flaring periodically. One of the reasons for that is the flow doesn't come steady; the temperature gets high during the daytime. We have even gone so far in the unit as to try to adjust our production so we take our heavy load at night to keep the plant operating without flaring.

Q Will the adoption of the rules we propose permit you to operate at a more efficient gas-oil ratio?

A Yes, they well, they certainly will. That will be not only to preserve oil that can be produced

on down the road, but to prevent possible waste of gas that might be flared through the plant.

Q Mr. Weyler, Mr. Horner testified that some limit on the total gas allowable was necessary and desirable. Will you explain and justify the proposal which we have made to limit the gas, the maximum gas allowable to 26,971 MCF per day for the field?

A You would like to show the derivation?

Q Yes, would you, please?

A Yes.

Q Explain what that gas allowable is and what is its purpose in these rules.

A Well, I think it would be wise at least to go, Ted, into a little bit of the background behind these rules to give the Commission our thinking in arriving at these rules. First for the Adena Field we certainly do not subscribe to the present rules. We think waste is occurring and correlative rights are not being protected. We believe that in the Adena Field that each owner of the property is entitled to his own recoverable oil and this can only be prevented by limiting migration of oil from one property to another to the very minimum; and that to prevent this drainage one property owner should not be allowed--of course, within reasonable

limits--to produce his sand volume at such an excessive rate as to unreasonably diminish his reservoir pressure and his reserves faster than his neighbor, which certainly allows migration of oil to the property of lower pressure; that to accomplish a just allocation by minimizing this drainage the production of oil should be based on the amount of oil originally in place, thus we can be quite sure that we will have what we might term constant percentage depletion of each tract. In other words, the pressure will drop equally as best we can hope for on each tract, and that we will not have what we do have in Adena now--and I will show you later--drainage resulting from unequal pressures and various rates of withdrawal.

Now, to accomplish this method of allocation, why, we must be able then to measure the amount of original oil and gas in place under each property. That was done. It was done for unitization purposes. In fact, it is the very basis of unitization. It was done by the Engineering and Geological Committee that was established by all of the operators in the field, and the maps that we will show you have only been slightly modified since the bringing in of the Delaney well in the southwest part of the field.

MR. JERSIN: Mr. Weyler, did Petroleum Incorporated have a representative on these committees? Did they endorse these oil in place figures that you are speaking of?

A Yes, Petroleum Incorporated was represented at the--check me on this--November 4th 1954 meeting which I think was the first meeting of the Engineering and Geological Committee where it was first decided and felt that the first thing the Committee should do was determine the tract value of each property in the Adena Field and the value of recoverable hydrocarbons. In fact, if I am not mistaken, the Petroleum Incorporated representative seconded the motion. I think we have the minutes, if those are necessary. After that we went into that work. It took a considerable amount of time. We looked at every well in the field and Petroleum Incorporated was represented at all of those meetings, to my knowledge.

We worked many many weeks and there were many many meetings. Of course, there could have been possibly one or two that they didn't attend, but they were one of the five companies that had very good representation, Lion, Pure, British-American and Falcon-Seaboard were each represented at nearly every meeting, others as they

could.

Q Mr. Weyler, you have recommended a pool allowable of a maximum of 15,000 and a gas allowable of 26,971 MCF. Will you please show us how you derived the gas allowable?

A That's what I started out to do. The twenty-six million, I think it might be well--it is actually the last page in the rules--it shows the total amount of oil and gas that these rules would allocate to the field. In fact, it is the last of the exhibit, the very last field showing the totals, page ten. 26,971 is merely a derived figure and it was done in the following way; We have established-- If we have established that 15,000 is the MER that should be rateably allowed to be produced from the various properties according to the oil and gas in place, we feel also that there should be a limitation placed on the amount of gas that should be produced from this oil. Certainly we don't want to waste the reservoir pressure, so the total gas that would be allowed out of the oil zone according to the formula would be 15,000 times 1,200 cubic feet per barrel. Now, that's a total allowable just like it is in the present rules where you have 125 barrels per well and 150,000 feet. That's using

the same limiting ratio factor.

The total allowable in the Adena Field right now is 27,000,000 cubic feet of gas, 181 times the full gas allowable, but this figure is eighteen million cubic feet per day (drawing on board).

Q In other words, Mr. Weyler, you carry forward--to carry forward the present concept of a penalty gas-oil ratio of 1,200 to one you would give to the oil zone only a gas allowable of 1,200 times the pool oil allowable?

A Yes.

Q Giving you then a gas allowable for the oil zone of eighteen million cubic feet per day?

A Yes. Now, this, of course, is just the derivation of the total gas allowable figure and does not explain it. We will go into how it is broken up and show that it is done on the same basis as the oil and an equitable common-sharing formula.

Now, that is for the oil zone only. That's the total amount of gas that would be allowed out of the oil zone if all the wells were high ratio and they were being produced at their allowable capacity. Now, likewise, you have a gas cap there. The gas cap owner which is in the unit should definitely be allowed a gas

allowable out of that gas cap, just as much as if it was a separate gas field. We are lucky here that the two fields happen to be together and the gas cap is going to help push oil out, but certainly the unit owning that entire gas cap which is about half as much in oil volume as the sand zone should be given an allowable. We believe that that allowable should be no more per unit volume in that gas cap as the gas we are allowing in the oil zone. On that basis we are allowing eighteen million feet of gas a day out of the oil zone--again this is just an allowable--and in the oil zone there is a certain amount of volume of oil sand. That volume is 188, 643,--188,643,255 barrels of space in the oil zone.

Now, you can use those figures to determine what is the gas allowable going to be on any property or what the gas allowable is going to be per unit volume that is under each property, the gas allowable per each barrel of space in the oil zone, because we are going to give the same amount of gas allowable to the gas sand.

This figure (indicating) is of much importance; it is just a factor used to apply the gas. It is .0945518 cubic feet per day allowable for each barrel of

reservoir space in the oil zone. As I have just said, we believe that the gas cap should have at least as much gas allowable as we are allowing gas allowable in the oil zone, so therefore we have applied the same factor to the amount of sand out in the gas cap. That factor times the total times of gas--total amount of gas in the gas cap, total sand volume filled with gas, which is 94,014,175 barrels of space in the gas cap that is filled with gas, that times that (indicating) would then give you your total gas allowable that you would at least allow the gas cap. That figure is 8,971,000 feet a day.

This shows you the derivation simply of the allowable, eighteen million plus 8,971,000 is your total gas allowable.

Q Mr. Weyler, you stated that gas allowable is approximately the same as the permitted gas allowable under the present field rules?

A In fact, it is a little less, Ted. The present field rules allow 150,000 cubic feet per day per well. There are 181 wells in the Adena Field. That is a total allowable under your present rules of 27,150,000 feet a day. The allowable as we have here happens to be a little less.

Q Your factor of 1,200 for use as a penalty gas-oil ratio is exactly the same as that in existence in the present rules?

A Yes, sir, and we subscribe to that penalty factor gas for a number of reasons.

Q Under the present rules you are not producing even though you are compelled to produce from your less efficient wells, you are not producing all of the permitted allowable, are you?

A Not nearly all of the allowable, no.

Q Under the proposed rules you would not produce all of the permitted allowable?

A It would be foolish to produce all of the permitted gas allowable. I don't believe there is any question on that. That gas isn't going anywhere and we are all interested in having it produce as much oil as possible before it is used. You are not going to lose any gas by letting it expend itself, its energy through the oil zone.

Q The important factor then is not so much the precise amount of the gas allowable permitted, but the establishment of a fair and equitable division of whatever gas allowable is given between the owners of the gas cap and the owners of the oil zone?

A Yes, sir.

Q Then you would not, if there is some fear that this amount of gas would be produced with a consequent flare, you would not have any objection to the reduction of the gas allowable so long as the pattern of division of the allowable was maintained?

A That's correct.

Q Establishing the allowable at a reasonably high figure does permit the rules to operate for a considerable period of time, does it not?

A That is correct.

Q In the face of the inevitable increase in gas-oil ratio?

A Yes, sir.

MR. STOCKMAR: Gentlemen, Mr. Weyler has approximately twenty more minutes of testimony. We can proceed or interrupt for lunch, as you wish. He is going to move into the---

COMMISSIONER BRETSCHNEIDER: He has about twenty minutes more testimony. Do you want to hear it now or later?

CHAIRMAN DOWNING: I thought we would continue until 1:00 o'clock and resume at 2:00, and we hope that you certainly will be through at 1:00.

COMMISSIONER BRETSCHNEIDER: He has enough testimony now to take us until 1:00 o'clock.

CHAIRMAN DOWNING: You say you want to examine him for twenty minutes further?

MR. STOCKMAR: I want him to show how we arrived at the oil in place, the hydrocarbons in place.

CHAIRMAN DOWNING: Is there any question about that? It strikes me that there is a lot of testimony here that is probably not disputed at all. A lot of it is corroboration.

MR. KIRGIS: Mr. Chairman, I will have a great deal of cross examination of this witness.

COMMISSIONER BRETSCHNEIDER: You had plenty of Mr. Horner; I should expect you would have plenty of this gentleman.

MR. STOCKMAR: I am sorry to take so much time, Judge Downing, but we are involved with the matter of $2,500.00 a day which we are claiming and the Petroleum Inc. people are claiming it is a very substantial matter.

CHAIRMAN DOWNING: If you can finish by 1:00 o'clock, go ahead.

COMMISSIONER BRETSCHNEIDER: He can't finish by 1:00. He can finish his direct examination by

1:00 o'clock.

CHAIRMAN DOWNING: All right.

(Discussion off the record.)

CHAIRMAN DOWNING: Proceed.

Q Mr. Weyler, therehas been some indication that the producing gas-oil ratio of the unit properties presently is higher than the producing gas-oil ratio of Petroleum Inc. I think it arose on the cross examination of Mr. Horner. What is in your opinion the reason for this differential in producing gas-oil ratioes?

A The reason of the difference in the producing gas-oil ratioes at the present time is that limitation of transferability of oil allowables.

Q If that were removed even under the existing rules could you reduce your gas-oil ratio?

A Yes.

Q Could that be done without getting into what has been referred to here as a line fight, or an undue concentration of withdrawals from properties near those of Petroleum Inc.?

A Why certainly it would have to be done. There would be no line fight. The unit is interested in a frontal migration of this gas. We certainly would not see our way clear to concentrate takes from wells

directly offsetting Pet Inc. We distribute those throughout the reservoir to most efficient wells.

Q If you wanted to get into that kind of an unfair and unreasonable approach to the production here, could you not do it now under the present rules?

A We could do it just as well under the present rules as we could under the rules which we are submitting without the transferability, that is correct.

Q And your reason for removing that is to take away the requirement that you produce from the least efficient wells?

A That is correct.

Q As an item of interest and importance, Mr. Weyler, we have heard stated many times that oil does not produce itself. I think the author of that statement is here with us, that it is produced by some driving mechanism which in this case is gas in solution and an expanding gas cap. The value of the oil then is related to that which can be produced or pushed out, therefore the gas has a true value in connection with the oil in moving oil so that it may be produced?

A Yes, it does.

Q It is the energy in the gas which is important. Would you give us the single factor of what percentage

of the total gas in the reservoir originally---and consequently the percentage of the available energy in the reservoir that underlies the properties---originally underlay the properties of Petroleum Inc.? I don't think you need to derive it presently, Jack; if you simply tell us what percentage of the total gas in the reservoir and the energy in it originally underlay Petroleum Inc.'s properties?

A Approximately 4.15 percent of the original gas in the Adena Field was under the Petroleum Incorporated properties in the form of solution gas.

Q Now, Mr. Weyler, will you quickly show us the application of this formula, the actual application of the formula that we propose to demonstrate? How we would divide up the oil and how we would divide up the gas--and may I inject, gentlemen, that we have a ten page exhibit to our application which shows the itemized work on a tract basis. It appears to be complicated. We have done that to permit the Commission staff to review any work which they may wish to. Actually the total tabulation and breakdown in that entire exhibit can be shown on one page as part of an order, and we herewith hand you a summary of the application of this formula (handing documents to the Commission. It is

approximately the same as page ten. It contains all of the information needed to allocate the oil and gas for the entire reservoir.

A All right, we have, of course, established the total pool oil allowable of so many barrels, whatever that may be, 15,000. The formula works the same, so it is a gas formula. I think you will find on page two of the rules in Rule 3, the formulae, the oil formulae and a gas formulae, to allocate the oil and the gas to the individual properties. I think that's what you had referred to, Mr. Stockmar?

Q Yes, sir.

A To show how each property would get its fair share of the production allowable. We have put then into quite simple formulae. The first one is the oil allowable formula and I will draw it here for the people that might not have the rules (drawing on board). This is a simple proportion that the total field pool oil allowable should be proportionate to the properties at the ratio that this property's original oil in place was a part of the total oil in place.

Q In other words, it is straight division; you find the total oil in place, you find the oil in place under each tract and divide the oil allowable in the

same proportion?

A That's right. Now, for the unit, if you want to refer to some figures there as an example, we have recommended 15,000 barrels a day; to find the amount of allowable for each unit of volume we would divide it by the total oil originally in place times the original oil underlying the property. We are trying to calculate the allowable for, in this case, the unit (drawing on board). 175,228,960 barrels of this was under the property (indicating). It just proportions the amount that ought to go to the unit of this 15,000 barrels, or any other daily oil allowable.

Q Then what share of an allowable would be allocated to the unit tracts?

A Than then equals 13,933 barrels. You do this same thing for every other property, in this case the five Petroleum Incorporated properties, substituting for this 175 the amount of oil that was underlying each of these properties in question.

Q So that the division of the daily production of oil is directly related to the original oil in place?

A That's right.

Q Would you derive for us the gas allocation formula?

A It is done in the same way, just using different letters. There is one thing we must remember here. We are giving a gas allowable to the oil zone. We are likewise giving a gas allowable to the gas cap on the same basis, so much gas from a producing property is allowed for the amount of sand volume that was filled with oil or gas. And you are giving the same allowable to the gas cap as you are giving to the oil zone per unit allowable, no more. So the top "C" would be the total gas allowable. We will do this for the unit again (marking on board). Let's call this MCF--well, cubic feet, 26,971,000 feet of gas as a daily oil allowable. You divide that by the total number of barrels of space in the entire reservoir because we have got to give an allocation of gas to an oil property--to a gas property--and do it the same way since it is consistent. The voidage is the same, the gas voidage allowed, so the total amount of barrels in the total reservoir, 282,657,430. Now, remember 188 million of it was oil zone and the rest of it is gas.

Now, multiplying that times the amount of reservoir space for the unit--in this example it is 269,243,135 barrels that is under the unit property, therefore the allowable should be based on this proportion.

All we want is our percentage of this gas. That totals 25,680,000 for the unit of cubic feet a day gas allowable, of which we certainly wouldn't produce it, but that we feel should be the gas allowable for the unit. We wouldn't produce that any more than we are producing our gas allowable today under the present rules, but we do believe the correlative rights of gas cap owners should be protected by having an allowable given to them. When the time comes that that gas cap encroaches throughout the oil section, does the work and is expending itself, by the same token it is going to keep on coming right out of the wells. At that time we certainly believe that the unit should be allowed to produce that gas cap from the leases it had it under originally.

We are going to use that gas, Petroleum Incorporated is going to use that gas.

Q Now, with respect to the difficulty of administrating such a rule, is this tabulation which we have shown here not as simple to use and as easy to administer as the present rules?

A It certainly is. Actually, the rules are quite similar. The only thing that has changed in this set of rules that was in the rules that are now in force

is the basis. In lieu of an inequitable per well sharing of the oil and gas we are substituting the amount of oil and gas in place to restrict and minimize drainage and that's all. We have used 1,200 cubic feet per barrel allowable as a limiting gas-oil ratio factor. We have given the gas cap an allowable similar to what we have now, no more than you are allowed in the oil zone, as we have now.

There is no different in this allocation other than the bases, which is on the basis of reserves rather than per well. The only time a per well allowable would be any good would be if you had a reservoir of equal volume all drilled at the same time, equal sand conditions throughout completely, no difference in fluids. You never find that.

MR. STOCKMAR: Thank you, Mr. Weyler. I am extending my few minutes here, gentlemen, I am sorry. Gentlemen, I would like to introduce as our Exhibit No. 4 a structure map with cross sections just to give you a visual picture of the field. Mr. Weyler as briefly as you can will you point up the factors which we have used in determining and calculating the oil in place under each and every tract in the field? As was stated there is possibly no dispute with respect to most of

these factors. Do it as briefly as you can and if Petroleum Inc. wishes to dispute anything we will let them do that on cross examination.

A All right. I won't spend much time here. This is a structure map of the field that was presented to the Commission in the December 20th hearing. It shows the oil zone. You all have the little books; the oil zone, the gas cap, and the area where the gas overlies the oil originally. Now, Mr. Stockmar has asked me to tell you the factors which were used to go into the determination of original oil and gas in place. The Engineering and Geological Committee sat down to determine the oil and gas in place. First, of course, we had to find the top and bottom of the sand. We did that. We used a core analysis and electric logs, every means that we could. We found the top and bottom of every sand section of every well in the field. To find oil and gas in place you have to have the porosity and you have to know the connate water. We used the porosity from all cored wells that we had, and I think if I am not mistaken about eighty-five percent of the wells in the field were cored, a great number of wells.

We used the permeability or the porosity directly from these wells. We subtracted from the amount

of porosity in the sand of each foot the amount of connate water. We used this curve here (indicating) to subtract the amount of connate water and find how much oil was in each foot of each sand in each well in the field.

We used a gas-oil contact of 1063 that the Core Laboratory found. We found the very same thing. We even found it closer than they thought it was. After correcting some of the footages on the well every well hit 1063 right on the button within a foot, if it didn't hit it right on the nose, so we were satisfied that 1063 was the gas-oil contact.

Q Mr. Weyler, there may be no dispute on some of these matters. Can we sum up this part of it by saying that you measured the thickness of the rock that carried oil or gas, that you divided it into oil and gas zones, that you then analyzed each well foot by foot to determine the porosity; that is, the amount of fluid space that could be found in the reservoir, the amount that you measured separate the amount of water foot by foot to arrive at the amount of oil in pore space foot by foot for each well?

A That's right.

Q Then how did you, using Exhibits 6 and 7, which

I would like to introduce, how did you arrive at the total quantity of oil in place in the reservoir and gas in place in the reservoir?

A All right, well then we knew the amount of oil and the amount of gas represented by that well in barrels per acre. We spot those on the map of the field. These figures here represent barrels per acre on both maps (indicating), space filled either with oil or gas. We then contoured this as a committee, contoured each of these maps, and with the use of a mechanical device called the planimeter that you measure area with, we measured the area on each individual property between the contour lines, and therefore, could determine within very reasonable accuracy the amount of oil in place under each segment and add them together, then the amount of oil in place for each property.

Q I believe that we went through this very thoroughly at the unit hearing and we will let this go to cross examination, Mr. Weyler. On the bottom of your Exhibit 4 you have a cross section of the field. I would like to call the Commission's attention to the cross section.

A Well, this is---

Q Excuse me, Jack. That is a much reduced cross

section. It is not to scale, and since we fully expected to hear lots of comments about downstructure and that kind of thing we have prepared a scale cross section. We would like to show you exactly what the length of this field is in comparison to its thickness. Mr. Weyler, was this, which I would like to introduce as Exhibit 4, prepared under your supervision?

A Yes, it was.

Q Excuse me, Exhibit 5.

A Yes, it was.

Q You will note the difference between the two (indicating). This is a cross section of the way the reservoir actually looks. The white lines are parallel to the sea level data. We would like to leave this here. We may have some further comments about it later. Will you move right into the pressure maps, please?

A All right.

MR. STOCKMAR: Henry, will you put up the exhibits, please? Excuse me, we are out of order on exhibits. The isopach maps we have entered respectively as Exhibit 6 and 7. In each of your books you will find two exhibits which I would like to enter as Exhibits 8 and 9. They just follow the isopach maps in your book.

Q (By Mr. Stockmar) Gentlemen, Mr. Weyler has placed on the board our Exhibits 8 and 9. Will you please explain those briefly, Mr. Weyler?

A All right. These figures here are percentages that show, this top one here is as of the 1st of July of 1956. Petroleum Incorporated has produced approximately 14.1 percent of its original oil in place; the unit, 8.5 percent of its original oil in place. To do that in the Adena Field there has got to be migration. This is being replaced by oil which was originally under the Adena unit. The pressure maps will very clearly point that out, as I will show you later. That's a lot of oil. If the unit were to have produced 14.1 percent of its original oil it would have produced over seven million more barrels of oil than it has already produced at about $1.85 a barrel. That's a lot.

Now, Petroleum Inc. had 7.1 percent of the original oil in place. Adena unit, had 92.9. As of the first of the year when the unit went into effect, Petroleum Incorporated already produced 10.4 of the produced oil at that time. Of course, the rest of the unit is here (indicating on board). It is getting worse. First quarter of 1956 they produced 13.7 of the

produced oil, second quarter of 1956 approximately 14.9. If these same rules stay in effect the next quarter it will be 16.2.

Q In other words, Mr. Weyler, the present rules in their daily operation day to day are increasing the inequity of the situation and not solving it, is that correct?

A That's right. There is plenty of inequities in the present rules. In the first place, the present rules in no way reflect the oil that was under each individual owner's property; by that they allow migration.

Q At the present time, as I understand it, the present division is on the basis of wells alone?

A That's right, wells alone.

Q Is a well any measure of the amount of hydrocarbon that you might find under it?

A No.

Q What does Exhibit 9 show?

A This is simply a bar graph, gentlemen, that referred to these figures. Again, Pet Inc. with 7.1 percent of the original oil in place as of the date of unitization; it produced 10.4; the first quarter of 1956 13.7; the second quarter, 14.9; and it would be expected to produce 16.2 of the oil in the third quarter

if the rules aren't changed. This is only the result of manmade rules; it hasn't anything to do with structural position. If you take that per well allowable off and place on a rule that permitted equal drainage of properties this will drop right back down to here (indicating). We are not asking for any of this lost production. We are not asking Pet Inc. to be shut in to a unit that produces seven million barrels of oil to make up the difference. We are asking for a correct sharing of the oil production in the future.

MR. STOCKMAR: We would like to introduce some pressure maps now which will take a few more minutes. We can do it---

A Ted, there is one more thing about why this has happened. We will have to talk about this just a little bit. One other reason why this is happening, getting worse, is the unit is unable to transfer other than a penalized allowable; in other words, under the present rules we take a gas-oil ratio every three months. According to that gas-oil ratio a well is given an allowable. Even though we take that oil allowable and transfer it to a low ratio well, under the 1,200 limiting ratio we cannot produce any more than the penalized allowable. That's why this is getting bad

(indicating).

The whole field is going to be subject to that. We are not able to transfer. Another reason for the present rules being inequitable, we can't transfer to good low ratio wells. We are taking too much gas out of that reservoir for each barrel of oil being produced.

Q Mr. Weyler, the Commission is anxious to get to lunch. I shall move right into the pressure maps and conclude your testimony.

A Yes, sir.

MR. STOCKMAR: Would you like to adjourn for lunch, sir?

CHAIRMAN DOWNING: It's ten minutes after 1:00. How near finished are you?

MR. STOCKMAR: We are within just a few minutes of finishing, sir.

CHAIRMAN DOWNING: If you just take a minute or two we will wait.

MR. STOCKMAR: All right; I would like to introduce as our exhibits---

CHAIRMAN DOWNING: Do you want to introduce these exhibits?

COMMISSIONER BRETSCHNEIDER: He wants to

explain these next two maps that are going on the board.

MR. STOCKMAR: It is up to you, Judge Downing, if you prefer to disband for lunch and resume again we will be glad to do that.

CHAIRMAN DOWNING: Is there any objection to these exhibits?

COMMISSIONER BRETSCHNEIDER: He wants to explain them.

CHAIRMAN DOWNING: All right.

MR. STOCKMAR: Whichever you wish, sir.

CHAIRMAN DOWNING: If it will just take a minute or two, as you said, all right. We don't want to wait here all afternoon before we go to lunch.

MR. STOCKMAR: Maybe we should go to lunch then.

CHAIRMAN DOWNING: I would rather get finished because this thing is running way too long; in fact, I can't promise you a full quorum here this afternoon.

Q Jack, will you please speed through these? I would like to introduce our Exhibit 10, 11, and 12. Will you explain which each is showing and refer to them, Jack?

A This is a bottom hole pressure map. It was

prepared not by me, but by the Engineering Committee in December from the December 1955 survey, just before the unit commenced.

Q What are the colored tracts?

A The colored tracts are the Petroleum Incorporated properties. It is apparent already that there is a considerable amount of migration toward the Petroleum Incorporated properties. The pressure sinks are not quite as apparent as they are in the next map. This map was taken---

Q Which exhibit is that?

A This is Exhibit 11.

Q That's Exhibit 11?

A Exhibit 11, bottom hole pressure map. The bottom hole pressures were taken in June of this year, the 2nd of June. There is no question but what this is happening to the oil and gas (indicating).

Q The record won't show the arrows, Jack. Would you make a statement as to what they are intended to represent?

A These arrows are drawn perpendicular to pressure lines; in other words, in the areas of low pressure the pressure sink here (indicating) is quite severe, and the pressure sink here (indicating), because of unequal

volumetric drainage creating low pressure. The unit oil and gas is migrating toward those pressure sinks and right into the Petroleum Incorporated properties. It is getting worse and it is going to keep on getting worse under the present rules. The rules which we have proposed would stop that migration of oil into the Petroleum Incorporated properties.

Q Mr. Weyler, what is our Exhibit 12?

A This Exhibit 12 as we construct it is a differential pressure map; in other words, from each map we had a pressure here and a lower pressure here (indicating), and we subtracted the two to show the difference in pressure drop. Again, the situation is getting increasingly worse. There was a 111 pound drop here in this Petroleum Incorporated well, and eighty-four pound drop here, so there are some moderately high in the oil zone, but the whole average field only dropped forty pounds and the pressure sinks here are substantially more than on the unit properties. Again showing this drainage here is not only continuing but is getting worse (indicating).

Q All of this tends to show the inequity of the present rules?

A That's right.

MR. STOCKMAR: I think with that we can adjourn for lunch and possibly postpone Mr. Weyler's cross examination.

CHAIRMAN DOWNING: We will recess for lunch.

(Whereupon, at 1:13 o'clock p.m., Monday, July 2, 1956, the Commission recessed until 2:15 o'clock p.m., the same day.)

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MONDAY AFTERNOON SESSION, JULY 2, 1956, 2:15 P.M.

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CHAIRMAN DOWNING: All right, we will come to order. Now, the next thing is cross examination.

MR. STOCKMAR: I would like to know if there is any objection to the exhibits which we have asked to be accepted here?

MR. KIRGIS: None.

CROSS EXAMINATION

BY MR. KIRGIS:

Q Mr. Weyler, you have stated, as I understand it, that the 15,000 barrels of oil allowable for the entire pool is not only one which is based upon the factors studied by Mr. Horner but also an independent survey of your own. Can you explain to us how you arrived at the 15,000?

A Yes. I did quite a bit of research, Mr. Kirgis, on that, went through books published by a number of the authorities, did quite a bit of reading. Some of them come out with formulae that they can predict MER's. They say they can predict them; I got a lot of background out of that, general observations of performance in the field certainly bears out 15,000 should not be exceeded.

Q And what factors do you take into account in

formulating a limitation to 15,000 barrels?

A The gas cap should not be allowed to migrate too rapidly and likewise many of the things that went into our MER testimony, the fact that you should not cause pressure sinks in the reservoir, move that gas cap at an unequal rate.

Q Well, is there any certainty that the 15,000 is a figure properly calculated to prevent these things which might otherwise be harmful?

A Yes, if these rules are promulgated, yes.

Q Do you know what the historical production is over the first four or five months of this year?

A Yes.

Q What is it?

A Would you like the exact figure, or roughly? It's about 400,000 to 540,000 barrels a month.

Q What is that daily?

A It's about 14,000.

Q It's less than your proposed 15,000 is it not?

A Slightly, yes.

Q Do you know whether that is the actual production or the allowed production or whether there is a difference between the two?

A That's the production reported to the State,

actual production as reported.

Q Actual production?

A That's right.

Q Has actual production since January 1 of this year been the equivalent of allowed production under the existing rule?

A Mighty close.

Q Do you know whether there has been any excess in actual production over allowed production?

A Not to my knowledge; if it has it was probably made up the following month.

Q If so it would have been just a one month proposition, is that right?

A Yes, as far as I know, that's correct.

Q Have you checked the figures or are you just basing this on your understanding from other sources?

A I have actually recorded the actual state production for each month. If you want to take time I guess we could check that with the allowable.

Q I would like to do that. Will you do that, please?

A (Witness looks through documents.)

Q Can you in doing that distinguish the unit production and the unit allowable from the field as a

whole?

A Yes, I would like to check. I am not certain I have the actual allowables in the Pet Inc. properties. I have the actual production here which I am about to tabulate. I will see if we can't get hold of it---

Q We will give you an opportunity to check so that we will have it accurately.

A All right; the first four months you asked for, I believe, didn't you?

Q That's fine. If you have later figures, yes, but my guess is you have only the first four.

A We have May kind of estimated.

Q Let's just stick to those that we know as a fact.

A (Witness draws on blackboard.)

MR. STOCKMAR: Mr. Weyler, will you recheck your April figure for unit oil?

Q Now, do you have a base of determining for comparative purposes what the figures would be under the allowables in the existing order?

A Yes. I guess we could assume a thirty-day month roughly.

Q That's all right.

A All right; roughly, each month?

Q Yes.

A Petroleum Incorporated would produce 32,000 barrels and the unit 418,000 barrels.

Q Now, that is under your proposed order, is it not?

A That's right.

Q Do you know what the figures are for these four months under the now existing allowable order?

A Well, Mr. Kirgis, I am quite certain that they are right close to these average figures (indicating). Those are right close to the average allowable.

Q You haven't, however, checked that out or can't immediately quickly check that out, is that right?

A I will see if I can. All right, the unit allowable in April was 363,960 barrels. Now, whether this increase of about 5,000 plus barrels is making up production because of underproduction here (indicating), I don't know.

Q Would the 363,000 figure apply to each month, January, February, March and April under the existing order?

A No, sir, that is only April because in April we went under the gas-oil ratio tests of the first quarter of '56. The first quarter here was higher for

the unit.

Q I am not sure I follow that. Do you mean by that that in the first quarter that your actual production exceeded your allowable production under the existing order?

A No, the allowable production was higher under the first quarter than it was the second quarter.

Q But you don't have the figure to give the comparison?

A I will try.

Q All right.

A We have the allowable schedule for the first quarter 1956 but it is not totalled for the units. It is only by lease; since at that time it was calculated for each lease, not for the Adena unit, since we just started the unitization. The State put it out on a lease basis. Maybe we can get it here.

Q Okay, fine.

A (Witness draws on blackboard.) During January the allowable was 392,150 barrels for the unit. By the way, you are making up some production in that month of January.

Q From a prior underage?

A I believe that's correct. Is that not correct?

A VOICE: Yes.

A That's correct. During February the allowable was 366,850 barrels. During March it was back to 392,150 barrels.

Q So there actually are overages there in three of those four months, is that right, of actual production over allowable?

A You are counting making up overproduction as overage?

Q Just on the facts there are four months when there was more production than allowable for those months?

A I guess you could say that.

Q Three out of the four?

MR. STOCKMAR: Mr. Kirgis, will you define the allowable, please, to include or not to include make-up production?

MR. KIRGIS: I was talking about it without reference to making up production.

Q Now, as I understood-- I am sorry. Did you want to go into something further there?

A No.

Q You are free to if you want to.

A No.

Q I understood you to say that under the proposed order that it would give rise to selective production. Am I correct in my understanding of your testimony?

A That's part of the rules.

Q Now, how is that selective production going to be administered? By whom will it be administered?

A By the operator of the Adena unit.

Q And that would mean that the operator of the unit could select those wells within the unit from which he would produce his share of the 15,000 barrels per day, is that correct?

A That's right.

Q Do you contemplate that the Commission has any retained authority, as Mr. Horner did?

A I think if the unit does something out there that somebody feels is hurting them, then that second party has the right to come to the Commission and have them look into it, but if the order itself is just and equitable the Commission shouldn't--I couldn't see why they would worry about it.

Q Did you hear the testimony regarding the possibility of a line fight?

A Yes, I heard it.

Q That was my phrase, not the witness'es phrase.

A Yes.

Q Do you agree with the former witness that that is not a possibility?

A Well, I will have to put it this way to answer that question: any time that oil is being transferred from one well to another you cannot--let me erase this. I will call these a couple of Pet Inc. properties (indicating blackboard). We maintain that if we can't produce transfer oil to those wells that we are going to have a less efficient operation.

Q May I interject there, do you mean less efficient for the field or less efficient for the unit?

A Both.

Q For both?

A Right. Now, whether we transfer great quanti- of oil to these wells back here (indicating) or to these wells back there (indicating), is there any difference in line fight? It's only a relative distance. I don't think there is cause for that for this reason---

Q Your first offset has the most direct effect on an adjacent property, does it not?

A Not necessarily, no.

Q Will you explain that to me?

A I think right back to Mr. Kavaler's article--

and I believe it, too, Herman--that wells do not produce from an individual lease, they produce from a pool, and if you are taking the oil out of here or out of here (indicating), let's use these two, out of here or out of here, you are going to have the same effect on some water out here or some gas out here (indicating).

Q What about the well, however, that may be in the triangle?

A This one?

Q Yes.

A The rules have given it its fair share of the oil. There isn't going to be any migration.

Q You say the rules; you mean the one that you are now proposing, is that right?

A That's right.

Q And do you say that the rule which is now in existence gives it an unfair share of the oil?

A Yes, I do.

Q And why?

A Because the rule is simply based originally I think it started out to even be a temporary set of rules. There was no reservoir information available. It does not reflect in any way the quantity of oil that underlies the property that gets drilled. It gives an

unequal share in it according to the number of wells.

Q Then your statement of fairness or unfairness is based upon the amount of oil in place, is that correct?

A It's based on migration, that we are trying by this new set of rules to eliminate. These rules would do it, eliminate the migration of oil either way without compensating drainage.

Q You did make the statement, if I understood you correctly, that under the present rule that the parties--and I don't know whether you mean merely the unit or whether you meant everyone in the field--is not presently taking all the oil or gas permitted under this rule.

A That's right.

Q Didn't the figures a moment ago indicate that at least substantially all the oil is being taken?

A I was speaking there primarily of the gas. We have more than thirteen or more gas wells in the field, each one of which has got an allowable. Never yet has the unit opened those wells up. We haven't even laid lines to them; we don't want to produce them. We don't want to use that gas.

Q Are those gas wells on the gas cap?

A Yes.

Q If that be so why then was there an allocation of gas to gas cap wells in your formula as contained in Rule 3?

A It's not the gas cap wells; it's the gas cap acreage, not on a well basis.

Q Well, I thought I understood you to say, and please correct me if I am wrong in this, that you found eighteen million cubic feet, I guess, of gas in the oil zone.

A That's the oil zone, gas allowable possible.

Q And that you then took an eighteen million figure for the gas cap zone.

A No, sir; it's about less than nine million; it's about 8,971,000.

Q But you do allocate eight or nine million to the gas cap properties, is that right?

A Yes, we are allocating gas to the gas cap property similar as to how gas is allocated to those properties now.

Q Why is it that allocation is necessary or proper if the gas cap wells are not to be produced?

A I think I made that clear, that that gas cap gas is moving as shown by these pressure maps. It is moving every day to the oil wells and it is going to be

produced out of oil wells. We hope to produce every bit of that gas out of an oil well. When that day comes we should be allowed to take our share of that gas production and we want to be able to do so.

Q Incident to your oil production, is that your point?

A Yes, sir; in other words, once it gets in the tube you can't push it back, so we want the right to let it come on out. It has done its work.

Q Would you be willing if that order include- that if it is to be adopted at all-a prohibition of gas from the gas cap wells, however we might be able to define them?

A It is not necessary.

Q Why?

A We have 150,000 cubic feet in any gas cap well and we haven't produced it; it would be silly to produce those wells.

Q You mean it would be unnecessary because you do not presently intend to do it, is that right?

A That is right.

Q Now, you stated also if I understood you, that the rule which you now propose will allow a more efficient gas-oil ratio. Am I not correct in that?

A That's correct.

Q Will you explain how that is so? I didn't understand the explanation, if it was given.

A All right. We will be able to transfer allowables to wells that we are unable to do it even now in the present rules. It will open up the possibility of transferring allowables to low ratio wells, these direct offsets.

Q In other words, it is nothing that is intrinsic in the formula; it is only intrinsic in your right to transfer from one well to another, is that right?

A Yes, but it goes a little further than that, if you would like that, too.

Q Yes, I would.

A These rules will eliminate these pressure sinks that were pointed out, which is going to keep that gas-oil ratio down.

Q That's a matter of intent. Now, on the figures which you have included on the last two pages, I believe it is, of your proposed rule, at the bottom of page nine you show the total amount of gas, the total amount of oil which will be allocated to the unit. Then on page ten you show total amount of oil and total amount of gas which would be allocated to areas outside the unit,

which means Pet Inc.?

A Right.

Q If you would merely make a mathematical computation, what would be your gas-oil ratio in the unit under those figures?

A I don't know what you are leading up to. You are leading up to an 1,800 gas-oil ratio?

Q That's right.

A I tried to make that clear in my testimony that we are speaking about two different areas. We are speaking about an oil area given a gas-oil ratio penalty; we are speaking about a gas cap that likewise should have an allowable.

Q But you said you would not produce from the gas cap.

A That's right, but when that gas cap gas gets into the oil zone it should be allowed to be produced.

Q You then advocate permission to produce at a gas-oil ratio of 1,800 to one, is that right?

A Under those conditions that is right.

Q And what would be, on these figures, the gas-oil ratio for Petroleum Inc. properties?

A A maximum of 1,200 to one.

Q And that's what it is in the field today,

isn't it, under the existing order?

A Well now, I don't know. I think we could transfer that gas allowable that we have--I don't want to get into that under the present rules--but, yes, generally right.

Q But that effect then is that your order proposes substantially an increase from approximately 1,200 to one to 1,800 to one gas-oil ratio in the unit area, is that correct?

A I don't even think about it that way.

Q Is it correct?

A Well, I think everybody here understands it. If that's your way of putting it, I guess you are correct, but my way of putting it is allowed production of gas cap gas after it has expended itself through the oil zone.

Q Yes, we will admit that some of the gas will come from the gas cap, but the net effect is a measured gas-oil ratio at the combined wellheads which could be as high as 1,800 to one?

A That's right.

Q Now, you discussed in your direct examination the matter of bottom hole pressures and you have at least one map here or two maps, plats, call them what you will,

your exhibits, what are they, 5 and 6?

A The pressures I think are about 9, 10 and 11, aren't they, Ted?

MR. JERSIN: 10, 11 and 12.

Q 10, 11, and 12, that's right.

A I will mark them (marking on exhibits).

Q Now, on one of these which is now designated as No. 11, Exhibit 11, you have put black crayon arrows pointing into the Petroleum Incorporated properties. I believe you said that that designated the drainage pattern as it would exist based on those bottom hole pressures, is that right?

A Even after shutting in twenty-four hours that's just the reflection that is left after the real severe sink has disappeared.

Q Now, you called that, I think, a pressure sink, is that right? Is that the proper phrase to use, sir?

A That's one I like.

Q Is there any other sink other than on Petroleum Incorporated properties?

A Yes, on the same basis you would have to call this one and even this one (indicating).

Q In other words, the arrows only point up the

Petroleum Incorporated drainage as you see it, but you don't point up the drainage into your own properties?

A I will point them up if you like, but here's the net result: that doesn't mean anything because we are draining our own territory. In other words, you are certainly not draining from here up to here (indicating). Now, from here, certainly, but that's our transfer provisions allowing us to move oil around and take it where we can take it best. Certainly you are going to have some pressure drop where you shut in your wells; as long as you are confining it to your own territory you are not hurting anybody.

Q But the fact is that this pressure situation and the suggested drainage pattern created thereby is not peculiar to Petroleum Inc.? It isn't Petroleum Inc. against the world or the world against Petroleum Inc. It also happens in your own property, does it not?

A The pressure sinks are there; the effects are different.

Q Why are the effects different?

A Your pressure sinks are draining the unit and ours are not draining you.

Q Okay, it's a matter then, just a fact that we have two leases, so to speak, in the field; the unit

is one and Petroleum Inc. is the other?

A That's right.

Q But the basic engineering fact remains that there are other pressure sinks with the same effect as those on Petroleum's Inc. in so far as reservoir behavior is concerned?

A You can go further than that. There is migration all over this reservoir. The only thing that matters is when oil and gas are moving over property lines.

Q You are talking correlative rights?

A I believe that's it, yes.

Q You are not talking greater ultimate recovery of oil or gas, are you, from the pool as a whole?

A This shows primarily to me correlative rights as being affected.

Q But it is not a matter of waste if one defines waste as limited to the greatest ultimate recovery. Am I right in that?

A I may be stepping on my lawyer's toes, but I think it says in the Act that abuse of correlative rights is waste.

Q My question was this: if you limit the definition of waste in terms of the greatest ultimate

recovery of oil, then the thing which you are now talking about has nothing to do with waste within that limitation, isn't that right?

A Well, I don't know; we are kind of Oakies from Oklahoma, but we are in Colorado and they don't limit it to that.

Q I am asking you merely to make my assumption. We lawyers will argue whether this is a proper definition of waste, and Mr. Stockmar no doubt will say that it is not, and I say that it is, but if that is the proper definition of waste--the legal problem is to be determined by the attorneys and the Commission--then is this thing that you are talking about now not waste?

A There is some waste involved.

Q How?

A The waste is involved is this pressure thing; there should not be sinks across here (indicating). It should be uniform. These lines should be straight. These two pressure sinks here (indicating) and the fact that we can't extend ourselves because we can't get up here to that oil next to the line are creating these sinks and therefore we are experiencing a waste.

Q Well now, isn't it true then of the pressure sink on your own property?

A Only because of the transfer provision.

Q That's okay; that's a good answer. Now, as to these particular pressure sinks as they are shown on the exhibits, I guess it is 11 and 12 basically where they appear, isn't that right? On 10 they do not appear, isn't that correct?

A Well, they are building, the sinks themselves. I mean, actual closure of lines aren't there, but certainly the effect of drainage is there.

Q Let's say on 11 and 12 where the sinks are exemplified, do you actually have data to locate all those contours, particularly those near the western edge, the contours of the sinks?

A On this one here?

Q On either 11 or 12.

A All right; 11 or 12. Let's start with 11. I was pretty sure that we were going to have that question and that's why we dashed them in. I have another red pencil here and if you don't want to take the contour lines, let's take the individual well pressure and draw some arrows. Let's throw all the contours out. If you would just look at the pressures alone you would see that there is still an arrow up there; there is still an arrow in there (indicating).

There are still arrows coming across to this low pressure--let's make it down here (drawing on board). All of these pressures down here are higher.

Q Do you know the pressures on the west?

A Well, there is no "J" sand drainage out there, I don't believe. Nobody is out there producing that water.

Q Is there water?

A There is some.

Q Is any of it coming in?

A It has certainly been picked up slightly in here (indicating). I don't know; if you get into engineering terms it might be called a very slight encroachment. I think water is always moving to some degree.

Q Of your knowledge do you know whether or not that water is enough to create pressure?

A Well, it is there under pressure.

Q It wouldn't move in if there weren't pressure, isn't that right?

A It wouldn't move in if there was a pressure differential of some degree.

Q Well then, what is your explanation without my interrupting you as I have been, for which I

apologize.

A That's all right.

Q ---as to why you think it is proper to draw those pressure sinks there or to pull the red lines there which you now have in the absence of data showing pressures on the west side of those sinks?

A Well, all we can do on the west side, you can open these up if you want on the west side. We are not concerned with the west side drainage here. If these open up to the west you are still going to have these arrows and you are still going to have the migration across the property lines, and I don't think that changes one thing about it.

COMMISSIONER BRETSCHNEIDER: Are there any wells out there?

A No, no "J" sand wells beyond the limit of the lines here (indicating).

COMMISSIONER BRETSCHNEIDER: How would you be able to get any pressures without any wells?

A That was the question I was asking Mr. Kirgis.

MR. KIRGIS: That was my question, but there is a water drive which you say you consider rather negligible, but if the water is coming in it is coming in under pressure higher than that which exists to the

east of it, isn't it?

A Would you please ask that again?

Q If the water is coming in at all, even though as you say it is coming in in relatively slight amounts, it nevertheless is coming in under pressure in excess of the area into which it is moving, isn't that right?

A Not necessarily.

Q Why not?

A If that pressure drop--we don't know what it is--we don't know what has been experienced out here in pressure drop. Somebody would have to drill wells out there to really have anybody get a real good idea what that pressure was. The only thing we have got here is reflections of these pressures here and we can construct and everybody is going to contour a little different, but you do have reflections of what it might be on the fringe edge of the field. I can't tell you what it is out here (indicating).

Q I understand that, but isn't it also true that the water wouldn't be moving in unless there was a pressure differential?

A That is true, what water there is moving.

Q Now, I believe that you testified on direct

examination that Petroleum Incorporated was represented at the various engineering meetings at which this formula of oil in place was discussed or developed. Am I right in that?

A That's right.

Q Is it your testimony that Petroleum Inc. agreed that that formula was a right formula or that it was one proper for allocation of oil in the field?

A As far as I know that was the feeling I had of their representatives just as all the rest of us that did all of this work. We were pretty well sold on it all the way along until the answers came out and I think some orders came back.

Q Did you actually unitize solely on the basis of oil in place?

A We tried to first.

Q Did you?

A No.

Q What other factors were taken into account?

A March 1955 production--no, it was thrown in and for a period which was called the primary production period it was given a certain amount of weight in the formula, and then after that amount of oil had been produced we went to the straight oil and gas in place

formula.

Q After-- I am sorry, I missed the last part.

A After what we felt was the primary production in the field we established a primary production reserve and through negotiations it was used to set up that figure during which this two-phase formula using the March production was used. After that amount of oil had been produced out of the Adena Field we went and agreed and unitized on the basis strictly of oil and gas in place and their values.

Q But you did give weight to March production?

A I didn't.

Q In the formula which finally was used for unitization that was given weight?

A Weight was given, that's right.

Q Do you know how much weight it was given?

A It was given--in the oil zone only it was given one-third weight and two-thirds were given to the value of the oil.

Q Why was March of 1055 selected as the period for production?

A Well, I think it was the last month that we had the data on and they just agreed on it. It was done in the interests of unitization, getting it done in a

hurry. Some people were willing to give up a little.

Q Does the formula which you now propose in this proposed order take into account recoverable oil as distinguished from oil in place?

A Certainly oil in place is a reflection of it; that's why it is used.

Q Is oil in place always the guide to recoverable oil?

A Well, right here, yes, in Adena it is.

Q Why?

A Well, I believe it is.

Q Why do you believe it is?

A Because without migration and rock characteristics, and the oil characteristics lend themselves, if there is no migration across property lines, then the recovery is going to be substantially the same on all properties.

Q Have all wells there been completed with the same degree of efficiency?

A Substantially.

Q Do they all produce at the same gas-oil ratio?

A No.

Q Is that a factor which determines recoverable oil?

A It depends on the set of rules you are talking about. The amount of recoverable oil is more susceptible to the rules than it is to the actual effect of each individual well or the efficiency.

Q Do you mean by that rules of this Commission or are you talking about engineering rules?

A Field rules.

Q Field rules which might be established by this Commission?

A Yes.

Q How does that affect recoverable oil in place and particularly that factor of gas-oil ratioes?

A I said the field rules might be enforced, one set of rules against another; that is certainly going to affect the ultimate production from individual properties more than if, as you referred to, the efficiency of completion of one well versus another.

Q How about gas-oil ratioes?

A Or the gas-oil ratio.

Q You are not saying, are you, that a well with a low gas-oil ratio may not produce more oil than one with a high gas-oil ratio, or are you saying that?

A It all depends on what you restrict that well to. Either a low ratio well or a high ratio well

can produce more than the other, depending on what restrictions are placed on that well.

Q Suppose there is a 100 barrel restriction?

A On each?

Q And you have got a low ratio well and a high ratio well; which ultimately is going to produce the most oil?

A You have got to add a lot more conditions than that.

Q Other things being equal?

A All other things being equal?

Q Yes.

A If you have two different wells in two different reservoirs or the same reservoir?

Q The same reservoir.

COMMISSIONER BRETSCHNEIDER: If they were equal they couldn't produce on the same basis.

A I wouldn't necessarily say-- I think what you want is a low ratio well produces most.

Q Isn't that true?

A Not necessarily, no.

Q Why not, if other things are equal?

A It depends on a multitude of factors that can't be equal or they would be in the same spot.

Q Location, that's correct.

A Well, I mean, to me that is hardly realistic because you never find the other conditions equal in the oil industry.

Q In general experience then, generally speaking, is it not true that your low gas-oil ratio well will produce more than your high gas-oil ratio well, more oil?

A Not if the high ratio well is allowed to produce maybe longer.

Q Well, let's assume the same period of time.

A No, then they will produce the same. As you said, they were both 100 barrel wells.

Q You have now gone back to the other hypothetical assumption which we made awhile ago.

COMMISSIONER BRETSCHNEIDER: What are you trying to prove, Mr. Kirgis?

MR. KIRGIS: I am trying to prove that a low gas-oil ratio well will normally, absent other limitations, produce more oil than a high gas-oil ratio well, that it has an advantage in that respect by reason of the peculiarities of the reservoir or that portion of the reservoir into which that well has penetrated, and I think it is obvious, but the witness

doesn't.

COMMISSIONER BRETSCHNEIDER: It seems to me you have to consider so many factors that you can't make a comparison like that. You have to first go back to the oil in place, don't you, and what kind of a formation you have and all of the factors that lead to production of oil and gas?

MR. KIRGIS: That's correct.

COMMISSIONER BRETSCHNEIDER: And you can put up a hypothesis this way or that way but you can't come out with an answer to answer this question.

MR. KIRGIS: But I have asked the witness at one time so to assume that all other things were equal.

COMMISSIONER BRETSCHNEIDER: They can't be equal.

THE WITNESS: Something has got to lead to this alteration of ratio.

Q One may be nearer the gas cap than the other.

COMMISSIONER BRETSCHNEIDER: Then all things are not equal.

THE WITNESS: Certainly; now put some conditions on it and we can start talking. You better add a few more because I still can't answer you.

Q All right. On the matter of recoverable oil

one of the factors taken into account apparently was connate water, is that right?

A That's right.

Q Does connate water have any direct relationship to the recoverability of oil?

A Yes.

Q In what way?

A The more water there is the less oil there is to produce.

Q There is less oil there to produce?

A Yes.

Q Now, assume a given amount of oil there to produce in some particular instance. Well, let me take that back; that won't work. Let me ask it this way: if you have a greater amount of connate water in one strata than you do in another, are you going to recover normally a larger percentage of the amount of oil which is there in the one instance as against the other?

A Other conditions being equal?

Q Yes.

A Well, certainly the amount of oil-- Actually what it boils down to--you can straighten him out and me, too, if I am not right, Herman--is the relationship between the volume of oil and the volume of water in any

particular porose medium, and there is some differentiation between percentage recovered depending on those ratioes. This subject was again one of those that was considered by the Engineering and Geological Committee. At that time it was the unanimous opinion of all--they can refute any of this they want--but at least we said that in our opinion that that need not, it was not necessarily a refinement, that's even an additional refinement over what we have done, and that the effect of that would not be such that it would materially affect any one property in relation to another.

Now, I will go further to say that if there is any difference it is certainly going to be to the disadvantage of the people that are structurally low and have the higher connate water, which happens to be your client, so if we were to go back over all of this work and incorporate relative recovery factors dependent upon the ratio of water and oil, Pet Inc. would have less than 7.1 percent of the recoverable oil.

Q That's on the basis of connate water as a factor in determining recoverability, is that right?

A That's right.

Q Let me in summary on this point see if I understand you correctly: It is your belief that

basically oil in place and recoverable oil will not vary substantially, is that right?

A Not if you don't allow migration in the Adena Field, unless you bring in time. Now, some of this 10.4 was because of time. Pet Inc. produced or had their properties drilled up earlier and a lot of it was before there were any rules. We are not asking for any of this oil that we have already lost; we are talking about recovery from now on.

CHAIRMAN DOWNING: I remind counsel he thought he could finish in fifteen minutes.

MR. KIRGIS: Beg pardon?

CHAIRMAN DOWNING: Counsel thought he could finish in fifteen minutes.

MR. KIRGIS: It is difficult to tell how long it may take to cross examine a given witness. I am almost through.

Q May I ask this just in clarification of your position: Is it your thought that in oil pools generally as distinguished from Adena as an individual pool, that oil in place without taking into account recovery factors is a proper basis for division?

A It would have helped a lot of oil fields suffer a lot less drainage.

Q Basically your position is a drainage position, is that right?

A Now we are talking--I think right now your question referred to a drainage position? Yes.

Q And your statement as to the fact that recovery would be the same in different areas of this pool is based upon prevention of drainage, is it not?

A Yes.

MR. KIRGIS: That's all.

MR. STOCKMAR: Just a few questions, if I may.

CHAIRMAN DOWNING: Go ahead.

REDIRECT EXAMINATION

BY MR. STOCKMAR:

Q Mr. Weyler, you just said that recoverable oil bears a rather direct relationship to oil in place. Is that not true only under proper field rules?

A That's what I tried to say.

Q In other words, if we were to write a rule which would close in all of the unit properties but permit Petroleum Inc. to continue production for an indefinite period of time they would soon reach a recovery factor of 100 percent, wouldn't they? In other words, they would take out the equivalent of all the oil originally in place, right?

A That's right.

Q Continuing, 200 percent, 300 percent?

A Not all the oil originally in place.

Q The equivalent of it I said.

A Yes.

Q Amount of oil equal to that which was under their property?

A Oh, yes.

Q Isn't that occasioned only by that absurd kind of a field rule?

A That's right; sure they could deplete the reservoir if we shut in.

Q Getting back to this 1,800 gas-oil ratio. If because you are permitted to produce wells at 1,800 to one, to do that would you not have to pick out your highest gas-oil ratio wells and produce them instead of the others?

A Yes.

Q And by doing so would you not be denying the right of selective production that we have fought so hard to get here?

A Yes.

Q Would you not lose ten million barrels of recoverable oil by doing that?

A Yes.

Q And again you do not intend to do that?

A Hardly.

Q Now, with respect to the gas allowable assigned to the gas cap itself, is that to permit you to produce gas from the gas cap wells?

A No.

Q Is it to give you credit for your right to produce such gas?

A Yes.

Q After you have used it efficiently?

A Yes.

Q With respect to the unit, or rather the pressure lows that are indicated there, and with respect to the one appearing on the unit property, Exhibit 12, as I understand it, is a differential map showing the difference between 10 and 11, is that correct?

A Yes.

Q Do you notice any distinct increase in the rate of pressure decrease in that area?

A Certainly, it is very apparent. The greatest increase measured in any well is the Petroleum Inc. Lodestar No. 7, 111 pounds.

Q I am trying to get up to this very briefly,

Mr. Weyler. Is it not quite possible that the pressure low on the unit properties is a result of the existing field rules?

A Partially, yes.

MR. STOCKMAR: I think I have no further questions.

MR. KIRGIS: May I ask just a question on one point. It was brought out just now, that you had transferred or could under the proposed rule transfer the gas allowable for gas cap wells elsewhere?

A Yes.

Q (By Mr. Kirgis) The net result is that individual wells could or would be operated at ratioes in excess of 1,800 to one, is that not right?

A Are you talking about the proposed rules?

Q Yes.

A We don't have any well allowables in the proposed rules.

Q No, but you and I went through the mathematics whereby on the average the unit would be allowed 1,800 to one, did we not?

A That was your way of looking at it again.

Q Yes.

A That's right.

Q Now, actually under the transfers which are permissible and in view of the fact you do not propose to produce from the gas cap wells as you state, then some individual well might be produced well in excess of 1,800 to one, might it not?

A No, it won't; it certainly won't.

Q Then why do you need all this allowable? Why do you then have to put in the gas cap gas into your allowable?

A It is going to be produced one of these days.

Q Well, maybe some day down the line, but eventually you could produce more than 1,800 to one, couldn't you?

A There is a gas cap allowable now on a well basis. We haven't done anything different in these rules except change the basis of the allowable. The State has given an allowance for gas owners to produce gas if they drill a well.

Q I don't want to argue the point, but I would like to restate a question and get an answer to it, and that is whether or not under this proposed rule where you do give gas allowable to the gas cap wells it is not perfectly possible that you produce some other well in excess of 1,800 to one?

A It is possible; I will have to agree to that. We are not going to do it.

Q If you are not going to do it would there be any reason for giving an allowable to the gas cap wells the transfer of which could only have that result?

A Yes, there is.

Q Why?

A We are not going to leave that gas cap there forever; we certainly plan to produce it and we certainly feel that the gas cap owner which is now the unit is entitled to a fair share of that gas.

Q Then you are going to have to produce it at this ratio sometime or other in excess of 1,800 to one, aren't you?

A Everybody is going to be over 1,800 to one if we don't get water in there.

CHAIRMAN DOWNING: Is that all?

COMMISSIONER BRETSCHNEIDER: I would like to ask a question right there.

BY MR. BRETSCHNEIDER:

Q Isn't there a value accruing to the unit or whomever may own the gas cap wells or the owner of the gas cap wells who has a percentage interest in the unit?

A Yes, sir

Q He gets credit by virtue of the gas allowable in the gas cap wells?

A Not exactly because of the allowable. We calculated the value of the whole gas cap and the value of the gas under each property and it was lumped with all the oil values of the people that unitized and the gas cap people in the unit are sharing in the oil and gas production from low ratio wells as can be produced.

Q That's what I wanted to bring out.

A They are sharing according to the value ascribed to their property.

Q Doesn't that answer his question?

A Well, it kind of helps.

Q Sure, they get the value in the percentage, don't they?

A Yes, it's all ours.

Q They have a percentage of the unit. The gas is figured in the unit, so they must get a value.

MR. KIRGIS: Mr. Commissioner, I don't propose to argue the case now, but I would like to point out there one thing which in my judgment the Commission must be concerned with here as, for instance, it is in Rangely, is gas-oil ratioes and the porosity of excessive gas-oil ratioes. The mathematics of this

proposal amounts to permission on an average throughout the unit area of 1,800 to one. Now, that includes allowance of gas for the gas cap area. I am not saying that that is improper, but I am saying that the net result is that if they are ever going to use that--since they won't produce from the gas cap, so they say that they are sometime or other going to be producing wells, individual wells, obviously well in excess of 1,800 to one and it will be part of my argument and part of my position that that may be a wasteful thing and that it is contrary to the function of this Commission.

MR. STOCKMAR: Mr. Kirgis, maybe we can shorten this a little bit. In other words, you will subscribe to the formula but you do not subscribe to the high gas allowable, is that what you are saying?

MR. KIRGIS: No. I think what I said could not be so construed.

MR. STOCKMAR: I will state for the commission here that if someone is concerned about the twenty=seven million cubic feet per day allowable which we do not expect to approach by any means, that a substantial reduction of that may be in order. It may shorten the time and we can come back and say, "The field gas-oil ratioes now require a raising of this."

MR. FREEMAN: Ted, is it our understanding that you intend to produce it as efficiently as possible but you want this margin, is that right?

MR. STOCKMAR: That's where we are going to get the ten million barrels that we are not going to get any other way. That is testimony. I will take an oath here.

THE WITNESS: He is right.

MR. KIRGIS: In other words, this is merely a formula to raise your oil participation right?

MR. STOCKMAR: It is a formula designed to give appropriate credit monetarily, if you will, to the gas cap owners who are increasing the ultimate recovery for all operators by not bleeding off their gas cap, which they are legally entitled to do.

MR. KIRGIS: Mr. Commissioner, I think we might argue this in a more orderly manner at the conclusion of the testimony.

CHAIRMAN DOWNING: Yes, any more questions of this witness? If not, you are excused. Thank you very much.

(Witness excused.)

MR. STOCKMAR: That does conclude our case, depending upon what develops on the case of Petroleum

Inc., however we have reams and reams of figures and work here and I would like to bring back these witnesses if required to rebut any testimony that is given.

MR. KIRGIS: Mr. Commissioner, it will take us just one moment to rearrange some things.

CHAIRMAN DOWNING: I will ask to be excused. They can go right on.

MR. KIRGIS: You are asking to be excused?

CHAIRMAN DOWNING: Yes.

MR. KIRGIS: Have we still got a quorum?

(Discussion off the record.)

MR. FREEMAN: In view of the fact that you will be leaving in another half hour, if there is no objection it is stipulated by the two parties that this case may be heard by Mr. Bretschneider and Mr. Eames and the decision will be made by the Commission, but they waive any technical objection to not having a quorum here to hear the evidence, is that correct?

MR. STOCKMAR: That's correct.

MR. KIRGIS: That's right.

CHAIRMAN DOWNING: And Dr. Van Tuyl, of course, disqualified himself, but I imagine that by consent of the parties in interest he can continue to serve.

MR. STOCKMAR: We certainly have no objection

to that.

MR. KIRGIS: We don't raise an objection. I understood Professor Van Tuyl disqualified himself. We aren't requesting it or requiring it.

COMMISSIONER VAN TUYL: I have no interest in the controversy, but I have a slight interest in the unitized area.

MR. STOCKMAR: That is not a statutory basis for disqualification, Doctor. We certainly have full confidence in your ability to overlook that.

CHAIRMAN DOWNING: If anybody has any interest they disqualify themselves, but if the parties don't want him disqualified, I don't imagine he has to persist in it.

MR. KIRGIS: Well, our position is this, that we have no objection to Professor Van Tuyl's participating. If he, however, feels in his own mind that as I understood he wanted to disqualify himself, we certainly do not object to that either.

COMMISSIONER VAN TUYL: Under the circumstances I will serve in order that we may have a quorum.

MR. STOCKMAR: Fine.

MR. KIRGIS: Are we ready to proceed with Mr.

Kavaler?

CHAIRMAN DOWNING: Yes.

HERMAN H. KAVALER

called as a witness on behalf of Petroleum Incorporated, being first duly sworn according to law, upon his oath testified as follows:

DIRECT EXAMINATION

BY MR. KIRGIS:

Q Will you state your name, please?

A My name is Herman H. Kavaler, spelled capital K-a-v-a-l-e-r. I am a resident of Tulsa, Oklahoma. I am a petroleum engineering and management consultant having practiced that profession for the past thirty-three years. I have had some twenty years experience in connection with engineering and production research on oil and gas matters.

MR. STOCKMAR: We will be very glad to accept the qualifications of Dr. Kavaler.

COMMISSIONER BRETSCHNEIDER: We will accept his qualifications.

Q Are you familiar with the Adena Field?

A I am familiar with the Adena Field and have followed it rather closely since early in 1955 when Petroleum Inc. employed me to act in an advisory capacity to

them. I have familiarized myself with all the reports that are available through public sources and have had the benefit of the very substantial volume done by one of my competitors, the Core Laboratory, Incorporated.

Q Mr. Kavaler, I hand to you here a map or plat, call it what you will, which bears the designation on the printed part of "Exhibit A." Can you explain what that designation tells us?

A Exhibit 1 is a map of the Adena Field which was drawn up to show first by a combination of the blue line and the red line the boundary of the field as fixed by orders of this Commission. The map shows further the area enclosed by the red line, which is the boundary of the so-called Adena sand unit.

Q "J" sand unit?

A The Adena "J" sand unit. The map further shows outlined in yellow and shaded in what appears to be gray or black pencil the tracts owned by Petroleum Incorporated and its partners. Petroleum Incorporated owns four leases in the field which on this Exhibit A, marked Petroleum Inc.'s Exhibit No. 1, might be conveniently designated as tract 7, tract 14, tract 63, which is a separate lease, and tract 62, which would have been the tract numbers had those tracts gone into

the unit. Petroleum Inc. has a producing well which lies outside of the unit area but within the designated Adena Field which they have recently drilled. That well is on tract marked 81 and it is denoted as the present Petroleum Inc. Delaney No. 1 well. That well was just recently drilled and completed.

Q Mr. Kavaler, just so that the base map may be understood, the base map is marked as Exhibit A. Where did that base map come from?

A I believe that was the map that was prepared by Pure Oil Company which was an attachment, one of the attachments to their application in this case.

Q That was at the time of the hearing on unitization, isn't that right?

A Yes, I believe so.

MR. KIRGIS: We ask that this be marked as Petroleum Incorporated's Exhibit 1. I wanted to explain this as a carryover from the former Pure Oil Exhibit 1.

Q Now, Mr. Kavaler, in your judgment--or, first, are you familiar with the present order of this Commission which is now in effect in the Adena Field "J" sand unit or "J" sand pool?

A I am. I think the present order is identified

as Order No. 26-27.

Q Can you express an opinion as to whether that order protects against waste from the standpoint of physical waste and not taking into account at this moment questions of correlative rights?

A It is my opinion that the present order by the Commission adequately prevents waste in that the order as it presently exists carries the provisions in respect to limitation on oil allowable, 125 barrels a day, and the limitation on gas allowable of 150,000 cubic feet, which the Commission first said in its order of June the 4th 1954 in an order No. 26-9.

Now, the present order, 26-27, has the same provisions in respect to waste prevention which the Commission set June 4th 1954, so I am firmly of the opinion that one of the reasons that we can be proud of the Adena Field is that for almost two years now--in fact, two years exactly--this field has been operated under an order of this Commission which in my opinion is very effective as a waste prevention order.

I can find nothing in the present order which would lead to waste. I also was impressed by Pure Oil Company's representatives in respect to the fact that they presented no information which showed that waste

was occurring in this field. In my study of the pressure decline that has occurred and my particular discovery that this field has produced some 1,885,000 barrels of oil with a production of only 740 cubic feet of gas per barrel, that denotes a very conservative expenditure of gas for the recovery of that quantity of oil, and I don't think that anyone could successfully contend that the Adena Field now or has it in the past been operated in a wasteful manner.

Q Have you heard the testimony of the two witnesses presented here today on behalf of Pure Oil Company?

A I have.

Q Have you heard their testimony regarding drainage and the alleged effect on correlative rights?

A I have to the extent that I understood them, yes, sir.

Q In your opinion is there under the present order any deprivation of the correlative rights of unit owners by reason of the operation of the Petroleum Inc. properties?

A I do not think so. I think it would be fair to call the Commission's attention to the fact that in respect to the correlative rights problem as well as to

the conservation problem, the fact that a unit has been formed of approximately eighty separate tracts does not in any wise pose a problem to the Commission in respect to correlative rights or to conservation that did not heretofore exist.

Now, before the Adena unit was formed on the 1st of January there were some, let's say, eighty-four tracts in the field, and the Commission's order applied to each of those separately owned tracts. Now, eighty of those tracts have been formed into one lease. The only thing different about Adena today c er January the 1st 1956 is that there are now five separate tracts, four owned by Petroleum Inc. and one owned by Pure Oil Company, et al, so that whatever problem the Commission had beginning in June 1954 to bring about conservative operation and the prevention of the abuse of correlative rights, that problem which they solved then by an order is the same problem which I think exists today, which I think is adequately met by the existing order, so that I find nothing in my study of the situation which would warrant the Commission adopting a unique and extremely scientific highly profound policy to correct an alleged abuse of correlative rights.

Now, I would further say to this Commission

that even on scientists there is a limitation. We all search and seek the truth. We seldom find it. It would be a magnificent thing if some order of this Commission would accomplish the driving of a fence around each of the separate leases so that there would be no migration. Perhaps we might get a Federal grant to construct a subsurface concrete dam around each of these separate tracts. Something like that might be possible, although it might be distant.

There is no oil field that we know with such precision that anybody, including myself, can tell precisely how much recoverable oil is beneath each separate tract. There is no one with such precise and infinite knowledge that he could tell this Commission how to prevent drainage across lease lines. Every conservation commission with whom I have had anything to do, while they desired that infinitive knowledge, were always handicapped by practical considerations. Drainage always occurs. This Commission may seek to minimize it. In seeking to minimize the drainage this Commission in my opinion is limited by the fact that the people of Colorado still have an interest in the greatest ultimate recovery of oil.

I know of no way whereby the greatest ultimate

recovery of oil can be had and at the same time the Commission would have full assurance that Pure Oil Company's plan would prevent drainage from their land onto Petroleum Inc., because the Pure Oil Company's plan might result in the drainage from Petroleum Inc. to the Pure Oil Company and that may not be so bad in their eyes, but it is terrible in ours.

So that I know of no oil field that can be gauged and regulated with such finesse that all parties would be satisfied that drainage would not occur.

Now, you can't count green cherries on a cherry tree and tell how many ripe cherries will be harvested, and that ought to be a relatively simple problem, because the cherry tree is on the surface of the earth. I would say that it is exceedingly difficult if the cherry tree were buried 5,500 feet to determine first how many green cherries were on it and to have any opportunity to judge how many of those would ripen at that depth; at least when you are that remote from a cherry tree you don't know very much about it.

Now, it seems to me that to make my testimony short I might call the Commission's attention to the fact that there is one lacking element in the considerations which Pure Oil Company have presented to you, and

that's the consideration of the productivity of wells. You might tell an old boy who came out here and drilled an oil well on the edge that "You just got five feet of sand, and therefore you don't get much allowable because the connate water or the permeability or the core analysis or something was wrong with his well," but he is apt to take the viewpoint that the best way to determine whether or not he is going to make anything out of that edge well is to produce it and see what it will yield.

When a farmer trades one cow for another cow he might measure the length of the horns and the length of the tail and take a core analysis of some part of the cow, but he is certainly going to ask finally how much milk does the cow give; and it's the amount of milk that the cow gives that finally determines the value, and as I see it, in all of the testimony that Pure has presented there has never been a mention made of the word permeability, which determines the productivity of the well. No mention was made of the fact that if a fellow had low permeability he could still fracture his well and increase the production, no mention of the fact that maybe Petroleum Inc. have got the best wells in the field from the standpoint of their productivity.

They certainly are doing pretty well according

to that one exhibit. They have out-produced everybody else and their wells are just as good today as they were, so that I would, in brief, say to you that the lack of consideration to the thing that has always stood in the oil business as a measure of the value of a well, its productivity, has been utterly disregarded.

Now, I would say further to the Commission in that regard that whatever these eighty-five fellows agreed to among themselves, they could do all the horse trading they wanted to, they could enter into any kind of a contract that they wanted to, but whatever contract they entered into among themselves certainly is not binding upon this Commission nor can it be held up as a paragon of decency and equity, to apply as between now this big lease and these four small leases that are not in the unit.

I don't know of a conservation authority that asks a group of people who formed a unit "on what basis did you trade your properties," and then take that basis of that private trade and say, "Well now, we will adopt that as a conservation measure and a measure of the correlative rights of the parties in our oil fields in this state." That in itself would be a most unique thing in my opinion.

So there is no dignity about this private contract as it applies to the public duty that this Commission must perform. Now, there is no doubt but what there is a great deal of work that has gone into the production and the formation of this unit, and it is a wonderful thing. Petroleum Inc. only regrets that it can't join, but who, if the Commission is to adopt a policy of using core analyses, electric logs, and who in the Commission, who is to produce this volume if this is to become the standard of allocation in Colorado (indicating book).

Is Adena to be the only field that will have this unique super-scientific method of allocation applied to it? It took these gentlemen two years to produce that result. If the Commission decides to accept this oil in place theory, then who is to do all the scientific work that needs to be done to reach the conclusion? Will you call upon an operator in the field to do it? Will you call upon a committee of the operators? Will you ask the Commission staff to produce a book like that for every field that you have jurisdiction over? And if the Commission staff seeks to determine the oil in place under this new theory, will the Commission staff give weight to electric logs? And

if they use electric logs will they use the resistivity curve or the normal curve or the long normal or the lateral curve, or will the Commission staff also use micrologs, and will they use radioactive logs and will they call a driller in here to testify and use a driller's log to reflect the character of the oil in place? Or will they have geologists come in who have examined the sample cuttings, or what combination of these things will you use to determine this elusive thing, the oil in place beneath each separate tract?

Will the Commission in determining the oil in place also consider that there might be oil in place but it might not be recoverable? Will the Commission recognize that some people are just better well drillers than others? And will the Commission recognize that sometimes you have bad luck in completing a well and sometimes you have good luck? And will the Commission recognize that a man might have sand fractured his well and changed the productivity and changed the concept of recoverability very markedly?

Now, all these things in the course of the oil business as it is normally carried on in this country, all those things go to determine how much of the oil in any pool or beneath any tract is actually recoverable;

and who will say what the percent recovery will be?

Now, this whole matter is so profound that there are certain subtleties involved in it, and one of them I would like to call to the attention of the Commission. In order to form this unit this is one of the things they did: They decided that they would use this chart, which I think is marked Exhibit 2 in this hearing. Now, the permeability simply is a measure of the size of the pipe through which the oil flows. A six-inch pipe has higher permeability than a two-inch pipe, and oil sands, they are coarse-grained and they have high permeability and they are fine-grained and they have low permeability.

Now,it is true that lower permeability sands retain more of the old sea water that once filled those sands than do the high permeability sands, and so while this Exhibit 2 can't be proven beyond doubt, all of us engineers suspect that there is some kind of a relationship between permeability and connate water.

Now, this is represented to the Commission as being a thing that is fixed and determined. It isn't. This is just a good educated guess, and that's about all. I could draw one with equal faith that would look a lot different than this one, but the point, Mr. Commissioners,

is this: Here's a fellow who, let us say, has sand that is ten millidarcies and he is sixty feet above the water table, and this chart says that forty-two percent of that ten millidarcies sand is still filled with water, so we can write down that the connate water content of that well is forty-two percent, and that means then that if it were all oil down in the oil patch that there would be fifty-eight percent oil saturation in that particular well; that's the oil saturation in that particular piece of rock.

Now, let's take a brother who is right down on the water. That is my client. Most of my clients are right down on the water. And he had ten millidarcies and he was only three feet above the water table, if that is where the water table is, and they come to the conclusion that anybody who has got ten millidarcies of sand and he is just three feet above the water with that foot of sand, that ninety-seven and a half percent of that rock, pore space, the connate water is ninety-seven and a half percent. He ain't hardly got any oil at all, because his oil saturation is only two and a half percent.

Now, they say the people didn't quarrel about that. Petroleum Inc--it didn't do them much good to

quarrel, but they would go along with that concept apparently from what my friends of the Pure say. But, the discrimination that was shown, and one of the reasons that Petroleum Inc. can't accept that unitization agreement, one of the reasons is this: that when they got all through with this fancy scientific study they said, "All of the oil in this field is recoverable only to the extent of twenty-nine and a half percent," or whatever the figure is. Is that it, Jack?

A VOICE: 29.9

THE WITNESS: 29.9. They took that recovery factor and applied it to the oil which was in this ten millidarcy sand sixty feet above the water and applied it to this ten millidarcy sand which was three feet above the water.

Now, I suggest to the Commission that you don't have to be a scientist to recognize immediately that what this little bit of oil was more recoverable, a greater percentage of that could be recovered than this larger amount up here (indicating), because I think the Commission understands this connate water concept. If this is a pore space (drawing on board) between four spherical grains of sand, that is the connate water that fills this pore space like that (indicating), and whatever

oil is out there it is a lonesome bit of oil out in the middle.

Now, if there is ninety-seven and a half percent of that pore space filled with water, then that little drop of oil that is out there, it is ready to go the minute there is a pressure difference, so the error that resulted from an application of one recovery factor after going through this high-powered science, the high-powered science would require that they apply a recovery factor to each foot of sand just like they applied a connate water factor to each foot of sand, and they fell short.

Now, the result of that is this: that when you penalize the boys close to the water table, by failing to give them their appropriate estimate of the recoverability of the oil, you pick out people like Petroleum Inc. and you say, "You have just got a little bit of oil, but it is no more recoverable than the rest of the field," when the fact is there is a higher degree of the recoverability of the oil in place on those four places than on any others in higher structure.

Now, I know this Commission is interested in knowing why it is in my opinion Petroleum Inc. was discriminated against in this unit agreement, and that

is one of the reasons, and in like manner Petroleum Inc. would be discriminated against if this Commission adopted the theory, the half-way scientific theory in the allocation of oil in this field.

I would say this further to the Commissioners, that every oil field, every oil field has an edge unfortunately they don't go on forever and ever. And you adopt this business of allocating oil in place as a policy of this Commission and there will be many and many a fellow who would like to drill an oil well on the edge of one of these fields in Colorado, and the people in Colorado would be very much interested in having him drill because it is very important to find the edge of these oil fields. No oil field is conservatively exploited until the edge of it is determined. But when some operator, one of the edge boys, wants to come out and perform a service by drilling a well off on the edge and he says, "Oh, my God, I can't do it because the Commission will slap this new oil in place business on me and I won't be entitled to produce if I do have recoverable oil in place."

To me this oil in place idea has beautiful theory but the oil business is still a practical matter and it would be more practical for the State of Colorado

to adopt an oil in place theory even though the question be worked out, and hope to cause the oil business to flourish and to prosper in this state.

Q Mr. Kavaler, do you know of any instances where a formula of the type proposed in this newly proposed order has in fact been adopted as a matter of exercise of the police function?

A It has never been adopted to my mind. I think it has been tried only once, and that was by John Hoyle and myself over in Arkansas, and we didn't get very far, but I don't know of a jurisdiction that has adopted this super-scientific approach simply because you can't tell what the recoverable oil is in an oil field.

Q Does this proposed formula--you may have answered this, at least in part--does this proposed formula deal with actual conservation or securing the greatest ultimate recovery on the one hand, or on the other hand does it deal only with a division of the pool?

A This order, application by Pure, et al, in my opinion deals only with the matter of dividing the common source of supply among the owners. It does in no wise deal with the question of conservation.

Q In your judgment if one were to take oil in

place as a guide for determination of participation, would it be necessarily oil originally in place as distinguished from oil in place at some other given point of time?

A Well, I would say to the Commission that if you did adopt a theory of allocating production in this field on the basis of oil in place, certainly equity would require that the allocation be done on the basis of the oil in place from month to month, if not from day to day.

Now, I think it is slightly ridiculous to come here some--what is it, three to four years after the field is discovered--and after eleven million barrels of oil have been produced and about eleven billion feet of gas has been produced and ask this Commission to hold up its strong arm and say, "Let's back up boys and let's start over," because you might find in some of these oil fields in California that you have some diligent people who go forward and drill and develop and produce, and you have laggards who trail behind them, and if you adopted the theory of this application and say, "Let's back up to the discovery," then you would penalize those people who have been diligent and have done the things that the State is interested in doing,

going forward forward to develop, so that I think it is obvious to the Commission that equity would demand that if you are going to allocate upon the basis of oil in place, then each month you would have the problem of determining what the oil in place is.

We would have to bring these pressure sinks in and unsink them and sink them and the Commission would have to deliberate about how you would change the formula so that it would more nearly fit, because this migration is one of the things that is beyond our control, and it would be foolish to try to persuade this Commission that at this late hour we should go back three years to the past and use that initial state as the basis for our allocating the production in the month of July 1956.

Q Mr. Kavaler, since the original discovery in this field have there been any indications that what is computed as original oil in place is not in fact there?

A You will have to give it to me again.

Q Let me restate my question more simply and directly. Have any dry holes been drilled in this field?

A I believe that these maps would reflect the

fact that there have been dry holes drilled, yes, sir. There has been a dry hole drilled on tract 25.

(Judge Downing leaves the hearing room.)

Q Do you know whether this formula of original oil in place takes into account the fact that a well may have been drilled in a particular spot without getting any oil?

A Yes, I think that there is a dry hole, at least it is a non-producer, which has been given ten feet of oil sand credit in the formation of this, and that would be carried over into the proposal before this Commission. I don't think this Commission would want to give to the Pure and its pals credit for ten feet of oil productive sand when the well is incapable of producing anything and has been plugged and abandoned, and that error has been created.

COMMISSIONER BRETSCHNEIDER: Is that in the calculations?

A It is in the calculations before you, Mr. Commissioner.

Q Is it something then which would result if the Commission should adopt the proposed order?

A Yes.

Q Is the same thing true as to any undrilled

tracts in the field?

A Well, there are fourteen undrilled tracts in the field that produce no oil at all which were given credit for recoverable oil in the unit which would be carried over by the proposal. I could mark that on Petroleum Incorporated's Exhibit No. 1. I marked with a blue "X" the fact that Tract No. 3 in the Adena unit doesn't have a well on it, and it has not produced any oil at any time.

Tract No. 5 doesn't have a well on it in the Adena unit. It has a dry hole and it hasn't produced any oil to date.

Tract No. 6 has got four dry holes on it and it hasn't produced any oil to date.

Tract No. 11, which is over here (indicating, it's got it looks like a "D" sand well on it, no "J" sand. That hasn't produced any "J" sand oil.

Tract No. 12 doesn't have any production to date. Tract No. 24. The southwest of Section 33 has produced no "J" sand oil to date.

COMMISSIONER VAN TUYL: It has a "J" sand gas well?

A It has a "J" sand gas well, yes, Mr. Commissioner. Tract No. 35 has a "J" sand gas well on

it. It has produced no oil to date. No. 42 has produced no oil to date. No. 43 has produced no oil to date; it does not have a well on it.

No. 55 in the east half of Section 18 has produced no oil to date. Tract No. 56 has no well on it and has produced no well to date. Tract No. 72 has a gas well on it and has produced no oil to date. Tract No. 73 is a pretty good piece of country that has no well on it at all.

Now, I think those are fourteen tracts, and to those fourteen tracts are attributed 3,766,000 barrels of oil in place, and that figure is in the computation which Pure, et al, have presented here to the Commission, and they are claiming recoverable oil from those tracts.

COMMISSIONER VAN TUYL: Does that figure include recoverable gas as well as oil?

A I don't believe so.

COMMISSIONER VAN TUYL: That is my understanding.

A Just recoverable oil.

MR. WEYLER: Oil in place.

THE WITNESS: Oil in place, yes, sir, rather than recoverable oil, but that is not gas credit; that is simply the oil in place that they attribute to these fourteen tracts.

Now, I might say further to the Commission that there are five tracts which have produced less than fifteen percent of the recoverable oil that you would compute was attributable to the oil in place, and the average recovery of the field has been twenty-seven percent up-to-date. So these five tracts are running about fifty percent behind schedule. That's tract No. 29 here in the northwest of 5, and I will mark that with a double "X." Tract No. 34, that's in the southwest, and I will mark that with a double "X". Tract No. 48, and I will mark that---

Q May I interrupt. Are you making a distinction between primary oil and total oil there, or are you not?

A I am just talking about it, taking the reservoir oil in place and converting it to recoverable oil using the recovery factor 29.9, reservoir volume factor, 136.

Q Are we talking only in terms of primary recovery as distinguished from secondary recovery?

A Yes, in terms of primary recovery, and these leases have a productivity which would make it hard for anybody to believe, but they were oil leases in the ordinary sense; Tract No. 53 is another one. I will mark

that with a double "X" in the northeast of 18. Tract No. 84, which is the lease at the south end of the field, Section 30.

Now, those five tracts are attributed 11,268,335 barrels of reservoir oil in place, and yet their productivity belies to an ordinary oil man that they have anything like that in place.

Now, the Pure people come in and add that eleven million on and claim that they should be allowed to have oil allocated to them in this field on the basis of the eleven million and the three million, about fourteen million barrels of reservoir oil in place, which any reasonable oil man would consider to be recoverable oil at all, and this is Exhibit 3 that sets out the percent recovery of these (indicating).

Q Will you explain more fully just what Exhibit 3 is? I am sorry; that is out of order, but we seem to have deviated from our---

A Exhibit 3 lists the tract number.

Q This is Petroleum Incorporated's Exhibit indicated as No. 3?

A Exhibit 3 lists the tract number and under reservoir barrels of oil in place as reflect by Pure's application, and then I have converted that using the

recovery factor 29.9 percent and a reservoir volume factor of 136 and computed how much recoverable oil that reservoir oil in place represents, and I have listed the accumulated production of each tract down to the 1st of May and then I have computed the percent recovery of the oil in place to May the 1st 1956. For example, Tract No. 2 in this Adena unit has already recovered 104 percent of the oil that they said was in place. It has had a very good recovery. Then Tracts 3, 4, 5, 6, haven't recovered anything, although they are supposed to have around 65,000 barrels of recoverable oil in place.

Tract No. 8 has recovered fifty-four percent of the oil they say is in place, and No. 9 recovered seventy-four percent. About three-fourths of the way down, Tract No. 38 has recovered 102 percent of the oil that they said was in place, and these are shown for the unit and also shown for Petroleum Inc.

Q Petroleum Inc. figures are those in the lower right-hand corner?

A Yes, sir, so that I think that the performance of the field to anybody who looks at this in the conventional sense of the oil business would say that some of these tracts are highly overrated by Pure and some of them are highly underrated, and it just reflects

the fact that it is practically impossible to tell how much oil will be recovered from any tract in an oil field.

Q Do you take the position then that this Exhibit 3 and the figures shown thereon shows a disrelationship between oil in place and producible oil?

A Yes, sir.

Q Have you explained that as fully as you wish?

A I think I could explain that briefly by simply saying to the Commissioners that it is very difficult, if not impossible to examine the core data and the electric logs and other things and draw any conclusion that would be within a reasonable degree of accuracy about not only the amount of oil that is beneath the lease, but how much that lease will recover through the wells drilled on it. If any of us were that smart we wouldn't be here working this way.

COMMISSIONER BRETSCHNEIDER: Mr. Kavaler, do you think part of this might be the result of the fact that a field or part of the field, ninety-four percent of the field, has been unitized for six months os so when it didn't make too much difference from where the oil came and would there be a difference resulting if the field were completely unitized?

A Well, Mr. Commissioner, the fact that the field has been unitized, a large part of it, for six months, and I suppose Pure has taken more production from certain tracts as a result of that than they would if the tracts had been separated--there is a little bit of that element in there, yes, sir, but I don't think that that, taking it for the last six months, would be sufficient to warrant the general conclusion that I draw, and that is that what you get from a tract usually doesn't bear any real accurate relationship to what we think is the recoverable oil on the tract. There has been some effect of the unit operation and I think, Mr. Commissioner, you asked whether or not it would be better if the whole field were unitized.

COMMISSIONER BRETSCHNEIDER: If the result might not have been different.

A Not in the six months, Mr. Commissioner. I think that relationship would still be there. Maybe a year from now or two years from now it would be kind of washed out.

Now, if the field were unitized, Mr. Commissioner, the operator would undoubtedly try to take all of his production from the west edge and some of those tracts out there that produce 2,000 percent of the oil in

place as a result of that, yes, sir.

Q (By Mr. Kirgis) Mr. Kavaler, I hand to you--I will call it a chart for lack of any better designation--which has been marked on the back since there is no space left on the front, as Petroleum Incorporated's Exhibit No. 2. Will you explain what that is?

A Petroleum Incorporated's Exhibit No. 2 is a comparison of the success that we might have in using some of this scientific data to determine how much oil is in place.

Now, on this exhibit I have placed the electric logs for the Shell Oil Company Plumb No. 1 well, which is Tract No. 84, and that's down in the south end of the field, and that little wiggle you see on the left, the potential curve, that suggests the fact that there may be porous sand and the separation that occurs with the two resistive curves on the right suggests that this is permeable sand. It doesn't tell you what the permeability is, although the people who sell these logs will give you all kinds of instructions on how to calculate it. You don't always get the right answer.

Then there is the Pure Oil Company Geyer B-1 well, which is Tract No. 34, the B-2 well, which is on Tract No. 34, the Tomberlin Cochran well, which is Tract

No. 38, and I believe that's out on the edge of the field over here (indicating). Yes, it's in the northwest of Section 12, and we have the Lion Oil Company Roark No. 1, which is on Tract 55, which is on the southeast side of the field in the east half of Section 18.

Now, the reason I put these logs up here, you look at them and they all look pretty much the same. They all have a wiggle here on the self-potential side in all five instances. That one has the wiggle up a little higher (indicating). This wiggle up here corresponds to the one down here on these other four (indicating).

Now, the fact is if you look at the unit agreement which is the same as what Pure is proposing to the Commission, you will find that this Committee of engineers decided that the Shell Plumb on tract No. 84 had nineteen feet of oil sand, and therefore they gave that well a recoverable oil of 282,000 barrels. Now, that's recoverable oil. And over here they gave the Lion Roark No. 1, which had sixteen feet of gas sand and five feet of oil sand, they gave that well 292,000 barrels of oil. One of them had nineteen feet of oil sand and the other one had five feet, but they got about the same amount of recoverable oil. That's due to

this connate water business and these other gyrations that were involved.

Now, the Lion Roark No. 1 well never did produce any oil. It was a gas well and I think that an oil man would tell you that if you try to make an oil well out of a well that has sixteen feet of gas sand and five feet of oil sand, you have pretty tough shooting, but nevertheless they got credit for five feet of oil sand and 292,000 barrels of recoverable oil. It never did produce any oil, no production, shut down, and that's at 1048. That's high up on the structure. That's where the connate water is supposed to be low and it's supposed to have a lot of productivity, if you got an oil site.

On the other hand this well over here that had nineteen feet of oil sand and no gas sand completed a year earlier, had an initial gas-oil ratio of 814. It's down in the south end of the field. It now has a present gas-oil ratio of 2,866; that has gone to gas. It's got an accumulated production of 24,000 barrels. They got it shut down and it looks like they are going to fall far short of this 282,000 barrels. I don't even think they are going to make it or even get close to it.

Now, if you take those two situation and look at it--well, let's just take this Tomberlin Cochran No. 2 which is off on the west side. It had only thirteen feet of oil sand, no gas sand. They gave it 105,000 barrels of recoverable oil. It was down near the water and got penalized for having high connate water. It was drilled in February of '54, about the same time as this Shell Plumb. It had a gas-oil ratio to begin with of 748, which is pretty good, and now it has a gas-oil ratio of 709. It is better than it was, and it has produced 158,000 barrels and is still a pretty good well. It is producing 125 barrels a day, so there is something wrong with the calculations, as I see it.

Now, this happens to be 11,018, low on structure. It got a little oil by migration, I guess, but it sure isn't wasting anything, and Mr. Tomberlin was luckier than Shell. He bought the lease at the right spot and Shell is probably unhappy that they didn't get it instead of him.

And the Pure Oil Company in their two Geyer wells; here's one in Section 34 that has twenty-three feet of oil sand and six feet of gas sand and this committee after their scientific deliberations said it had 340,000 barrels of recoverable oil. It was completed

in April of '54, had an initial gas-oil ratio which is kind of high for an oil well, 3,325 to one. It has a ratio now of 9,582. It has produced 15,000 barrels and is shut down. I don't think it is going to get anywhere near 340,000, yet the unit people are asking for an allowable based upon that one.

This Geyer B is on the same lease, about the same proposition, twenty feet of gas sand, fourteen feet of oil; it got 250,000 barrels of reserves. They say it had an initial ratio of 8,277. Now, it has gone up to 11,819. It has produced 10,000 barrels of oil. It is shut down; I don't think it is going to get anything like 250,000.

So, while I admire and sometimes make an effort myself to estimate how much recoverable oil is beneath the tracts, I admire people who try that. I try it myself. It is practically impossible to look into the crystal ball and tell so I come to the conclusion long ago that its the capacity, the production characteristics of a well that measure what share it should have out of the pool, and I believe this Commission has all through its time used the individual well tests as a measure of what a well's capacity to produce is.

Now, the day may come when Petroleum Inc. can

join these fellows, but we are going to have to have a different set of arithmetic, though, and then there won't be a problem of dividing, and we won't be making speeches about this because we will have agreed, and the Commission won't have this problem, but until we can get a new set of arithmetic and get Petroleum Inc. into the unit, then this Commission has a difficult problem of deciding just how the oil shall be divided among these five leases.

Q Mr. Kavaler, do you consider a high gas-oil ratio well to be a wasteful well?

A I do if it is allowed to produce unrestricted, yes, sir.

Q Is it true then that for the greatest ultimate recovery it is wise to have the largest possible amount of production through the low gas-oil ratio wells?

A Yes, sir. If conservation is to be regarded at all the low gas-oil ratio wells are the ones that are least wasteful.

Q What is the situation with the Petroleum Inc. wells as to gas-oil ratio?

A For the four leases that Petroleum Incorporated operated, produced for the last three months, this last quarter, a gas-oil ratio of 665.

Q Do you know how that compares with the average for the unit?

A The average for the unit is for the first three months this year was the figure I just gave you for Petroleum Inc., January, February and March. They had produced their allowable, 655 gas-oil ratio. The unit, on the other hand, produced its oil with gas-oil ratio of 826, so that Petroleum Inc.'s leases are 160 cubic feet per barrel better than the units'.

Q Do you have an explanation for that situation?

A Well, one of the reasons for it is that the Petroleum Inc.'s properties are not near the gas cap. The Petroleum Inc.'s properties are away from the gas cap down off to the left (indicating), and so they are not aggravated by the encroachment of gas downstructure. They have a fortunate structural position.

Q Do you have anything further to add on that point?

A No.

Q I hand you what has been marked as Petroleum Incorporated's Exhibit No. 4. Will you state what that is?

A I prepared Petroleum Incorporated's Exhibit No. 4 and in doing so I took the two-mile stretch which

is represented by Sections 12 and 13 in Township 1 Range 58 West, and I will draw a bracket on Exhibit 10 of Pure Oil Company, and I took all the wells in that two-mile stretch east-west across the field, and then for each contour line on the structure I made this chart so that the chart reflects the average oil allowable under a 1,200 to one gas-oil ratio, depending upon the structural position.

For example, on this there are two months; there is the month of October, and in the month of October 125 barrels a day, 1,200 to one limiting gas-oil ratio. The Commissioners may look at the No. 1090 on the left. That's the subsea top of the wells, and all wells that were lower downstructure than 1090 feet subsea had a full 125 barrels a day allowable; and then as you went upstructure from about 1090 feet the gas-oil ratio on the average increased to the point where if you got up to about 1050, which is pretty high on the structure, you had an oil allowable of only about 20 barrels a day under the Commission rules, and I drew this to show to the Commission that in October 1955 before the unit was formed there was some advantage in being low on the structure; and then I drew it again for April 1956, which reflects in that month, too, there was some

advantage to being low on the structure, and that advantageous structural position under a limiting gas-oil ratio that will apply to any month in which the field has been operating.

In a field like this when there is little if any water drive, the best place to be, to have your property is downstructure. Now, if this were a water drive and the water was coming in from the west, then everybody would wish that they had bought their leases on the east side; so it just depends on what nature did to these fields, depending upon whether you had good luck or bad luck in the purchase of your leases.

Now, I have made some dots over here on the right-hand side of this Exhibit 4 which shows the structural top of the wells on Petroleum Incorporated's four leases. You will notice that there are two dots just below the writing which correspond to a subsea height a little bit higher than 1,000 subsea. There are two wells there, and then the lowest structural well they got is deeper than 1130 subsea on the top of the sand, so that up to the present time none of Petroleum Incorporated's wells are penalized for high gas-oil ratio. At least they haven't been up until April 1956.

Q Mr. Kavaler, have you made a computation from

pagesnine and ten of the proposed order which would show the average gas-oil ratioes under this proposed order for the unit and for Petroleum Inc.?

A I have.

Q Will you state those, please?

A The proposal that Pure places before the Commission provides that the unit properties shall have a gas-oil ratio--my arithmetic is 1,850 to one. I hope that's right. That's for the unit lease, the big lease, and for the four leases that Petroleum Inc. has they are going to be saddled with the 1,200 to one, which I think involves some discrimination.

Q Now, you have heard testimony by the Pure witnesses regarding what is equitable and what is unequitable. Do you consider that division to be unequitable or equitable?

A That is inequitable.

Q Why?

A Because I think it places too much of a burden on Petroleum Inc. in respect to two facts: first, that the Pure people are all nice fellows individually. They are still oil men and they also produce their allowable. I have seldom found Pure when they didn't produce their allowable and I would be surprised if they

didn't produce their gas allowable along with their oil allowable. They are pretty good operators, so I see there is no policeman to make them behave themselves if the Commission is going to turn them loose to take care of business as they see fit. They produce 1,850 cubic feet per barrel. They are going to cause a decline, an abnormal decline in pressure up here in the gas area, and the gas-oil area where they have pressures, and Petroleum Inc., who is down here (indicating) might suffer some drainage from this excessive pressure decline due to the production of excess gas. That's point No. 1.

Point No. 2 is that Petroleum Inc., their gas-oil ratio is going up just like the Pure's, and if the Pure needs an umbrella to live under, why, Petroleum Inc. needs an umbrella to live under, and I would say that the same shoe ought to fit both feet, and if 1,850 is a fair gas-oil ratio, well then, I think everybody should have it; or if, as the Commission has consistently found in all other cases in the Denver-Julesburg basin, if 1,200 to one is a fair gas-oil ratio, then the Pure Oil will live under that.

Q Aside from whether it is fair or equitable, is a distinction of that type good conservation?

A I don't think it is good to encourage operators in the field where gas is the sole and only productive force, I wouldn't urge the Commission to do anything to encourage people to produce an excessive amount of gas as they would if they had an 1,850 gas-oil ratio.

Q Now, Mr. Kavaler, did you hear the testimony this morning regarding bottom hole pressure and its effect on recoveries?

A Yes, sir.

Q Do you have any comment on the effect of bottom hole pressure on recovery?

A Well, the first thing, Mr. Commissioner, it was inferred that the Adena Field is kind of going to pot. I don't believe that. I think it is just as good an oil field today as it was the 1st of January.

Now, the Commissioners are often impressed by an engineer who will get up and say, "This month we recovered 61,000 barrels per pound drop in pressure, and last month we just recovered 31,000 barrels per pound drop in pressure." Now, I have used those figures myself at hearings, ones like that, but the fact is, Mr. Commissioners, that every oil field declines in pressure except those that are under perfect water drive, and the fact is that in a field like Adena the pressure

was 1,546 to begin with before any oil or gas was taken, and about twelve million barrels have been produced as they are now. The average pressure is, oh, about 1,256 pounds, about 1,256 pounds. That's from Pure's Exhibit No. 11. That puts it at a point out here (marking on board). Now, the pressure is going downhill and it will continue to decline. Now, it so happens that this pressure production curve, if I should measure it here between these two points I would get what they call the slope of the curve (indicating). There are relatively few barrels recovered per pound drop at that point because these oil fields all fall off pretty quickly in pressure at the start, so I got a low value of 31,000 barrels per pound there (indicating). But then this curve flattens out, so I get down here a little bit later and I get 61,000 barrels per pound drop in pressure, and not just a natural consequence of the arithmetic--it doesn't have a thing to do with changed conditions of conservation, because this curve will finally flatten out down here when the pressure is zero.

We know a lot of stripper oil fields where the pressure is five pounds or less that produces hundreds of thousands of barrels of oil with no pressure change;

then you get one hundred million of pressure per pound drop, if you do that arithmetic, so the fact that Adena showed this figure sometime past and shows this figure now doesn't mean that the field is being operated more conservatively or less conservatively. It just happens to be a trick of this curve describing pressure of production, so I say that there is no testimony that shows that this field is being operated more wastefully or less wastefully. I think it is being operated just as conservatively now as it was on the 1st of January.

Q Now, Mr. Kavaler, I have one more point here I would just like to have you state. There was some testimony this morning, and I believe you heard it, that any delay in effecting a water flood is going to reduce ultimate recovery. Do you recall that testimony?

A Yes, I think Mr. Horner testified to that.

Q Do you agree with it?

A No, sir.

Q Will you state why?

A Because there may be confusion in respect to that point if the engineer either doesn't understand the question or he doesn't make himself understood.

The proposition is: Will there be as much recoverable oil by water flood if Adena--say it falls down to 100 pounds instead of starting the water flood out there this week at 1,200 pounds--and I suggest to the Commission that in so far as the recovery due to water flood is concerned, it will be the same in either instance.

Now, there is a difference in how much money will be made by the operators and the royalty owners if you start now. The most economical time to start is at 1,200 pounds, but from the standpoint of the barrels there wouldn't be a difference of but a few barrels due to higher cost of operation. This is a higher cost operation (indicating). This is a lower cost operation (indicating). The difference in recovery is very small. I think the fact that a lot of fellows are water flooding these striped down fields even though the pressure is down to zero proves there is a lot of recoverable oil.

Q Mr. Kavaler, do you have anything you wish to add to your testimony?

A Well, I would say this to the Commissioners as an engineer and one who has followed this matter of the allocation of production for a long time, that I would

say that to step into the Adena Field with a plan which the proponents admit is unique and complicated and difficult, hard to calculate except that they come forward with a book and hand you the answer, that conservation in the development of the oil industry in Colorado in my opinion would not be furthered by the adoption of this unique system of allocation. If the Commission would continue to allocate and to regulate fields on the basis of the per well allowables which it has always used up to this time, I think the Commission would best serve the people.

I would say further to the Commission that a well's capacity to produce, its operating characteristics, is the best measure of how much recoverable oil it has to draw upon, and I would urge the Commission to stay with the principle at Adena of measuring the allowed production on the basis of the performance of individual wells.

MR. KIRGIS: I offer in evidence the documents and charts identified as Petroleum's Exhibits 1, 2, 3 and 4.

COMMISSIONER BRETSCHNEIDER: That's this map and these three exhibits?

MR. KIRGIS: That's correct.

COMMISSIONER BRETSCHNEIDER: Any objection? If not, they are admitted.

MR. KIRGIS: The witness is available for cross examination.

MR. STOCKMAR: Does the Commission have any questions first? I wanted to let a moment pass so some of the smoke would clear out of here and we can see what Mr. Kavaler has said.

CROSS EXAMINATION

BY MR. STOCKMAR:

Q To sum it up, and correct me point by point if I am wrong, Mr. Kavaler, you have said most recently here that the proper method of allocating production is on a per well basis in the State of Colorado, is that correct?

A (No response.)

Q I am asking you---

A I think on the basis of a per well test, yes, sir.

Q Mr. Kavaler, in an article written by you which appears in the booklet, "Well Spacing," the article was delivered September 10th 1951 to the Interstate Oil Compact Commission, page 62, and speaking of allocation policies, you said, "Allocation formulas giving full or

partial credit to the well itself are formula that permit disproportionate sharing in a common source of supply," and continuing: "The share granted by the allocation formula bears no relationship to the proportion and quantity of recoverable oil in place beneath the lease."

Now, which of those two apparently divergent opinions do you subscribe to today?

A Mr. Commissioner, I don't know whether counsel has the book with him or not. I would like to inquire.

Q Yes, sir, I do (handing document to the witness).

A What page?

Q 62. Would you take this one, Mr. Kavaler, so I can have my notes on there (handing document to the witness).

A 62, Counselor?

Q Yes, sir.

A I stated, Mr. Commissioners, in this article, which was well received by the Interstate Oil Compact Commission--I also had my picture in there--I stated in there, Mr. Commissioners that, "In too many instances the allocation of production within a pool is essentially on a per well basis or on a basis where the well or wells

bring a bonus in allowables. Many wells have been drilled and are being drilled under circumstances where the allowable to separate wells is based on a formula fifty percent to acreage and fifty percent to wells," and Counsel didn't copy that part. He omitted that, so I was addressing myself to the situation that exists in many states, in Texas, for example, where if you had a five-acre lease offsetting a fellow with a forty-acre lease, this fellow that had a forty-acre lease here, in Texas you drill a well there and this fellow drilled one well on the forty acres, the Commission gives him half of an allowable just because he has a well and the other half they put on the basis of five acres and forty acres, and that's a very disproportionate allocation, and I will say that when you put allocation on a per well basis regardless of how many acres are involved, well then that is unfair.

Counsel didn't read to me the second sentence, so it is confusing. I didn't quite recognize what he was saying.

Q I think I misunderstood what you must have meant, Mr. Kavaler, and I believe it is because two months later in an article written by you entitled "Progress of Unit Operations," presented at the November 1951 A.P.I.

meeting you said this statement, page 328 in that article:

"In continuance of inequitable sharing in the form of allocation formulas basing allocation upon per well, fifty percent acreage and fifty percent well, or even on 100 percent acreage, represents one of the outstanding failures of the present system of proration. Were regulatory bodies to promulgate allocation rules that were fair and equitable they would adopt what in the true sense would be the distribution of production under a unit plan."

Back to your well spacing book at page 59, and that is what I must have misunderstood you on---

MR. KIRGIS: May he answer them one at a time?

THE WITNESS: Do you have the book?

Q Yes, let me conclude the thing here.

A Do you want me to answer these one at a time?

Q I think you can answer these together.

A Let me have the first reference, Counsel.

Q Page 328, back in the well spacing book you had said:

"Speaking of division and sharing under unit operation, the result is that each separate owner

entitled to share in a common source of supply comes into possession of an undivided interest in the petroleum in place and thereafter shares in proportion to his undivided interest in all of the petroleum produced. That is the most practical method for achieving a fair and equitable sharing in division." The last word is not correct, whatever it might have been. "In division of a pool."

I cannot justify those remarks with your testimony here today, Mr. Kavaler. You will now have an opportunity to do so.

A I appreciate counsellor's calling attention of the Commission to these statements, which I think have contributed a great deal to the progress of the oil business.

COMMISSIONER BRETSCHNEIDER: You mean you changed your mind?

A No, I haven't changed my mind. Counsellor, I---

COMMISSIONER BRETSCHNEIDER: You are privileged to do that any time on these complicated problems.

A I did that last Monday, didn't I?

COMMISSIONER BRETSCHNEIDER: Yes.

THE WITNESS: I didn't get the reference until

the last one, Counsellor.

Q On the second one?

A The second profound statement. The third one I guess it was---

Q Page 59 in Well Spacing.

A Do you have the book?

COMMISSIONER BRETSCHNEIDER: Do you have a lot of these references to go over like this?

MR. STOCKMAR: Not many.

COMMISSIONER BRETSCHNEIDER: It would take hours to go back and collect all the literature he has subscribed to and compare it with his present-day beliefs.

THE WITNESS: Well, Mr. Commissioner, these statements stand as they were written and they stand today. I say here again that:

"In continuance of inequitable sharing in the form of allocation formulas basing allocation upon per well, fifty percent acreage and fifty percent per well, or even on 100 percent acreage"--now, I am not advocating to the Commission here that they base these allowables fifty percent per well and fifty percent acreage or 100 percent acreage; I am recommending to the Commission that they base these allowables on a well

test subject to a limited gas-oil ratio of 1,200.

Q Mr. Kavaler, you just testified that the proper method of allocation in Colorado was on a per well basis.

A Yes, with a 1,200 to one ratio with the present rules. I have been supporting the present rules and that's what I am advocating. Now, the other question counsellor asked me, I would say that unitization is by far the best way to operate an oil field and I think that the best way for a person's rights to be protected is to have a unit, to join the unit. I said that in 1950 and I say it now.

Q Do you believe there is any relationship between recoverable oil under a property and the number of wells that might be drilled into it?

A Yes; I suppose a fellow in good judgment wouldn't drill any more wells on a property than the amount of oil recovered would justify. I think "yes" is the answer.

Q Is there any relationship between the number of wells drilled into a pool and the oil that is in place in the ground?

A Well, do you mean generally?

Q Generally speaking.

A When there are more wells drilled that means that there is more oil in the ground?

Q I say, is there any relationship between the number of wells drilled and the petroleum in place in the reservoir?

A Well, it is hard to answer, Counsellor, yes or no.

Q If you drill more wells there is more oil in place?

A Not necessarily, no.

Q If you drill no wells there is still the same oil in place?

A Yes, I suppose you wouldn't know that there was any oil there unless you drilled a well.

Q Well can you say yes or not? Is there a relationship between petroleum in place and the number of wells drilled?

A Not necessarily, no, sir.

Q Is there any such relation where that is the case?

A Not that I know of, Counsellor.

Q You mentioned that you were testifying last week; at that time you made quite a speech that there are three bases for the allocation of oil production?

A Yes, sir.

Q Would you repeat those?

A Yes, sir, I would be delighted.

Q Not the whole speech. Let me hasten the thing by stating that you said there is one method under unit operation, allocation, and by contract under unit operation?

A That's one method to accomplish the division of a common source of supply, yes.

Q The second was that the---

A Are you going to make the speech forme?

Q I will make the speech for you. --that another way of allocating the production from a pool was under the rule of capture?

A Yes, sir.

Q And the third way was pursuant to an order of a Commission?

A Yes, sir.

Q A regulatory body?

A Yes, sir.

Q Now, as I understood your testimony, you are advocating the rule of capture as the proper rule to be applied in the taking of the allocation of production from this field?

A Well, Counsel, I explained all this to you last week, and I can explain it to you now, but I can't understand it for you, and apparently you didn't understand me.

I said that in Colorado the rule of capture is ruled out by statute and this Commission has been imposed, given the duty of bringing about a more conservative operation. I said about that pool--you won't mention it and I won't either--and it is the same as Adena--that a complete unit is not possible, so that the only thing left in Colorado in the case of Adena is for this Commission to accomplish a division of the common source of supply, yes, sir.

Q I don't want you to testify to the law, Mr. Kavaler, but for an order of the Commission to comply with the Statute we must then rule out the law of capture, is that correct?

A Yes, if you want my legal opinion.

Q I would be glad to have it; it's affirmative. In this field then, Mr. Kavaler, you refer to somebody building a concrete--and I presume an impermeable concrete--barrier around the Pet Inc. properties. Now, were we to do that around any one of those properties, the unit of reservoir locked in place there would still

produce oil, would it not?

A Yes, sir.

Q And what would be the driving mechanism?

A Gas.

Q What gas?

A The gas that is on Pet Inc.'s properties.

Q And no gas that comes from other properties, correct?

A Well, if this is an impermeable barrier, Counsellor, you postulated it as a permeable barrier--impermeable barrier?

Q That's right.

A Well, nothing could get in or out.

Q Then the recovery factor from that particular tract in that insulated condition would depend upon a producing mechanism, the rock characteristics, the pressure available to produce the oil and so forth?

A And the ingenuity of Petroleum Inc., their skill as oil producers.

Q Granted.

A Their capacity and art of completing wells.

Q But the recovery factors would be the result of all of those things applied to that tract alone?

A Yes, sir.

Q Now, if we move over and postulate a reasonably similar structural location which I do not think is too difficult here, the same factors would apply to that operator, would they not?

A Well, if you are using the same factors for the purpose of the question, the answer is yes. You haven't entered any new postulates; the answer is yes.

Q In other words, will reasonable similarity of the rock characteristics, the characteristics of the fluid and the characteristics of energy content and pressure, assuming equal abilities of the operators---

A Equal skill.

Q You should have approximately uniform recovery factors, should you not?

A Well, Counsellor, that is hard to answer. The permeability of the sand is the same?

Q Reasonably uniform.

A And the connate water is the same?

Q Reasonably uniform.

A And the porosity is the same?

Q Same.

A Same kind of drilling mud used to drill each well?

Q In a prudent operating practice.

A Same arc used in setting the casing behind the cement and to perforate, and both operators have the same good luck in the fracture treatment? I can't follow all the stipulations is the reason I am asking.

Q I said a reasonably similar piece of property.

A Reasonably similar piece of property. Then what do you desire, sir, for me to answer?

Q Just yes or no, Mr. Kavaler.

A I don't know what I am saying yes or no to, but I will say yes.

Q That is, that the recovery factor should be reasonably uniform?

A Whatever you mean by "reasonably," the answer is yes.

Q All right.

A I don't know what you mean by reasonably.

Q Then if one of those tracts demonstrates a substantially higher recovery factor can it not be an indication that there is a breach in the cement wall someplace?

A Oh, yes, sure, well drainage, yes, sure; the answer is yes.

Q All right; then the recovery factor of these particular tracts is first based on the factor of the

individual characteristics that we discussed of the particular tract, and second, it is the--we must add the concept of drainage onto that tract or off of that tract?

A Yes, I am sorry. I didn't understand what you were getting at. There has been migration in this field. There is migration in every oil field.

Q Migration is taking place today onto the Petroleum Inc.'s tracts?

A And it is also taking place generally from east to west inside the unit. That may have been one of the clubs that the unit used to get the eighty boys together on, I don't know.

Q Are you testifying that there is migration of oil from the unit properties onto the Petroleum Inc. tracts at the present time?

A I think there is migration, as I said, Counsellor, east to west, and some of that oil may be migrating onto Petroleum Inc.

Q Is it or is it not from the information you have available?

A I think there is some migration from the unit onto Petroleum Inc.'s tract, which is an inescapable consequence of the fact, Mr. Commissioners, that there

is a large gas cap off to the east which the State of Colorado wants to utilize to bring about deficient recovery. Now, Counsellor seems to be obsessed with the idea that in order to bring about an increased recovery by a proper utilization of the gas that if Petroleum Inc. is getting some oil by migration as a result of that, that we should blow up the conservation program and I don't subscribe to that theory.

Q Your answer was yes, that migration onto the Petroleum Inc. compensated by migration is now occurring?

A It could if you relied solely on Pure's Exhibit No. 11. In order to shorten the testimony, I didn't go into the details of that, but to the extent that one could reliably interpret that exhibit, the answer is yes.

Q And if the present rules are continued that situation also will continue?

A I suppose, unless something happens out there to change it under the present rules. Now, I don't think that we would be entitled to draw the conclusion, Counsellor, that because migration is occurring this month it will occur forever. We might have another hearing some day here in a couple of months

when the migration may be off of Petroleum Inc.'s tract. This oil and gas is a fluid substance and these reservoir pressures change from time to time. They haven't always been like Exhibit No. 11 shows, and I doubt that they will ever be like that again. We will have some other pictures at the next survey, so this doesn't represent an eternal situation.

Q Because of your so-called structural position then you feel that your client is entitled to the oil that is migrating onto the tracts?

A Well, it is a difficult question without repeating an hour's testimony, Counsellor, but I would say this: that anybody who was fortunate enough to have a lease down on the side--I am going to come to that; I had forgotten about that one--in a state where they try to conserve oil and gas, where oil and gas conservation is paramount, if in order to accomplish conservation that party gained some advantage, I don't think you can particularly blame him; that drainage is forced on him.

Q Are you saying that this drainage is forced on you because of the shutting in of the gas cap?

A Because of the necessity to conserve oil and gas in Colorado. Now, this exhibit, which is so large that I can't find the exhibit number---

Q No. 5.

A No. 5, I think it is a valuable addition to the exhibits because I think the Commission can realize that this sand thickness is about the same over this whole field. Just an inspection of that exhibit suggests that to me, and it looks to me like a pretty--well allowable subject to a gas-oil ratio is a pretty good manager, because everybody has got about the same amount of sand, and that exhibit shows that, I think, pretty well.

Q To back up one statement, you have just testified that this migration is being forced upon your client because of the conservation practices now in effect in the field, is that correct?

A Yes, sir, that's a common situation in many oil fields that are subject to a conservation program.

Q The existing conservation practices arise out of orders of this Commission do they not?

A Yes, sir.

Q Then the order of this Commission which we now have in effect is causing migration of oil onto your tracts?

A To a degree, yes, sir.

Q Is there any situation inherent in the location

of your tracts which contributes substantially to that migration, or is that so with the existence of the present order that is driving oil onto your client's tracts?

A I think the fact that the tracts are located downstructure, Counsellor, is an inherent characteristic. I would rather have Petroleum Inc.'s leases there than to have Pure's or somebody else'es.

Q Under these rules or the rule of capture?

A Under the Commission's rules.

Q Would you have any advantage by structural location if the rule of capture were in effect there?

A Yes, sir, we would have a lot of advantages we don't have now. We would have an advantage of more skillful operation for one thing.

Q And the rule of capture, could we not blow off the gas cap and sell that gas?

A Yes, sir, but you would have to race with us because we would be blowing out the oil when you were doing that. I don't know who would come out first, but I think we would come out ahead.

Q Just as you are under the present rules?

A Well, we are a small aggressive company and it takes some fast walking to keep up with us.

Q Under these rules I cannot deny that. The rules we are seeking to change, Mr. Kavaler.

A We were just smart enough to buy the best lease in the field, four of them.

Q I gather you have not made any testimony that pressure maintenance as such is not a good thing for the ultimate recovery from the field as a whole? You do subscribe to our---

A I would encourage the operators to inject the gas. I think gas cap expansion would be a very, very effective, perhaps just a effective as water injection.

(Recess taken.)

Q Mr. Kavaler, I believe you testified that the higher the connate water saturation of a particular section the higher the percentage of the oil in place would be recovered from that tract?

A Yes, sir.

Q In other words, twice as much of the oil?

A I didn't say twice as much; that's your number.

Q The larger percentage of the oil will be recovered from a tract which has only two and a half percent oil saturation than will be recovered from a tract which has fifty percent oil saturation?

A The higher the percentage of the oil in place would be recovered. If there are only two and a half barrels compared to fifty-eight barrels, I believe were the numbers I had on the board, Counsellor, obviously the two and a half barrels of oil can't produce as much oil ultimately, but the percentage of oil recovered will be much higher.

Q Do you believe the higher connate water percentage cannot produce as much oil ultimately?

A Yes.

Q And the Petroleum Inc. tracts are generally located downstructure, say, near the water table where we have higher percentage of connate waters?

A The answer is yes, but their recovery of the oil they do have in place is going to be a lot higher than 29.9.

Q But, there actual recovery will be less?

A The total amount of barrels will be less but their actual percentage recovery will be a lot more.

Q Percentage of the oil in place?

A Yes, sir, and if they had gotten a percentage of the oil in place they are entitled under this unit plan they might be in there with them.

Q I don't want to make a lot of hay about this;

I just wanted to hear you say it, Mr. Kavaler, and get it in the record.

You said we added so many factors and refinements in engineering technicalities here that I gather if we eliminated the factor of connate water percentage and gave your client--your hypothetical client--there with 2.5 percent oil saturation the same benefits as the fellow with fifty-eight percent, we would be doing equity?

A Well now, Mr. Commissioners, Counsellor is just trying to dog me a little bit. I didn't make any statement even resembling that, so I don't think I need to answer it.

Q Do you believe that adding these extra engineering concepts which are available to us here, refining the problem, is poor practice? Is that your testimony, sir?

A No, I think it is good practice for the engineers, but I don't think it necessarily produces an acceptable result.

Q You say that you believe it impossible to make accurate determinations of oil in place and recoverable oil?

A Well, Counsellor, that depends upon what you

mean by the word "accurate."

Q Do you evaluate your reports?

A Yes, and they are highly regarded.

Q Accuracy then is sufficient for making purposes but not sufficient for conservation purposes?

A Well, Counsellor, I would say this, that a man's reputation is to be judged by his conduct, and my conduct has been such that people have found that my estimates were good and they have a good deal of faith in me. I don't think that the mere fact that I have a diploma from some university necessarily establishes me as an expert, as a competent person, but I think a fellow's performance is what counts.

Q Mr. Kavaler, you said that the individual well potentials and capabilities are quite important in determining the recovery factor of that particular well and that permeability was one of the important factors in that, is that correct?

A Yes, sir.

Q Do you have any idea how the Petroleum Inc. wells stack up in permeability when compared with the rest of the unit wells, the rest of the field wells?

A I think, Counsellor, that I can best answer this way, and the Commission would be interested in this

number, that Petroleum Incorporated has 9.76 percent of the millidarcy feet of sand in the field, and Pure, et al, claim that they have only 7.1 percent of the recoverable oil, so that the permeability of Petroleum Inc.'s leases is above the average in the field.

Q The permeability of your leases is above the average?

A Yes, sir.

Q Gentlemen, I don't want to take too much of your time with rebuttal testimony, but that is not the information which I have here.

A If you find that they are different we will fracture our wells tomorrow and put it that way, if it gets to be a matter of depths.

COMMISSIONER BRETSCHNEIDER: May I ask you a question?

MR. STOCKMAR: Yes.

MR. BRETSCHNEIDER: Is it the purpose of this hearing under your application primarily to change the present rules and regulations under which the unit is being operated?

MR. STOCKMAR: Under which the entire field is being operated, yes, sir.

COMMISSIONER BRETSCHNEIDER: Under which the

unit is being operated?

MR. STOCKMAR: The entire field. We are trying to establish an allowable, a daily allowable for the entire field.

COMMISSIONER BRETSCHNEIDER: Which includes Petroleum Inc.?

MR. STOCKMAR: Which includes Petroleum Inc. We are also trying to, by our formula, achieve a division of that daily oil production in relationship to the hydrocarbons in place under the tracts, under the unit and non-unit tracts.

COMMISSIONER BRETSCHNEIDER: All right.

MR. STOCKMAR: I think I have no further questions of Mr. Kavaler. I do not want to prolong this hearing unduly, but this Exhibit 3 of Petroleum Inc.'s seems to have and to raise a lot of questions as does Exhibit 4. Now, there are hundreds of other similar questions, and I can put Mr. Weyler back on the stand and you can ask him any question with respect to anything which might appear upon here, or any other apparent discrepancy in our findings and our calculations that have been pointed to by Petroleum Inc. He has a justification for each one.

COMMISSIONER BRETSCHNEIDER: Mr. Van Tuyl wants

to ask a question, I think, perhaps about these notes.

MR. JERSIN: One more thing, Mr. Kavaler, before you have a seat:

BY MR. JERSIN:

Q The oil in place figures that are presented by the unit operators, have they been analyzed by the Petroleum Incorporated people?

A Not completely. We understand, I think, the manner in which they computed what they call the reservoir barrels in place using this connate water curve and the porosity, and we understand what they did in the instance of those wells where they didn't have core data. I think fifteen percent of the wells didn't have all of the information that was required, and they estimated it from others. We have examined all of that and we disagree very heartily.

Q Do you have some figures to indicate the extent of the disagreement?

A Well, Mr. Jersin, in order for us to get the figures we would have to take that big book and another one just like it (indicating), and I think they said they spent two years at it, and we would have to spend about two years at it before we could come up with an answer, and it's a burdensome thing to go at it that

way, but in respect to the point that I specifically testified to about this morning, I think it is generally accepted that while the connate water varies in rock, when the connate water is high the droplets of oil that are there are highly recoverable. Out most substantial objection goes to the fact that after they deducted for the connate water then they just put a blanket percent recovery of 29.9.

Now, they did this in a very scientific way. They took this thing foot by foot; in order to apply a correction for this mistake you would have to go back and agree upon some kind of a curve like they agreed upon (indicating) as to what the relationship of the curve of the connate water is.

One other objection we went over, we think the gas-oil contact is actually four feet lower based on drill stem tests than what the boys agreed to among themselves in forming the unit.

Now, they took, as I understood the testimony this morning, they took core analyses to pick the gas-oil contact. I think if we examine the drill stem tests and other facts about completing a well you would establish the gas-oil contact about four feet lower; so they threw an extra four feet of thickness over here

in the gas area which they are proclaiming the right to produce oil for, and we don't agree with that.

I would say, Mr. Jersin, it would be quite a while before we could submit to the Commission our ideas of what to do with that big thick book.

Q I was just trying to determine whether Pet Inc., the figures that they accept as oil in place originally in the field under their properties.

A Are you talking about going into the unit?

Q No, an independent study of how much oil in place Petroleum Incorporated thinks they have.

A We don't know. I don't think you can tell how much oil there is in place in these properties.

COMMISSIONER BRETSCHNEIDER: You don't accept the original tabulation that was made then?

A No, sir, I don't think that we could accept that arithmetic.

MR. STOCKMAR: Mr. Kavaler---

A May I answer the Commissioner just a little bit further. You see, Mr. Commissioner, that deal was a deal cooked up between parties who were willing parties to a contract and whatever they agree upon is something that is their business. I am not here to criticize that, but I don't think you can take that

contract that they agreed upon among themselves and hand it to this Commission and say, "Here, you saddle Petroleum Inc. with the same thing." I just don't think that is the thing to do.

Fred Kirgis and I might enter into some kind of a contract and come up here and ask the Commission to saddle the State of Colorado with it because between Fred and I it was good and we think it is good for everybody.

MR. STOCKMAR: I would like to make it clear that we are not trying to impose unitization on you. Our approach is consistent with the unit determinations, yes.

THE WITNESS: Well, that depends on how you look at it.

MR. STOCKMAR: Gentlemen, I have one further---

COMMISSIONER BRETSCHNEIDER: Just a minute.

MR. STOCKMAR: This is it, Dr. Van Tuyl. We do have Mr. Weyler here available for rebuttal testimony on any specific detail or point no matter how small it might be that some of the exhibits of Petroleum Inc. may have raised in your mind. We would appreciate the opportunity of having you question him.

COMMISSIONER BRETSCHNEIDER: All right, go

ahead.

COMMISSIONER VAN TUYL: I have one question to ask, Mr. Kavaler, before we go to Mr. Weyler.

BY COMMISSIONER VAN TUYL:

Q You mentioned that the estimated two and a half percent of oil and ninety-seven and a half percent of water under the Petroleum Incorporated leases--you apparently meant the west edge of those leases, did you not, rather than the entire leases, because if you estimate a regional dip of forty feet to the mile there, the eastern part of those leases would be far above the water table?

A Mr. Commissioner, I didn't make myself very clear and I apologize to the Commission. I did not mean to infer that the Petroleum Inc. had ninety-seven and a half percent water and two and a half percent oil. I was using when I stated that example, I was just taking as an example two extremes off of this chart, all for the purpose of showing that if there was a situation like the ninety-seven and a half percent and the two and ahalf percent, to demonstrate that the 29.5 percent recovery figure didn't apply equally to them.

Q Can you give us the percent of oil saturation

that was estimated by the Petroleum Incorporated leases?

A By these other parties?

Q Yes.

A No, Mr. Weyler would be a reliable witness on that, whatever he said they calculated. I wouldn't believe what he said, but whateverhe said they calculated I would believe him. What did you calculate, Jack, for the connate water?

MR. WEYLER: The volume, the specific volume I couldn't quote except that I could say that the connate water is higher on the Petroleum Incorporated properties than the average in the unit, and there is some difference, it's not a large difference. There is a little more, there is more oil in place per foot of unit sand than there is per foot of Pet Inc.'s sand.

THE WITNESS: I don't know whether Mr. Weyler would join me, Mr. Commissioner, in this statement to you, but this is a rather imaginary thing. I know a lot of oil sands that lie just above water that have very high oil contents and very little connate water, so that these boys--you see, this thing was the subject of a mutual agreement contract between the parties. They all agreed to use this and entered into a contract. That doesn't dignify this thing with any scientific value.

Q Now, there is one other question, you referred back to the uniform thickness of the "J" sand on this chart, but we have an isopach map here which shows a great variation in thickness of that sand.

A Yes, sir.

Q Now, I imagine that the line along which this section was made, the sand is less variable in thickness than elsewhere?

A That may be true, Doctor. I don't know what line they made it on. They have got west to east through the Braden-Hoover B-1 Glenn.

MR. WEYLER: It starts from here and continues across to this gas well (indicating) and---

A It lies approximately between the center of the Section 11 north and Section 9, it lies generally west through there.

MR. WEYLER: Dr. Van Tuyl, you are absolutely correct; this does not show great variations in thickness that exist mainly in this part which is the unit and this well here, seventy-four feet thick, the thickest well in the field. Most of these are fifty to sixty feet thick in this area; the average in the sand is about twenty-five in general for the average well in the Adena Field.

COMMISSIONER BRETSCHNEIDER: Is that to scale?

MR. WEYLER: It is to scale for this particular cross section.

MR. KAVALER: I might say, Dr. Van Tuyl, in connection with your inquiry, I believe this statement is responsive to it: There are frequently instances when a man will drill a well and he will just barely penetrate the sand and not drill through it. There are a few wells like that in this field, so that in the interests of conservation it might be well for him to complete his well with a shallow penetration.

Now, if this Commission adopts the principle that it has great scientific dignity but little practicality, the fellow who would do this in the interests of the State of Colorado would be denied to show how much recoverable oil he had, and I know from your reputation as an oil man, you can appreciate the fact that sometimes shallow penetration is to the best interests of all parties, and I point that out to back up my conclusion that while this might have some scientific appeal, as a practical matter for this Commission to use that for the discharge of its duties, I think it would be found to be unwise.

COMMISSIONER VAN TUYL: Mr. Kavaler, don't you think the people owning acreage and royalty in the gas cap are entitled to some participation in the production from this field?

A Yes, sir; yes, sir.

COMMISSIONER BRETSCHNEIDER: Is that all now?

MR. STOCKMAR: Is that all? I would like to make one remark.

COMMISSIONER BRETSCHNEIDER: All right.

MR. STOCKMAR: You will recall that this hearing was postponed for six days to meet the convenience of Dr. Kavaler, and that in recognition of that we sought a general agreement of the parties that the order be made effective as of July 1st. It has the merit of starting with a quarter, even though a day or two has passed, and so we would like to urge that the effective date of the order be July 1st.

With respect to the single point that this particular kind of an allocation formula may or may not be suitable for application in all of the fields in Colorado, we cannot differ with that. This formula is complex. It is difficult, but we do have the unique situation here of being able to apply that kind of conservation that people have been giving lip service to

for years without doing it. Thank you.

COMMISSIONER BRETSCHNEIDER: Well, the mere fact that an order might be issued on this field according to what you suggest doesn't necessarily mean that it will apply everywhere.

MR. STOCKMAR: Not by any means.

COMMISSIONER BRETSCHNEIDER: It would apply here.

MR. STOCKMAR: Wehave a unique situation.

COMMISSIONER BRETSCHNEIDER: If we have a different situation elsewhere we would have a different basis. Does anyone else have anything further to add to this?

MR. KIRGIS: If the Commission please, I would like to make a very brief closing statement, if I may.

COMMISSIONER BRETSCHNEIDER: You may.

MR. KIRGIS: In summary of what we believe the evidence shows, I would like to point out first, as has just recently been stated, that this is not an effort on the part of the unit operator to force Petroleum Inc. into the unit. I can see that point, of course, but I wish to point this out--and to me it is most significant: that the thing which they ask this

Commission to impose on Petroleum Incorporated is something less than the unit operators among themselves have agreed to for themselves. The testimony has brought out the fact that original oil in place was only one factor taken into account in the formulation of the unit and in the private agreement among those parties as to how they would participate one with the other in production.

That actual productive history for some designated month that happened to be the last available month was given, I believe, one-third weight, if I remember the testimony. I point out to you that though they may have agreed that that was a fair thing among themselves they are now asking this Commission to do something far different. They are asking this Commission to invoke a formula here which as between the unit and Petroleum Incorporated will have the effect of giving effect only to original oil in place. It does not give any effect whatsoever to oil in place today. It does not give any effect whatsoever to produceable oil in place.

Now, there may be or there may not be, as the testimony would indicate, a relationship between oil in place and produceable oil; but, I think it is perfectly

clear that the one is not the equivalent of the other and I think that Mr. Kavaler's testimony has shown clearly and that practically all other men know and that this Commission will take judicial notice of that fact, that some wells are better than others, that some are completed better than others, and that produceable oil is in fact something different from oil in place when determined by strict and technical scientific formula, and yet they are asking this Commission to do it only on the basis of that strict and technical formula.

They are also creating a situation whereby if an unbalance occurs here this Commission is going to be faced with the necessity in the future, and perhaps repeatedly in the future, of analyzing a bookful--where is one of the books? That book that thick (indicating)--of highly technical data for the purpose of determining who now has become right or who now has become injured.

Furthermore, they propose that structural position be given no weight whatsoever. I think any oil man who is fortunate enough to turn up with the lease that from a structural standpoint happens to be the best lease, he is entitled to believe that that is an

element, not necessarily controlling--the law of capture would make it controlling--but, as Mr. Stockmar has pointed out, we are not discussing the law of capture, we are discussing the law of conservation in Colorado under our Conservation Act.

But, that does not mean that the position on structure is not entitled to recognition in some degree. Now, we point out to you again that on the basis of the testimony, Petroleum Incorporated is receiving now over fourteen percent, close to fifteen percent, of the pool's production, whereas simple mathematics applied to the proposal which is submitted here and to the exhibits attached to that proposal, show that it would be reduced to--by my figures--7.2, I think, slightly less than that, between 7.1 and 7.2. In other words, on the basis of a purely technical determination of an arbitrary concept that original oil in place as so determined technically is the only controlling factor, they propose to take over half, slightly over half of Petroleum Inc.'s production and take it unto themselves, and I point out in that connection that one of the bases upon which they do that is an allocation of gas allowables and an allocation of oil to non-oil producing properties in the gas cap.

We do not deny that gas cap is entitled to recognition. The gas cap performs a function in the mechanism of a field, but we do not think that a formula should be proposed whereby Petroleum Inc. has to bear the burden of allocated oil to non-oil producing properties, to properties which have dry holes that have been capped, as the testimony has shown, and the properties that have never even been drilled--they didn't think enough of them to drill them--because they didn't think they would get enough to make it worthwhile. That's the only obvious answer to that.

Now, their proposal would use those factors to transfer barrels of oil from Petroleum Incorporated to the unit and we cannot see in any manner, any conceiveable justification in fairness or equity for that.

Beyond that the testimony I think is conclusive that the new order is not necessary as a waste order or to create a greater ultimate recovery of oil.

Under cross examination the witnesses for Pure have admitted, as I have understood their testimony, that they are concerned about migration of oil, and that the matters which they are talking about do not have to do with the greater recovery of oil from the pool or with waste as such.

for the people of the State of Colorado and for the nation from the oil reserves which we are fortunate enough to have in this state; but, absent waste I think this Commission has no authority legally to go out and adjust correlative rights between parties in any field. Once waste is found to exist, then the Commission is authorized and required to take into account correlative rights and to do those things which are practical, to protect correlative rights in the formulation of an order which will prevent the waste which has been found to exist; but, absent waste--and I submit there is no testimony here whatsoever that waste exists in the sense of an effect upon ultimate recovery, and absent waste, I do not believe this Commission has the authority to go out to John Jones and Bill Smith who have adjoining properties and say, "John, you are taking too much; you have got to stop it so Bill can take more."

Now, I think that that is the legal situation, but I don't leave our case on that legal problem, so I urge that as the proper legal interpretation. I said that beyond that that the proposed order here leaves out of account a number of factors which would have to be taken into account if this Commission were just to figure

correlative rights.

I don't think this Commission or any other Commission or any court can determine correlative rights without taking into account the productive capacity of wells or the productive history of wells or the position of wells on structure and the relationship of that to recovery. And on that basis we say that this Commission cannot accept this order, and if it does so that it will be exceeding its authority and being, we believe, unreasonable, and in that connection I point out that I would assume that Pure must think so, too, or else when they unitized they would have done it on this basis alone, whereas they did not.

They are asking this Commission to do something which they themselves were unwilling to do and to do it merely for the purpose, as I see it, of transferring barrels of oil from Petroleum Incorporated to them.

MR. STOCKMAR: The plaintiff always gets the last word, and I would like to dispel the illusion that we are trying to take oil that belongs to Petroleum Inc. Our legal theory can be summed up by saying that we would like to milk our own cow for awhile.

MR. JERSIN: Mr. Kirgis, do you have any

recommendation as to revising it?

MR. KIRGIS: It has been in effect since the formulation of the unit. We concede that the unit operator said he agreed to the present order after the unitization only as a temporary device, but it was proper before the unitization. The existence of the unitization has no effect upon waste. It only delimits the number of properties in the field, cuts them down to about four or five, four on one side and one on the other.

It was not wasteful before; it is not wasteful now, and there has been no evidence even suggesting that it is wasteful.

COMMISSIONER BRETSCHNEIDER: Dr. Van Tuyl wants to ask Mr. Weyler one question and then I think we better adjourn.

MR. WEYLER: Yes, sir.

COMMISSIONER VAN TUYL: Mr. Weyler, it has to do with this other one, Exhibit No. 3, which shows a great variation here in the production from various tracts as compared to the estimates of oil in place of the committee which worked up the report on it to submit for unitization.

MR. WEYLER: Yes, sir.

COMMISSIONER VAN TUYL: I wish you would refer to this.

MR. WEYLER: I have got one here, sir.

COMMISSIONER BRETSCHNEIDER: I think you have particular reference to Mr. Kavaler's discussion concerning this column and this property and these did produce something and these didn't.

MR. WEYLER: I could run through and explain any particular tract you care to take.

COMMISSIONER VAN TUYL: Take this No. 2 here with 104 percent of oil produced as compared to the estimated amount.

MR. WEYLER: No. 2 here (indicating)?

COMMISSIONER VAN TUYL: Yes.

MR. WEYLER: The Lion tract. We have a time element involved there. It was drilled after the average well in the field. There is, according to the core analysis, logs, of all of these wells up here (indicating), we treated them all alike; throughout the whole field there was no difference. We in the Engineering Committee-- Let me point to this here, this oil in place map (indicating). From core analysis this Tippy No. 1 indicated 12,380 barrels per acre foot, barrels per acre, represented by the core analysis of

that well in place. That's a pretty solid calculation.

On this well nearly 7,000 barrels per acre was represented by the core analysis of this well (indicating), these contour lines; the outer limits were drawn as you draw any contour lines. You don't exactly know where the edge is, no, but we all--including the representatives of Pet Inc.--drew these maps and agreed 100 percent on each of the values given each tract. There was unanimous agreement amongst all companies and all representatives to the values ascribed to each tract.

Now, there is a lot of recoverable oil here (indicating) that will be recovered. This tract is always brought up; it is a high ratio tract. A number of them along here, gas, very rapidly figured to a number of the high ratio wells that are now high ratio wells (indicating), but certainly that doesn't--just because those wells go to high ratio and are all then shut in is no reason at all to believe that there isn't a great amount of recoverable oil under that property represented by these numbers which come from things that we know; the core analysis showed so much oil. By transferring these allowables we are going to produce all of that. It is going to be produced downstructure at an increased

recovery rate by using the gas cap as an expanding force.

Here's another good one (indicating), Tract 6, a dry hole on it. Actually in Tract No. 6 was a Petroleum Incorporated lease and they had an oil well on there, I believe; they said they did. The casing collapsed. That isn't a dry hole; it is a lost oil well. There is a recoverable oil well there. There was an oil well there (indicating). I believe they will agree to that, that that was a lost well.

MR. KAVALER: Could you afford to redrill that well?

MR. WEYLER: Pet Inc. didn't try it.

MR. KAVALER: Do you want the lease to redrill it?

MR. WEYLER: It's in the unit. They drilled a well; they got a well. That well indicated recoverable oil. They lost the well before unitization and released the tract. Just because the casing collapsed is no reason that their recoverable oil disappeared.

There is a reason for the recoverable oil on every lease that we have. We could go over every one. Here is a dry hole down here (indicating). There was actually three feet of what could be called oil pay, but

the oil was one of those marginal things that wouldn't pay out under the rules; but, on that property there is very likely according to the data that we have, our best judgment, that there is recoverable oil on this property, and any other place--and I again say all this was done and argued out on these various points. We would satisfy completely--and I mean all of the companies' representatives--that these figures that we finally put by each well were correct to the best of our mutual judgment, and that the contouring was done likewise.

COMMISSIONER BRETSCHNEIDER: Is that all?

COMMISSIONER VAN TUYL: I have no more questions.

COMMISSIONER BRETSCHNEIDER: Does anyone else have anything more to say? If not, the hearing is adjourned. Thank you very much, gentlemen.

(Whereupon at 5:32 o'clock p.m., Monday, July 2, 1956, the Commission adjourned.)

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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 232, 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 9th day of July, A.D. 1956.

Keith Watson

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