BEFORE THE

Oil Conservation Commission

SANTA FE, NEW MEXICO

IN THE MATTER OF:

CASE NO. 330-330A Special Hearing

VOLUME I

1 through 129

June 21, 1954

TRANSCRIPT OF PROCEEDINGS

OFFICIAL RECORD

OIL CONSERVATION COMMISSION

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VOLUME NO. I

Monday Session June 21, 1954

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SPECIAL HEARING JUNE 21,1954, N.M. OIL CONSERVATION COMMISSION

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R. S. Dewey	Humble Oil & Refining Co.	Midland, Texas
C. C. Chapin	Wood River)Oil &	Wichita, Kansas
Sam Smith	El Paso Natural Gas & Oil	El Paso, Texas

BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico

June 21, 1954

IN THE MATTER OF:

(Consolidated with Case 330-A) The first case is derived from Stanolind Oil and Gas Company's application for the amendment of Order R-110 relating to the Blanco-Mesaverde Pool, San Juan and Rio Arriba Counties, New Mexico.

CASE 330-A is concerned with the application of the Commission upon its own motion to consider an order promulgating rules and regulations for the Blanco-Mesaverde Gas Pool; Matters to be considered include gas pool delineation and definition, gas proration, gas well spacing, gas proration units, and related matters.

Case No. 330 & 330-A

BEFORE: Edwin L. Mechem, Governor
E. S. Walker, Commissioner of Public Lands
R. R. Spurrier, O.C.C. Secretary and Executive Director

TRANSCRIPT OF PROCEEDINGS

MR. SPURRIER: The meeting will come to order, please. The first case on the docket this morning is Case 330 which you will note is consolidated with Case 330-A. Stanolind is the applicant. I presume they will testify first.

MR. SMITH: May it please the Commission, we have already put into the record all the testimony that we care to put in at this particular time. We have already stated our position and we would like to reaffirm it in so far as the proration rules are concerned. It appears now that prorationing is in order as we anticipated when we first filed our application. Under the circumstances, we are prepared now to stand back and let some of the other operators and purchasers in the field take up the proceedings.

MR. SPURRIER: I have got a list. I would like to know--

MR. KELLAHIN: (Interrupting) At this time, Hancock does not desire to put on any testimony.

MR. SPURRIER: We have Pubco, Mr. Kelleher.

MR. KELLEHER: Would it be possible, in view of the fact, in view of the fact that Phillips, they have the opposite side of it, to put Phillips on next and follow immediately?

MR. SPURRIER: I think it would be possible.

MR. FOSTER: I don't know whether it is or not. I think that some of these other proponents of this matter would do very well to lead off first. I don't know why it should all be reserved for rebuttal.

MR. SELINGER: Mr. Spurrier, we will be willing to start off the ball.

MR. SPURRIER: Thank you, George.

J. D. C O O P E R

the witness, having been first duly sworn, testified as follows:

DIRECT EXAMINATION

By: MR. SELINGER:

Q State your name? A J. D. Cooper.

Q You are associated with what company?

A Skelly Oil Company.

Q In what capacity?

A As a petroleum engineer.

Q Mr. Cooper, have you heretofore testified before the New Mexico Oil Conservation Commission as an engineer?

A I have.

Q Are you familiar with the Blanco Field, particularly the Mesaverde Reservoir?

A I am familiar with it to the extent that I have made a study regarding allowables under different formulas.

Q You have made an investigation of the factors with respect to this field and this pool in preparation for this hearing?

A That is correct.

Q You have also had a number of exhibits made under your supervision?

A That is correct.

Q Are you familiar with the Skelly Oil Company's interest in this field in so far as the records are concerned?

A Do you mean the land that we own?

Q The wells and lands, yes, sir.

A As to the wells that we now have or have an interest in, yes. As to the undrilled acreage only generally or vaguely.

MR. SELINGER: Are there any further qualifying questions of this witness from anybody?

MR. SPURRIER: Proceed.

Q Mr. Cooper, I will direct your attention to Skelly Exhibit 1, which is the left hand map of the three maps on the wall. Will you explain to the Commission what that map is and the coloring?

A When we began to gather information to make a study of the allowable formulas, we went to the Commission's files and gathered what data we could obtain there. On 355 wells we gathered information as to deliverability and this yellow color indicates the 355 wells in the Blanco-Mesaverde Pool.

Q There are in excess of 700 wells, however, in the field?

A That is correct.

Q At the time that you were working on this matter, the Com-

mission's records indicated the information on approximately 355 wells? A That is right.

Q You not only assembled the deliverability figures but also the pressure figures, is that correct?

A We took from the records the shut-in pressure which was determined at the same time the deliverability test was taken.

Q Also on Exhibit 1, Skelly Exhibit 1, there is an outline in black or blue. What is that area outlined?

A That outlines the limits of the Blanco-Mesaverde Field.

Q There are pencil figures which the Commission may not be able to see along side of each of the wells indicated on the yellow area. What are those pencilled figures?

A The upper figure is the shut-in well head pressure. The lower figure is the well deliverability as reported to the Commission.

Q You obtained that information from the Conservation Commission's records?

A That is correct.

Q Directing your attention to Skelly Exhibit 2, which is the middle map on the wall, will you indicate to the Commission what that shows?

A Well, it shows the distribution of the well deliverability with a color code. We split the deliverability range into six colors and colored the half section enclosing the well in the color corresponding to its deliverability.

Q The explanation of that, that doesn't necessarily indicate the 320 acre unit assigned to that well, but indicates 320 acres to each well on a density basis?

A It indicates the south half of the section to each well is

what we colored for.

Q It may be that the 320 acres may run north and south rather than east and west but you have followed a general practice of using the south half and north half of each section?

A That is right.

Q But at any rate, it is on the basis of 320 acres to each well?

A Yes.

Q The low is indicated in yellow?

A The low is in yellow, that ranges from 0 to 100 MCF per day. The pink is from 101 to 300 MCF, the blue from 300 to 700, the red from 700 to 1000, the gray from 1000 to 5000, and the green is over 5000.

Q From the looks of that Exhibit 2, is there any apparent correlation between the deliverability and the location of the wells in the field?

A Apparently not. There is a general grouping of the extremely high deliverability wells in the area of Sections, Townships 30, 31 North, Range 9 West. Also there is one sticking out of here like a sore thumb, however, if you look at the offset wells to these high deliverabilities, for example, in Township 30 North, 9 West in the North East Quarter of Section 21, there is a well with a deliverability of 17,840 MCF per day.

Q Point that well out on the map.

A That is this well here.

Q Is that the highest deliverability?

A That is the highest.

Q Of the 355 so far?

A Of the 355. The five wells surrounding that well have de-

liverabilities as follows: in the South West quarter of Section 21, 454 MCF per day; in the North East Quarter of 20, 1,208 MCF per day; in the South West quarter of 22, 2,860 MCF per day; in the South West quarter of 15, 2,925 and in the South West quarter of 16, 418 MCF per day. There is a ratio there of maximum to minimum of 42.7 to 1.

Q In other words, the maximum of that well in Section 21 of 17,840 cubic feet as compared to a low in Section 16 of 418 cubic feet is 42.7?

A That is correct. That follows not only for the extremely high wells as an example in 31 North and 10 West in Section 22, in Section 21, I beg your pardon, but Section 22 is a well that,we have it circled. In Section 22, in the South West quarter the deliverability there 986. The diagonal South West offset which isthe North West quarter of it has 425. The diagonal South East has a deliverability of 180, the direct East offset in Section 23 has a deliverability of 1,043 and the other well in the same Section in the North East quarter of 22 has a deliverability of 1,982.

Q Is that deliverability or pressure?

A That is deliverability. In Section 21 of the South West quarter, of the well has a deliverability of 4,749, there is a range from 47 to 4,749 in this cycle of wells.

Q So, that the range of the well in Section 21 of 4,749,000 cubic feet of gas as compared to the well in Section 27 of 180,000 cubic feet is a ratio of approximately 26 and a half times?

A That is right.

Q Is that correct? A Yes, that is correct.

Q Will you look at Skelly Exhibit 3 which is the map on the extreme right of the three maps on the wall. Will you indicate to

the Commission what that map is?

A It is a color code on surface shut-in pressure. The pressures began at 500 pounds and extended through the 1,100 pound range and they are coded in 100 pound increments. The Exhibit is not completely for pressure contours, there are too many wells in between there and about all it shows, the orange color is the average field pressure and it shows a distribution throughout the field that there is a fairly, at least uniform pressure. There are some anomalies but it is fairly uniform.

Q The orange color on that map, does that indicate the average pressure?

A We averaged the pressure of the 355 wells and came out 967. That is an arithmetic average pressure and that orange ranges from 900 to 1,000 pounds so the average pressure falls in the orange zone.

Q Are these three Exhibits among the Exhibits that you have had made up under your supervision? A Yes.

Q It is based on the information secured from the Oil Conservation Commission records?

A That is right.

MR. SELINGER: We would like to offer into evidence the Skelly Exhibits 1, 2, and 3.

MR. SPURRIER: Without objections they will be admitted.

Q Now, Mr. Cooper, have you had occasion to make additional Exhibits indicating the exhaustive nature of your study?

A Yes, I have made other exhibits.

(Marked Skelly's Exhibits 3, through 8, for identification.)

MR. SELINGER: I might explain to the Commission at this point, the position of Skelly Oil Company, so they may be able to follow

the testimony and Exhibits more closely than if they were in the dark as to what our position was. We have always adhered to the time honored policy of this Commission since the establishment of proration in 1953, of utilizing formula of 100 percent acreage in both the oil and gas proration. We are still agreeable and acceptable to continuation of such a formula. However, we feel that if the Commission deviates from 100 percent acreage in gas allocation that our recommendation for a formula is 100 percent acreage times pressure, and for that reason, we want to make that explanation now and all our subsequent Exhibits will go toward that view.

Q Mr. Cooper, I will call your attention to Skelly's Exhibit 4. Was that Exhibit made under your supervision?

A It was.

Q Where was the information that is indicated on that Exhibit taken from?

A The information used in the calculation was taken from the Oil Conservation Commission's records.

MR. SPURRIER: When?

A At the time of the last hearing on this matter.

MR. SELINGER: It was taken in or about the middle of May, on or about May 16th.

Q What does that Exhibit show with respect to the information indicated on that which you have secured from the Oil Conservation Commission records?

A This Exhibit is a tabulation of the 355 wells. We tabulated them by Section, Township and Range because that was the way the information was tabulated in the files. The columns across the page are Township and Range Sections, quarter sections where the well

is located, the operator, the well number, the lease, and the well capacity. We took, to determine well capacity, production history for 1953 where it was available on these wells. We also took the deliverability. We multiplied the deliverability by 30 and where that was larger than any production, any one month's production from the well in 1953, we used 30 times deliverability as the well capacity. Where the previous history of the well in 1953 indicated it could produce in excess of what the deliverability test gave it, we used the past producing history. We have indicated by an asterick those wells in which deliverability was the controlling factor in determining capacity.

Q Those wells that don't show that asterick, you used the previous production history, is that correct?

A Previous production history, that is correct. In a few cases we had no history for 1953, so we went into the records and used 1954.

Q They are in rare instances three or four at the most?

A Three or four at the most, rare instances.

Q What does the next column show?

A The next three columns are a group, a calculation of the allowable based on a 75 percent deliverability times acreage plus 25 percent acreage formula. The first column is the deliverability of the well as was taken from the Commission's records. The middle column is headed Theoretical Allowable, by that we mean the allowable of that well if all the wells could make their allowable.

Q That is the allowable under the allocation formula of 75-25?

A That is correct. We then calculated an adjusted allowable by determining which wells had a capacity less than their theoretical

allowable subtracting that amount from the total nomination and re-allocating the remaining nomination. We followed that process , repeated that process until all wells would make their allowable. Those which we designated as limited wells, wells whose allowable was greater than their capacity are marked with a cross hatch.

Q So, that your theoretical allowable is the allowable for each and every well under the formula, regardless of whether they were able to make it or not?

A That is correct.

Q You adjusted it downward in the actual practice of proration of giving the limited wells their capacity and prorating the balance to the proratable wells?

A That is correct.

Q That is the allocation under that formula for all 355 wells?

A Yes.

Q You have similarly followed that process in the 5-50,a five percent acreage times deliverabilities times 50 percent acreage formula and also the formula which you have recommended, 100 percent acreage times pressure?

A That is correct.

Q You have done that under both allocation formulas for all 355 wells?

A For all three allocation formulas in all 355 wells.

Q Mr. Cooper, I will call your attention to what has been designated as Skelly's Exhibit 5 and ask whether or not you had that Exhibit made under your supervision?

A Yes, sir.

Q Where was that information secured?

A This information was secured the same place as the rest of the information we have presented, from the Commission files.

Q At the time your computations were made on or about the 16th day of May?

A At the time they began, which was on or about the 16th day of May.

Q What does that Exhibit disclose?

A It discloses the same information as Exhibit 4 except we have removed the column showing deliverability and shut-in pressure and theoretical allowable. It is a straight comparison of adjusted allowables under the three formulas.

Q It is an allowable for each of the 355 wells under the 75, 25, 50, 50, and your recommended plan of acreage times pressure?

A That is correct.

Q It compares the allowables of all the wells under each of those three plans?

A Yes. The same symbols, well capacity is on there and the same symbol is used to indicate a capacity defined by deliverability and the cross hatch is used to indicate limited wells.

Q Now, Mr. Cooper, have you determined the minimum allowable and the maximum allowable for prorated wells under each plan?

A Yes.

Q Calling your attention and referring you entirely now to the 75 - 25, the first formula under the Exhibit, what is the minimum allowable for a prorated well under that plan?

A I think first, we should explain that this Exhibit is based on a total allowable of 6,860,000 MCF per month. That is 6,860,000 MCF per month.

Q Or 6,860,000,000.

A (Continuing) We arrived at that figure by taking the sum of the average production of each well for 1953 and adding all those up and that is the figure that we got.

Q That is the field production and allowable and nominations secured, that you based on actual production during the year, 1953, with the exception of the three or four instances where you had to use the 1954 figures?

A That is correct. We took the average well production for 1953 per month.

Q On that basis, what is the minimum allowable for proratable well under that first formula of 75-25?

A The minimum allowable is 6,983 MCF per month or 233 MCF per day.

Q Under that basis what is the maximum allowable for proratable well under that first plan of 75-25?

A 233,878 MCF per month or 7,796 MCF per day. This is a maximum to minimum ratio of 33.3 to 1.

Q In other words, that first formula of 75-25 the maximum well would get over 30 percent, 30 times more than the allowable of the minimum well?

A On the proratable wells, yes.

Q On a proratable well? A Yes.

Q What is the minimum allowable for a proratable well under the last plan indicated on the Exhibit which is the 50-50?

A The minimum allowable under the 50 D x A plus 50 A is 13,996 MCF per month or 466.5 MCF per day.

Q That is approximately 466,000 cubic feet a day?

A That is right.

Q On that basis, what is the maximum allowable for a proratable well under that formula?

A 155,094 MCF per month or 5,169.4 MCF per day. That is a maximum to minimum ratio of 11.1 to 1.

Q What is the minimum allowable for a proratable well under the allocation formula that you are recommending to this Commission, of pressure times acreage?

A 16,700 MCF per month or 556.7 MCF per day.

Q That is approximately 556,000 cubic feet of gas a day?

A That is right.

Q What is the maximum allowance for a prorated well under your recommended plan for pressure times acreage?

A 30,721 MCF per month or 1,024 MCF per day.

Q What is that a variation from?

A This is a maximum to minimum of 1.84 to 1.

Q Under your allocation formula, the difference between the highest allowable well and the lowest allowable well is less than two times?

A For proratable wells?

Q For proratable wells. It was in excess of 30 times under the 75,-25 and in excess of 11 times under the 50,-50?

A That is correct. Incidentally, this total nomination is equivalent to 644 MCF per day per well if all wells had the same allowable.

Q Under the one hundred percent acreage?

A Yes.

Q Based on 320 acres? A Yes, sir.

Q Having studied these three plans as evidenced by your Exhibits 4 and 5, will you relate to the Commission your reasons why you favor an allocation formula of pressure times acreage as compared to the other two?

A As a prelude, I would like to explain that pressure, by pressure times acreage, I intend to mean bottom hole pressure times acreage. To me an allocation formula should be based as nearly as possible upon the relative reserve between wells. Decline curve extrapolation to bottom hole pressure versus cumulative production is generally accepted as a very accurate method of determining gas reserve. I feel that this principle can be applied between wells in the same field in a proration formula and that such a formula will be more directly related to individual wells gas reserve than either of the two deliverability formulas. As an example, if two wells started with equal bottom hole pressures but unequal reserve they will receive the same allowable on the first proration schedule, However, assuming both wells produce this allowable, the well with the smaller reserve will have a greater pressure decline and will consequently receive a relatively smaller allowable for the proration period following the next pressure survey. This adjustment will be continuous between all the wells in the field throughout the life of the field.

Q Mr. Cooper, you have secured the results of the deliverability tests from information garnered from the Commission's records, will you indicate to the Commission what range of deliverabilities you found?

A We found deliverabilities reported from 32 MCF per day to 17,840 MCF per day, a ratio of 557 to 1.

Q In other words, the ratio of the highest to the lowest, which is approximately 550 times?

A Yes.

Q In your opinion, as an engineer is the reserve variations between these wells as great as indicated by the range, such range in deliverability?

A Well, it is entirely possible for such a variation to occur. Especially since we have edge wells in any field and the reserve ratio between edge wells and fat field wells could easily be as great as a 557 to 1. However, under those conditions I don't believe the edge well would be a proratable well, it would be more likely to be a limited well.

Q You mean under any of the plans, it would most likely be a minimum well?

A Yes. Further on the same point, if you refer back to Exhibit 2, in the examples which we set out there in Section 15, 16, 20, 21, 22, Township 30 N, Range 9 West, this was a range of deliverability between offset wells of 42 to 1. It is my opinion that the difference in reserve between these offset wells will not approach 42.

Q Do you find similar instances in the field?

A There are instances, all you have to do is look for them.

Q Mr. Cooper, do you, of your own knowledge know of other fields, other gas fields that are prorated under the acreage times pressure?

A Yes, sir.

Q Mr. Cooper, I will hand you what has been marked as Skelly's Exhibit 6 and ask you to state what that is?

A Exhibit 6 is a tabulation of every 10th well on Exhibit 4

and 5, a total of 36 wells, since we began with the first well, it shows the effect of different nominations on the allowable under the recommended pressure times acreage plan.

Q In other words, you have taken the wells in Exhibits 4 and 5 and taken every 10th well?

A Yes.

Q Starting with the first well, No. 1?

A That is correct.

The red line on the Exhibit indicates the demarcation between prorated wells and limited wells, the wells above the red line are limited, the wells below are prorated?

The first column,to make this calculation, I assume this was a 36 well field with pressures on the wells as indicated. The first column is based on the total nominations of 270,000 MCF per month or 250 MCF per well per day. The second column is 540 MCF per month or 500,000 MCF per well per day. The third is 810,000 or 750 MCF per well per day and the fourth is the well capacity as we determined it on Exhibit 4 and 5.

You will note from the way the nominations increased the number of wells which are limited, increases in like manner. Until you reach the ultimate capacity of the field and you, in effect, have no proration. We think that with this type formula, no minimum allowable or maximum allowable would be necessary. In fact, that a limitation such as that would probably be undesirable because on a reduced market the maximum number of wells bear the brunt of proration and this is as it should be.

Conversely, with the increasing market, increasing as it does across this Exhibit, only those wells with better and then greater

and then exceptional producing ability are prorated until the field capacity is reached and there is no proration.

Q Under this Exhibit, the way the plan works of acreage times pressure on a restricted market, more wells participate in bearing the brunt of the limited market?

A That is correct.

Q And as you have an expanding market, only the better wells gradually are prorated and gradually more and more of the medium size wells are dropped from proration?

A That is correct. This is possibly further better illustrated on the next Exhibit.

Q Exhibit 7?

MR. SPURRIER: Can we take a short break?

MR. SELINGER: Yes, sir.

(RECESS)

MR. SPURRIER: Mr. Selinger.

Q Mr. Cooper, referring to Skelly's Exhibit No. 6, that is the allowables under the various market demands as you have indicated under the recommended formula of acreage times pressure, is that correct?

A That is correct.

Q Again referring back to Exhibits 4 and 5, with respect to the pressure information indicated on there, will you please tell the Commission where that information was secured?

A The pressure information on those Exhibits was taken from the Commission's records at the same time we obtained the deliverability information and that pressure represents the shut-in in casinghead pressure or shut-in well head pressure taken at the close of the

deliverability test.

Q As required now by the existing rules of the Commission?

A That is right.

Q Now, you were going to refer to Skelly's Exhibit 7, which is now on the wall, will you further explain that Exhibit?

A Exhibit 7 is based on a hypothetical 20 well field with assumed equal bottom hole pressures and equal acreage per well and well capacity as shown on the Exhibit. This curve was drawn to demonstrate changing of nomination on individual well allowable.

Q Will you explain the side and the bottom so that we can follow it?

A Along the vertical scale of the Exhibit, the well allowable is plotted and along the base of the Exhibit, the total nomination.

Q That is the total allowable for the field?

A For the field, that is correct. Now, reading the Exhibit across, you notice, no nominations up to a nomination of 100,000 MCF a month and this is per month, all the wells are prorated at 5,000 MCF per month.

Q All the wells in the field of 355 wells--

A (Interrupting) No, all the 20 wells.

Q That you have used?

A Are prorated. As the nominations increased from 100,000 to 400,000, we drop from proration 9 wells and 11 wells remain prorated. Those wells have an allowable of 26,455 MCF a month, all the same allowable, the other wells have greater capacity. As the nomination then increases to 800,000 MCF per month, only the wells with the capacity in excess of the allowable as shown here which is 94,000 MCF per month are prorated, that is 4 wells prorated and 16 limited. When you reach the end, none of the wells are prorated, and 16 limited. When you reach the end, none of the wells are prorated,

that is the field capacity. We feel that by looking at this Exhibit, you can see that as the nominations increase the wells, the smaller capacity wells become limited. They are entitled to this allowable and they are given an opportunity to make that allowable. It is only until they fail to make it then the allowable is prorated among the wells who have additional capacity.

Q Under that formula then, the market demand for the field is taken care of if some of the wells fail to make their assigned allowable, the balance is thrown back into the proratable wells?

A That is right. This curve, if you look at the decreasing nomination, that as the nominations in the field fall, more and more wells, the poorer class of wells come under proration so that in a time of very low nominations, the greatest number of wells would be prorated or all the wells would be bearing the brunt of proration.

Q Then, in an unusual restricted or hard ship time, more wells participate in bearing the brunt of the restricted market, is that correct?

A That is correct.

Q And conversely in a more favorable expanding market, why more and more wells are permitted to capacity and the better wells are solely prorated?

A That is correct.

Q Under this formula then, all the wells are given an opportunity to produce their share of the gas, is that correct?

A All the wells are given an opportunity to produce their share of the gas market based on the relative reserve.

Q Mr. Cooper, I asked you before whether or not you had any

experience with respect to a formula which you have recommended to this Commission for proration of gas in the Blanco-Mesaverde Field in San Juan County in the event the Commission deviates from the 100 percent acreage. You stated that you did. I call your attention to what has been marked as Skelly's Exhibit No. 8. Does that indicate the allocation formulas of a great many, if not all of the gas fields in the State of Texas?

A Of the gas fields carried on the non-associated gas schedules.

Q Will you explain that Exhibit to the Commission with respect to the number of gas fields that are prorated under the various plans using whatever factors are applicable?

A Page 3 of the Exhibit is a summary of the formulas used in Texas. I have divided this into formulas, which are formulas that use only acreage and well factors and of the 125 total gas fields 44 use either straight acreage or acreage and well. In a field where all units are the same size or essentially the same size that amounts to a straight acreage formula. In the state of Texas, there are 45 gas fields using acres times bottom hole pressure as the proration formula. There are two gas fields which use one half acres time bottom hole pressure plus one half well. There are six fields which use two-thirds acres times bottom hole pressure plus one-third well. There are four fields which use one-third bottom hole pressure and two-thirds acres. A total of 57 fields which utilize either acres times pressure or acres time pressure to some extent modified by well.

There are also four fields which use acres time rock pressure or shut-in surface pressure and three fields which use two-thirds acres times rock pressure and one-third well. Seven fields, if you

add the two pressures together, that is a total of 64 fields. There are 8 fields using potential in the deliverability formula. Two use one half potential and one half acres. One uses one-fourth potential and three-fourths acres times rock pressure. Four fields use one-third potential and two-thirds acres times rock pressure. One field one quarter potential, one-half acres and one quarter well. There are six fields which have deliverability in their formula. There are two fields which use state acres time deliverability. Two fields which use one-half deliverability and one-half acres times rock pressure. One field one-third deliverability, two-thirds acres times bottom hole pressure and one field with one fourth deliverability, one-half acres times rock pressure, and one-fourth per well. There are also three fields which use acre feet in their formulas.

The comparison there is acres times bottom hole pressure of 45 fields, and acres times bottom hole pressure in a total of 64 fields which is compared with six fields which use deliverability.

Q So, you have a total of 125 fields that you have looked as to its allocation formula, just to the State of Texas, at least half use the pressure factor? A Yes.

Q And only six fields use deliverability in a portion of the factor, either from 100 percent on down?

A That is correct. As a further insight, of course, the one field which comes to everybody's mind in Texas which uses acreage times deliverability is Texas Hugoton. The comparable field in Texas which uses acres times bottom hole pressure is Carthage. We are the largest operator in the Carthage field.

Q We are the operator of the largest number of oil and gas wells in the field?

A That is right. To give you some idea of the relative size of these fields, I obtained production from March, 1954 from the Carthage Field from an Oklahoma Hugoton and Kansas Hugoton and I took the allowable from Texas Hugoton because I couldn't get the production. The Texas Hugoton had an allowable of 15,754,640 MCF, The Carthage produced 29,802,335 MCF, that is almost twice as much as Texas Hugoton. The comparison between Carthage and Oklahoma Hugoton is 1.66 times, it is 80 percent as large as Kansas Hugoton or it is half as large or 40 percent as large as all three Hugoton Fields put together.

Q In all three states? A In all three states.

Q Now, Mr. Cooper, have you had occasion to study the existing rules and have made modifications in the existing rules to take care of your recommended allocation formula of acreage times pressure?

A We have taken the present existing rules and modified them to include the acres times pressure allocation formula.

Q In drawing up these proposed rules for the Blanco-Mesaverde Field in San Juan and Rio Arriba Counties, New Mexico, you have followed the existing rules with the deletion of deliverability and addition of a new Section 4 and 5 with respect to allocation following your present proposed program?

A That is correct.

Q Mr. Cooper, in allocating gas, it is quite evident, is it not, that it is almost impossible where you have limited wells to attempt to fulfill your market demand on a daily or even a monthly basis, is that correct?

A Well, if you mean a dailey nomination basis.

Q Yes.

A I think that is essentially true. I understand the pipelines want a longer nominating period. They want to nominate for a longer period to allow, they want to nominate for a longer period because they make long range forecast.

Q In line with the existing statutes of the Commission and in line with the desires of the purchasers to follow proration periods for stability purposes, does not your rules provide for a section which would insure such a thing?

A It provides a six months proration period.

Q In Section 5 of your proposed rules, you advocate the proration period and the assignment and consideration of underproduction and overproduction on a six months period?

A That is correct.

Q With balancing dates?

A Yes, sir.

Q With that provision in your proposed rules, it would be possible, would it not for the purchasers to fulfill their non-desirable market demand for the proration period?

A I believe so, yes.

Q You have also in attempting to comply with the recommended allocation formula made provision in Section 4 for pressure determinations, is that correct?

A That is correct.

Q As the rules are now written, it provides for a semi-annual pressure determination, you are continuing such a practice?

A Yes.

Q The dates of such semi-annual pressure determination is left blank depending upon the desires of the Commission?

A That is correct.

MR.SELINGER: We would like to offer in evidence, Skelly's Exhibits 4 to 9, all inclusive.

MR. SPURRIER: Without objections they will be admitted.

Q Mr. Cooper, in concluding, therefore, I want to ask you just a general Mother Hubbard question. In your opinion, do you believe that the allocation formula that you have recommended of one hundred percent acreage times pressure would more nearly approach the reserves under the various tracts as required under the statute than any other allocation formula?

A As the field is produced, I believe so, yes.

Q I want to read you this provision and ask you not for your legal interpretation but whether or not your recommended allocation formula will do what is required under the statute? That is the rules and regulations or orders of the Commission shall so far as it is practicable to do so afford to the owner of each property in a pool the opportunity to produce his just and equitable share of the oil or gas or both in the pool being an amount so far as can be practicably determined and so far as such can be practicably obtained without waste, substantially in the proportion that the quantity of the recoverable oil or gas or both under such property bears to the total recoverable oil or gas or both in the pool and for this purpose to his just and equitable share of the reservoir energy. Do you believe that your allocation formula will more nearly approach that objective than,for example, the two comparitive formulas?

A I do.

MR. SELINGER: I believe that is all.

MR. SPURRIER: Anyone have a question of Mr. Cooper?

MR. TURNER: Does the Commission wish to cross examine each witness or do you wish to finish direct and then go to cross?

MR. SPURRIER: Each witness.

CROSS EXAMINATION

By: MR. TURNER:

Q I would like to ask a few questions. Mr. Cooper, what is your title with Skelly Oil Company?

A I am a petroleum engineer.

Q Are you in charge of the petroleum engineering department with Skelly?

A No, sir, I am not.

Q Who is in charge of that department?

A Our Chief Engineer is Mr. W. P. Whitmore. Our executive Vice-President is Mr. J. S. Freeman.

Q Were you assigned to make a study of the Blanco Field?

A I did this work.

Q When were you assigned to do that work, Mr. Cooper?

A That came just prior to the last May 16th hearing.

MR. SELINGER: I assigned him to do that work.

MR. SPURRIER: The question was when?

MR. SELINGER: May 16, 1954.

Q That is roughly six weeks ago that you began your study of the Blanco Field?

A That is correct.

Q Have you been out in the field there during that six weeks period?

A No, I haven't been out.

Q You made an office study at the Skelly Office in Oklahoma?

A In Tulsa, yes, sir.

Q Where did you get these logs that you studied?

A I didn't have any logs.

Q You didn't have any well logs?

A No, sir.

Q What data did you study?

A The data reported to the Commission.

Q What was that?

A The data reported to the Commission.

Q By whom?

A By the operators.

Q You mean you get a transcript of the record?

A No, sir, I understand that the Commission's files are open to anyone who wants to go in and look at them.

Q I want to get for the record, I am not questioning that. We are entitled to know what you studied and the basis on which you arrived at this opinion.

A The basis for this opinion is an engineering fundamental to me.

Q We understand what your thoughts on it are, but there is some little difference in opinion.

MR. SELINGER: Are you asking about the factual data or are you asking about his opinion, are you talking about the data he secured?

MR. TURNER: I think this Commission is entitled to know whether he is an expert on the Blanco Field or whether he has made a superficial check on it.

MR. SELINGER: You sat through the presentation of direct

testimony and in each instance the witness testified from what data all these exhibits were taken from. I was very careful in every Exhibit to put that prefix on so there wouldn't be any question about it.

MR. TURNER: I may have misunderstood him.

MR. SELINGER: You misunderstood him eight times then.

MR. TURNER: Maybe so. I would like for him to tell us again if there is not any secret about it as to exactly the data he used in making these computations.

MR. SELINGER: These Exhibits?

MR. TURNER: Yes.

MR. SELINGER: All right, repeat them, Mr. Cooper.

A I used the data from the Commission's files showing well deliverability tests which I and one other engineer copied in Santa Fe last month.

Q I see. Those were the only records that you considered?

A Those were all I thought necessary.

Q So, you took well deliverability data from the Commission's files and it was on the basis of that information that you have arrived at the conclusion that you have given here today?

A No, sir. That conclusion again, is based on engineering principles.

Q It is on your judgment as a petroleum engineer of what that shows?

A No, sir, the formula that I proposed is on my judgment as an equitable formula based upon reserve as nearly as possible.

Q How many wells does the Skelly Oil Company have in the Blanco Fields?

A As operator or as an interest owner?

Q Well, you might tell us if there are two categories, you might give us both of them?

A I find two which we operate.

Q You operate two wells in the field?

A In the field, yes, sir. In the Blanco-Mesaverde. 12, I believe if I counted correctly, which others operate and we own an interest therein.

Q Are those wells in which your Company has a partial interest or undivided interest, the 12 that you have mentioned?

MR. SELINGER: You mean the working interest?

MR. TURNER: Yes.

A Which 12, we own a working interest in 12 wells as I counted.

Q You own the entire or partial?

A Partial working interest.

Q Could you tell us what percentage of those wells that the Skelly Oil Company owns?

A I couldn't tell you that.

MR. SELINGER: I don't think this information is very pertinent.

MR. TURNER: If we didn't have a single well, we are entitled to know the factual basis.

MR. SELINGER: I think you are wasting a lot of time with unnecessary information.

MR. TURNER: We want to show--

MR. SELINGER: (Interrupting) Go ahead, you can go far a field.

MR. TURNER: We would like to show that he has two wells and

a small interest in some others.

MR. SELINGER: And some undrilled acreage and drilling some wells now.

MR. TURNER: We will get into that.

Q How much undrilled acreage does Skelly have in the area?

A I do not know.

Q Could you approximate it?

A I could give you a guess of about 20,000 acres.

Q In the Blanco Field?

A I do not know in that area.

Q Well, the area?

A The field has been extended about 12 times.

Q You have drawn the outlines of the field up here on these maps, how many acres would you say you have within the outlines of the field as you have shown it to be?

A I do not know.

Q You don't know. Have you made any study of the reservoir conditions in the Blanco Field?

A I have read some of the literature published in the various trade journals and that has been the extent.

Q You have picked up a magazine and read it from time to time about the Blanco Field? A Yes.

Q Do you know that the Mesaverde is from 450 feet in thickness down to as low as, well to zero?

A Well, it must vary, there are dry holes.

Q Some of it, it is a wide variation, isn't it, if you are familiar with that. Does n't it vary?

MR. SELINGER: We would like to object to that question.

That is a question for a geologist. This man is here as an engineer. We are going to object to any question with respect to geology.

MR. TURNER: He is supposed to be an expert on reservoir capacities.

MR. SELINGER: We stayed away from the geological formation whatsoever. There wasn't a single question in the hour and a half that he was on the stand that had anything to do with geology.

MR. SPURRIER: Objection sustained.

MR. TURNER: We wish to note our exception if the Commission please. I think that is all.....Could I ask him another question?

Q Where are your two wells located, what part of the field?

A I couldn't tell you that.

Q You don't know where your wells are located?

A Wait just a minute. 24, 27, 28.

Q What was that?

A 24, 27, 28.

MR. SELINGER: Did you get that? 24, 27, 28.

A And 26, 29, 7.

MR. SELINGER: That is the Township, Section and Range.

MR. TURNER: Sections 24, 26, 27 and Section--

A (Interrupting) No, Section 24, 27, North 8 West, Section 26, 29, North, 7 West.

MR. SELINGER: You want the location of the wells that we have an interest in, the 12 wells?

MR. TURNER: No, I don't think we need that for the moment.

MR. SPURRIER: Mr. Smith.

By: MR. SMITH:

Q I am not quite clear, Mr. Cooper, as to just how you go about

adjusting these individual well allowables each month?

A Mr. Smith, the procedure that we followed was to first calculate the theoretical allowable or the allowable each well would have, if all the wells could make it. We then compared that allowable with the well capacity determined in the manner, I spoke of before. If the allowable was in excess of the capacity, we assigned that well its capacity and called it a limited well. We then, subtracted all of those wells, the capacity of all of the limited wells from the total nominations and recalculated the allowable for all the other wells. We then checked it again, capacity versus allowable and we followed that procedure until we found that all wells would make the allowable.

Q In arriving at the capacity of the well, what figure did you use for that purpose?

A We used the higher of two figures. We had production figures for 1953 on most of the wells and in a few cases, production figures we looked up for 1954. If during any month in 1953 the well produced more than 30 times its deliverability, we used production history as the capacity, that high month. If 30 times deliverability was the high figure we used that as capacity.

Q Then, as I understand your testimony, the basis for your rule would be the deliverability of the well?

A No, I used that only to find capacity.

Q To find the capacity of the well. In the absence of the deliverability test you used the actual production, is that right?

A Yes.

Q Coming back to the question that I just asked you, in order to work your formula and arrive at capacity, it is your recommendation,

as I understand it, that the Commission consider the capacity based on deliverability?

A No, sir.

Q What is your recommendation?

A I used deliverability because it was a newer figure. It was newer than the past history, I was attempting to get the maximum capacity of each well. My recommendation is and it is in the field rules also in under and over production that past history will determine when a well becomes limited.

Q In other words, its inability to meeta particular allocation that would be made to that?

A A particular allowable, yes.

Q As each of these wells accumulate over production, they are to be balanced in six months period, is that right?

A The provision for overproduction is that overproduction accrued during one six months period must be balanced out during the six months period. The well must be in balance at some point during the next six months.

Q It naturally follows that underproduction can't be balanced too, is that right?

A Yes.

Q If a well can't make up its underproduction during the six months?

A The underproduction accrued during the first six months is not made up during the second six months, it is cancelled.

Q Would it be possible under your formula for allowables to be so stacked, shall we say, to the point where at the end of the six months period, you might have the situation of certain of the

more productive wells being shut in for a period of time due to the fact that they have overproduced?

A It wouldn't necessitate a shut-in. They might have to reduce.

Q Is it possible by continuous stacking of allowables on wells that are unable to make their allowable assigned to them to result in the wells becoming more productive during the shut-in period?

A It is possible for a productive well to be shut-in provided it has overproduced greatly in excess.

Q If the underage is cancelled out, what about the overage, are you going to cancel that out?

A No, sir, the manner in which overage is handled at least my experience with the Carthage Field, overproduction is adjusted by adding that to the nominations since there is a market for that gas. Therefore, it should be added to the nomination and become a part of the allowable.

Q So, that under that theory, you would have no time that you would actually shut a well in?

A There shouldn't be, if the operator is in any way cognizant of what is going on.

Q In making----

MR. FOSTER: (Interrupting) Repeat that last answer.

A There shouldn't be an occasion to shut a well in if a operator is watching his allowables. He shouldn't get overproduced enough to have to shut himself in.

Q In making your determination of the reserves in place, as I understand it, the only test that you made was again back to your deliverability test that had been filed and/or actual production?

A I made no calculations of reserves in place.

Q I understood from your testimony that your recommendation was to make sure that each of these wells produced the reserves they had?

A It is my feeling that the relative pressure decline between wells with production is indicative of the reserve between wells.

Q That the pressure alone is--

A (Interrupting) No pressure decline, not pressure alone, pressure decline with production.

Q Would be the only basis for determining reserves so far as the proration formula is concerned?

A That is the basis.

Q Isn't sand thickness also indicative?

A Yes, sir.

Q Don't you think that more equity would result if sand thickness were included?

A If it can be determined. I think, however, the equity would probably not be any greater.

Q In other words, you think that the average sand thickness from well to well is uniform?

A No, sir, but I think the change in pressure decline, the well in a thin sand will have a smaller pressure decline.

Q Isn't your pressure more or less dependent upon porosity and permeability? A Pressure?

Q That is right.

A Not bottom hole pressure, shut-in bottom hole pressure.

Q You don't think that permeability has anything to do with--

A (Interrupting) It enters into the time that requires a well to build up, yes.

MR. SMITH: That is all.

MR. CHAPIN: With Wood River Oil and Refining Co. Here is a man with six weeks experience in gathering statistics, doesn't know where his wells are, trying to tell us how to run the files. I request that his testimony be rejected as to not being qualified.

MR. TURNER: I would like to make the same motion. He has sought to compare the Blanco with the Carthage Field. As I understood, he said they were similar fields.

MR. SELINGER: He didn't say that. I will challenge the record.

MR. TURNER: We will take his statement about what he said about it.

MR. SELINGER: Show me in the record where he said they were similar.

MR. TURNER: At least he has sought to compare different fields and claimed this formula should be put in Blanco Field because it applies in another field. As this gentleman points out the witness is not shown to be qualified. We move that his testimony on that point be stricken and we join in the motion to strike his testimony as a whole.

MR. SPURRIER: This Commission feels that the witness is qualified and said so at the beginning of the witness's testimony, qualified as to what he testified to. We also understand what he is testifying about. Anyone else have a question of Mr. Cooper? Mr. Howell.

MR. HOWELL: Ben Howell, with El Paso Natural Gas Company.

By: MR. HOWELL:

Q Mr. Cooper, referring to Skelly's Exhibit 4, as I understand

your testimony, you have designated the well capacity either by the actual production or by taking 30 times the deliverability. In one column, these are listed with an asterick. Which character of figures is shown by the asterick. Is that the calculated figure?

A That is the calculated figure based on deliverability, yes, sir.

Q So, that the asterick here in both columns, if I am correct, show at least half of the wells you have given a calculated deliverability that was in excess of what they actually produced during the year, 1953?

A I don't know the number, Mr. Howell.

Q You might take a look here.

A I assume it as about half.

Q It is approximately half, is it not?

A I believe it is, approximately, half, yes, sir.

Q Then, your testimony is based upon an assumed figure that in operations the well actually did not produce?

A It had produced up to this time.

Q Furthermore, in continuing your calculations and applying your different formulas, you assumed that each of the wells would be on the line 30 days out of each month?

A That is in here, in assumption, yes, sir.

Q That is your assumption, you are assuming that there are not shut-ins of any of these wells, you are assuming in making that calculation that the market demand is constant so that a well can be permitted each day to produce that day its allowable, haven't you?

A I have assumed the constant market demand because there were

just too many calculations to make the difference.

Q All the figures that you have given us here are based upon that assumption of the constant market demand the same volume each day?

A We presented other exhibits to show the effect of the change in market demand.

Q But this particular Exhibit 4 that we are referring to and Exhibit 5, all of your computations there are based on those assumptions?

A They were based on that constant market demand, yes, sir.

Q So, that if your Exhibit 4 shows and if you will check it, I believe you will find that you have some 60 of the 335 wells that are what you call the limited wells under that calculations, is that correct?

A Under which formula, Mr. Howell?

Q Under the basis of calculations you used 75-25 there are approximately 60 wells, are there not, that would be limited wells?

A As I counted, there are 71.

Q 71? A Yes, sir.

Q There are a number of those wells which, if not produced every day at the same volume or which if shut-in, would then become limited wells?

A Yes, sir.

Q And that there are more and more wells that become limited wells, that simply cannot make their allowable as the formula is changed giving more emphasis to acreage and less to deliverability?

A That is correct.

Q From the standpoint of the market, the marketer of gas has got to market the gas on the days and the months and the times when

the market is available, doesn't he?

A I presume so, yes, sir.

Q And that if a well on a fluctuating operation fails to make its allowable in a continued fluctuating operation, there is very little opportunity of that well ever making the allowable and that gas ever being marketed, isn't there?

A The well would be placed on limited capacity based upon its capacity.

Q But even though it be placed on limited capacity unless the operation is a constant day by day taking of the same amount of gas that well is going to continue to fall behind from time to time, isn't it?

A I believe that is essentially correct.

Q So, that that gas that is underproduced from that well just can't be made up?

A No, sir, it is also cancelled off.

Q It has to go to--

A (Interrupting) Cancelled off the proration.

Q It is cancelled off and isn't available and can't be made up and isn't available for marketing?

A It isn't available, that is right.

Q Unless it has been obtained from wells that have deliverability that market simply isn't made?

A I presume it would be obtained from those wells that would accumulate overage. The overage would be added to the nomination and be part of the allowable.

Q The result is that constantly the ability of a well to deliver continues to give it a larger percentage of the production from the

field, isn't that true?

MR. SELINGER: Would you mind rephrasing that so I can understand.

Q The ability of the well to deliver under any formula is going to result in that well producing a larger proportion of the production from that field than the wells that can't deliver?

A If I can, Mr. Howell, I think I can answer your question in this way. The better wells in the field as the field is produced will get an increasingly larger share of the market.

Q Regardless of what formula is used?

A Regardless of what formula is used, correct.

Q You spoke a little while ago in your method that the two wells, I believe the illustration was used with varing sand thicknesses that you would expect the pressure to decline on the well that had the lesser thickness more rapidly than the well with the greater thickness?

A I think I said reserve, other than that the statement is correct.

Q If the reserves of one well are greater than the other well, the well with the lower reserves you expect to have its pressure decline?

A More rapidly.

Q And also the deliverability will decline more rapidly, wouldn't it?

A The deliverability of the well will decline with its pressure against a constant pressure.

Q That is right, so that as against a constant decline pressure the deliverability of the well with the lesser reserves declines as

the pressure declines?

A Yes, sir, but I think not in direct ratio with reserves.

Q That is your opinion on that particular matter?

A That is right.

Q Referring to your Exhibit No. 2, I believe you have taken two colors and shown as your yellow, the half sections with zero to 100,000 and then in pink, the 100,000 to 300,000 deliverability. Actually those two groups really belong about together, don't they?

A Well, they are both kind of sorry.

Q They are both sorry. They are both going to be the limited wells that we talk about?

A Yes.

Q We find both of them pretty well scattered over the flanks of the field, don't we? We find the two colors rather concentrated around the flanks, the yellow and the pink, do we not?

A They are more or less concentrated. They are also there in the middle, the pink not as much as the yellow. The pink is scattered lightly.

Q And also you find, for example, in your high deliverability with 1,000 to 5,000 MCF daily for which you use a gray, you find several rather solid blocks of that toward the center of the field, do you not?

A Not very big blocks but there are some blocks there.

Q There are some solid blocks there and, of course, as to this shown in white on your studies, you don't know what the wells are going to show when completed?

A I do not know,that is correct.

Q Furthermore, did you make any effort on any of the instances

that you chose to determine the number of feet of sand that was exposed in the well bore?

A I did not.

Q You didn't take into consideration whether a well was completed only in the Cliffhouse or in the entire Mesaverde?

A No, sir, I assumed that if the entire Mesaverde was productive, the operator had the whole thing open, maybe it was a bad assumption.

Q As a matter of fact, you know there were some wells that were in the early days completed only in the Cliffhouse and from time to time they are being reworked?

A That is what I understand.

Q Also in making your studies, did you give any consideration to the improved techniques of completion that have taken place?

A Mr. Howell, I didn't consider that either because I don't think deliverability has any bearing upon what I have proposed. Again, it is my opinion as you say, but it is still my opinion that deliverability has no relationship to reserve.

Q In reaching that conclusion you failed to take into consideration these factors that I have mentioned?

A I did not take them into consideration.

MR. HOWELL: Thank you.

MR. SPURRIER: Mr. Howell.

MR. HOWELL: Could I ask one more question?

MR. SPURRIER: Yes, sir.

By: MR. HOWELL:

Q In applying your formula, would you allow more than 320 acres for any one well?

A I think that is pretty well loaded. I will put it this way, Mr. Howell, if after a notice and hearing which would be required the Commission felt that a well would drain in excess of 320, I would have no objection to allowing more than 320.

Q You would do that regardless of the capacity of the well to make deliveries into the pipeline?

MR. SELINGER: If the Commission please, this witness has not testified on direct examination as to what size unit, the existing rules now call for 320, we have no opinion as to whether it should be 320,640 or 980.

MR. HOWELL: The question I am asking and I think it is a pertinent question, Mr. Selinger.--

MR. SELINGER: It is improper cross examination. If you want to make him your witness. Nothing was said about the spacing.

MR. HOWELL: I haven't read the rules. I think it is a pertinent question to ask whether the rules provide for multiple units. I will ask the Commission to rule on the admissibility.

MR. SELINGER: At the time that I introduced the field rules, we explained to the Commission that no rules, none of the existing rules were changed except the addition for the Section 4 for allocation and Section 5. I made it nuclear that we had no changes for the other existing rules.

MR. SPURRIER: Does the witness care to answer the question?

MR. SELINGER: Go ahead and answer the best you can.

A If you will repeat your question, I will do my best to answer it for you.

Q Would you give us a multiple allowable to a well where a lease had more than 320 acres regardless of its ability to deliver into the

pipeline or not?

A I think the ability of the well to deliver into the pipeline is the concern of the operator and if he wants to take that loss then it would be his business and I would be willing to grant him the additional allowable.

MR. HOWELL: Thank you for answering the question.

MR. SPURRIER: Before anyone else cross examines this witness, perhaps I should make the Commission's position clear. In the first place, I said we understood what the witness was talking about. That is questionable. I don't mean to be facetious and I would direct some of these remarks to Mr. Turner and this gentleman from Wood River that this Commission accepts statements and I think that Mr. Cooper made his testimony, the type of testimony which he was giving very clear. I don't think your objection was in order at the time that you made it. We would like to have statements from all of you and we would like to have proposed rules in this case. We are not being arbitrary when we deny Mr. Turner what he called the right to cross examine. Counsel objected to the cross examination because it wasn't covered in direct examination. We agreed with it. The rules of the Court do not all apply here or this Commission does not conduct a hearing in the manner of the Court, yet we have to have some conduct of our hearing and if you wish to object, I think you should, then the Commission can rule on the objection.

In other words, your position has to be clear but the Commission wants a complete record and we also want everyone to have an opportunity to state their case. Now, Mr. Chapin from Wood River.

MR. CHAPIN: I would like to ask the witness another question.

MR. TURNER: Mr. Spurrier.

MR. SPURRIER: Let Mr. Chapin.

By: MR. CHAPIN:

Q You are qualified as a petroleum engineer?

A Yes.

Q Do the duties include going in the field, setting pipe, setting the well and completing the well and operating them? Those are the duties of the petroleum engineer, aren't they?

A That is a company designation and means different things in different companies.

Q Most companies use petroleum engineers to do those operations?

A Not this company.

Q Most companies do, don't they? A I don't know.

Q Most of them do, they do use them to complete the wells. You have not done that out here in Blanco?

A No.

Q You have never turned a valve?

A No, I have never been in Colorado.

Q You never set pipe in the Blanco?

A Never been in the North West corner.

Q Never shot a well, don't know anything about the reservoir characteristics but from the statistics, you qualified as an expert and tell us how to run the field.

MR. SELINGER: Answer his question. The answer was yes to the last question.

MR. CHAPIN: I still say he is not qualified to do it. He is not qualified as a petroleum engineer in the Blanco Field. He is qualified as a statisticion.

MR. SPURRIER: Do you have testimony to introduce, Mr. Chapin?

MR. CHAPIN: No, sir, I am just asking questions.

MR. SPURRIER: Anyone else have a question of Mr. Cooper?

MR. GRENIER: Yes, sir, Mr. A. S. Grenier, Southern Union Gas Company.

By: MR. GRENIER:

Q I believe, Mr. Cooper, you proposed in your rules to determine pressures for purposes of your formula at approximately six months intervals, is that correct?

A That is correct.

Q How long or what was the method of pressure determination that you were going to use?

A Are you meaning bottom hole pressure?

Q Yes, as I understand it, you were going to use bottom hole pressure, is that correct?

A That is right.

Q How did you propose to determine those bottom hole pressures?

A There are three methods to determine the pressures and I think the selection or the election should be left up to the operator. Of course, what we consider to be the most accurate would be to run a bomb, which is a little time consuming and some people don't like to do it. The second method would be to have a zonic survey made because some wells in the field do make fluid and have that made to determine fluid level and calculate from a shut-in surface pressure with gas and fluid level to datum. The third would be the purchase calculation of the bottom hole pressure assuming gas only in the hole.

Q Would you leave that up to the option of the operator as to which one of these tests he would use? Would you think it preferable

to have some uniform standard established to be observed by all operators?

A I think it should be left to the operators.

Q He could try whichever he liked best and whichever came out with the most favorable pressure, that would be the one he could use?

A I think he is entitled to the most favorable pressure, yes, sir.

Q So, that you don't think it would be necessary then to have a shut-in pressure, a shut-in necessarily of seven days twice a year on each of the wells?

A There is a shut-in twice a year provided in these wells.

Q Have you made a study as to the effect of shutting in some of the smaller wells for 14 days a year would have on the production of gas from those wells? How, adversely, would it effect these wells to have to shut in for that length of time each year?

A I think I answered that in response to one of Mr. Howell's questions that it would in effect give the well or the well would produce less than the capacity that we have indicated for limited allowable wells, because this was built on an assumption of a well produced every day.

Q This is merely then a further aggravation of the problem that Mr. Howell was getting at in his cross examination. Then, in addition to having some days when, because of the total take from the field, we weren't pulling every well as full capacity there would also be some days when these smaller wells would be shut-in and able to produce nothing at all?

A They would be shut-in, yes, sir.

Q Are you familiar with the length of time it takes in this

field for wells to stabilize their pressures when they are shut-in?

A Not to any extent. I put the seven day shut-in in here because that is a present rule for shut-in well head pressures taken with the deliverability tests.

Q You are expressing no opinion as to whether or not seven day shut-in is or is not adequate to give a stabilized pressure?

A I think probably in some cases it would not be.

Q In your formula, you are making use of only two factors, pressure and acreage, bottom hole pressure and acreage, is that correct?

A That is correct.

Q There are some other factos which are generally recognized as having some bearing on reserves and I believe you said that your formula was one which you believed would result in allowables per well as nearly as practicable in relating to the underlying reserves, is that correct?

A That, I believe, is my statement.

Q How would your formula take into account, variances in porosity, for example, as between wells in this field?

A I can best answer that, I think by the statement that was made along with one of the Exhibits that if you take two wells where everything is equal except reserve, that difference could be brought about by variance in porosity.

Q Could it also be brought about by variance in sand thickness?

A Yes, sir.

Q It is also your feeling that the decline in pressure relative to production will adequately compensate for variances between wells, either in sand thickness or in porosity or in any other factors that

there may be affecting reserves?

A As nearly as possible.

Q I believe you testified that there was a ratio of approximately 1.84 to 1 between the top allowable and the minimum allowable, if your acreage times pressure formula was adopted, is that correct?

A That is the ratio which we, the ratio of the allowables under this formula based on this total allocation we used to calculate. Under a different total nomination or total allowable it would be a different ratio.

Q Would that ratio increase as the takes went up or would it decrease?

A It will increase as the takes go up. It will increase for all three formulas.

Q I am talking particularly about your formula.

A Yes, it will increase.

Q Let's limit this to yours for the moment. Do you feel that a ratio of 1.84 to 1 between the highest and lowest allowable will adequately compensate for variances in reserve such as might be anticipated in a field of this kind?

A I feel this way, Mr. Grenier, that the 1.84 was the figure that we calculated here. That ratio would not necessarily hold between the same two wells with further production. I do feel that the compensated ratio for pressure decline with producing history would hold to the reserve.

Q In other words, over a period of time it will come out to about the right result, is that what you are saying?

A That is essentially what I am saying, yes, sir.

Q Do you feel that your ratio of 1.84 to 1 will provide an

adequate incentive to operators to use and develop more effective completions or recompletion methods?

A To me, the incentive to develop more effective completion or recompletion methods is primarily with deliverability included from a proration formula, the incentive is still there to get a higher percentage of recovery.

Q If the best you can do is only 84 percent better than the worst and all you do have to do then is get a well a little bit better than average to be as well off as you could, why would you be interested in getting the very best instead of getting a pretty good one?

A Well, just a minute. Let me get a figure or two out of here. The difference of maximum and minimum allowables under the pressure times acreage formula is about 14,000,000 per month. The incentive is to get a better well to produce that 14,000,000. In other words, a well, there are wells in there which had a higher allowable but which didn't have the capacity to produce it. The incentive to get the 14,000,000 a month, that is 14,000 MCF at ten cents a thousand, is a pretty good incentive.

Q I am assuming a well that has a capacity on your basis of making this extra 14,000,000 million a month. There are some other wells which in addition to making that 14,000,000 could also make another 14, or two, or three, or four more, 14?

A Yes, sir.

Q What incentive would there be left after you had gotten up to the first 14, why should a fellow worry about trying to get any more than just this rather low maximum?

A Well, I think the answer to your question is that he would

worry because later on that low maximum might not be enough. In other words, with an increased nomination or an increased take from the field he would then go on a limited capacity. It is my understanding that the market is expanding in this area.

Q It probably even then would not be as much incentive if we assume what greater ratio between maximum and minimum allowables were provided?

A I can only speak from experience with my own company and it is always our incentive to get the best well possible.

Q At the least cost?

A Yes, sir, certainly that goes without saying.

MR. WALKER: Mr. Turner, did you have a question you wanted to ask?

MR. TURNER: I just wanted to inquire if the Commission had ruled, I was going to ask Mr. Spurrier if the Commission had ruled that they would not allow cross examination of the witnesses to show the qualifications and what experience they had. He said we were somewhat out of order in proceeding along that line. We didn't wish to transgress it. We do wish to except the ruling of the Commission denying us the right of cross examination.

MR. WALKER: I will let Mr. Spurrier answer but I can answer for myself. I don't believe that was the intent, as far as I am concerned you can cross examine the witness any time you feel like it, as far as his qualifications. I think Mr. Spurrier meant as far as the direct testimony that the witness had given. I think there was some doubt in his mind as to whether your cross examination was his qualifications or his direct testimony. I think that is what he was trying to bring out, however, when he comes in, you can

ask him for his own thought on it. Does anyone else have a question of the witness?

MR. GALLOWAY: L. D. Galloway, El Paso Natural Gas.

By: MR. GALLOWAY:

Q I would like to ask if he intends to base his pressure on the seven day or maximum bottom hole pressure?

A The rules as written call for a seven day period. As far as I am concerned, I see no reason to put any limitation other than if you don't put a limitation then, the Commission would have trouble scheduling the pressure test within a given time period.

Q Are you aware of the time that is necessary to reach a maximum bottom hole pressure?

A I think I answered that one once before.

Q It is from 30 to 40 days.

MR. WALKER: Anyone else have a question of the witness?

MR. SPURRIER: If no further questions of the witness, he may be excused. Do you have some more questions, Mr. Turner?

MR. TURNER: Not from that witness.

MR. SELINGER: That is all the testimony we have on the part of Skelly Oil Company, except the fact that we wish to make a statement at the conclusion of the hearing, we rest now.

MR. SPURRIER: Very well. We have two cases on the docket, which I have been requested to set up, Cases 741 and 742. We will recess for lunch and come back at one o'clock. Anyone that doesn't care to hear these two cases, 741, 742 could expect to be back at 1:15. We would like to get those cases out of the way.

(RECESS)

A F T E R N O O N S E S S I O N

June 21, 1954

MR. SPURRIER: The meeting will come to order, please. We started out with Stanolind. We got to Pubco who moved over in favor of Phillips, who moved over in favor of Skelly. We will try Pubco again.

MR. KELEHER: I would like to have Mr. Frank Gorham called as a witness and sworn.

F R A N K D. G O R H A M,

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

DIRECT EXAMINATION

By MR. KELEHER:

Q State your name.

A Frank Gorham.

Q What official position do you hold with Pubco, Inc.?

A Chief ceologist and vice-president.

Q Mr. Gorham, you are a resident of Albuquerque, New Mexico, are you not?

A That is correct.

Q Can you state your qualifications as a geologist? That is, to say, do you have a degree, did you specialize in geology in your school?

A I am a graduate geologist from the University of Missouri. Since time in the Service I have spent working as a geologist with Standard Oil of New Jersey in Venzuela, with the Pure Oil in Denver,

Colorado, and since the inception of Pubco in the San Juan Basin.

Q When did you begin in the service of Pubco?

A March 1, 1951.

Q Subsequent to that date, have you had occasion to make frequent trips of an extensive nature in the San Juan Basin?

A That is correct.

Q If you will state to the Commission, please, in what way the company has an interest in proration of gas in the Blanco Mesa-Verde Pool?

A Pubco Development, Inc., owns leases covering 12,974 proven acres in the Blanco Mesaverde Pool, of which 7,023 acres are developed for Mesaverde production. The company operates or has an interest in 36 gross wells in the pool, or a net full interest totalling 23 producing Mesaverde wells.

Q Can you break that down as to how many the company operates?

A The company operates approximately 18 wells. I beg your pardon, operates 28 wells.

Q And has an interest in the remaining?

A That is correct.

Q Of a total of total of 36?

A Yes, sir.

Q Will you please state, for the benefit of the Commission, those factors and precepts which, in your opinion, should be considered and should be incorporated in an equitable gas proration formula, and the reasons, as you go along, for your opinion?

A An equitable proration formula will enable each well to

currently produce its fair share of the market, based upon its reserves, and ultimately produce approximately the amount of gas underlying the approved drill site upon which it is located. In view of the widely divergent conditions existing in the various gas producing areas, regulatory bodies have developed and approved several types of formulas involving many different factors both as multipliers and as additives. The determination as to whether or not a given pool is one reservoir or a number of reservoirs is one of the major factors, and directly concerns the problem of gas proration in the Blanco Mesaverde gas pool. In the Kansas-Hugoton accepted formula, acreage devoted to the well was used as a multiple with well deliverability even though the pool was developed on an irregular spacing pattern and the pool was actually one reservoir.

In the Blanco Mesaverde Pool, such a multiple type formula would be even more equitable in that I do not believe that it is one reservoir, but a large group of interbedded individual reservoirs which have been developed on an equal spacing pattern.

Q Is it correct to state that, in your opinion, the basic problem is the establishment of the true reserves which can be allocated to each producing well?

A Yes, it is correct. To further elaborate, the immediate problem in the Blanco Mesaverde Pool is to establish the presence or absence of drainage from one Mesaverde well to another, and whether or not individual drill sites have more or less reserves than other or adjacent drill sites.

Q In connection with the preparation for this particular

hearing, have you had occasion to make rather an extensive study into the problems involved here?

A Yes, I have.

Q And in connection with that study, have you prepared a map to show more or less reserves in other or adjacent wells?

A Yes, I have. I would like to present as evidence, Exhibit Number 1 "A".

Q I will ask you, at this time, to state whether or not Exhibit 1-A and the other Exhibits to which you will testify here today were, or were not, prepared under your direction?

A They were prepared under my direction and supervision and checked, personally, for accuracy.

Q To a considerable extent based on your personal knowledge?

A That is correct.

Q I will ask you, at this time, to demonstrate from Exhibit 1-A and discuss that.

A Exhibit Number 1-A is a regional cross-section of the Mesaverde group obtained from measured sections of the group outcrop around the periphery of the Basin, and was taken from published information of the United States Geological Survey and the Geological Society of American bulletins.

Q At this time I will ask you to take your pointer and explain that Exhibit 1-A.

A This is Exhibit Number 1-A (indicating) and the sections which were measured by the United States Geological Survey show that not only does the entire interval of the Mesaverde formation

as it outcrops around the Basin itself, vary in overall thickness, it varies extremely in actual content as to whether it is sand, shale or coals. For example, in the far northeast portion of the Basin in the Pajarito River area of LaPlata County, Colorado, there are only 422 feet of Mesaverde section in that particular area which is divided into sands and primarily shales.

To the west, in what may be considered the northwest portion of the Basin there are 1,020 feet of sediments which are broken down into the Cliffhouse sandstone, the Menefee formation and the Point Lookout sandstone formation. By that I mean that there is a large massive groups of sands at the top of the Mesaverde group. There is a series of sands, shales and coals in the middle part of the Mesaverde group and the basal portion of the Mesaverde group does have a large amount of interbedded sands.

As we go further around the Basin to the far west portion of the Basin, we have an overall section of 1,628 feet which generally is broken up but can't possibly be classified into three separate major overall groups.

As we go to outcrop Number 4, which is located in the southwest part of the Basin there is a total of 1,800 feet of sediments in the so-called Mesaverde group which actually varies so much in stratigraphy and sedimentation that they have been allocated in entirely different names in that particular area, the Allison, Hasta, Gibson, Bartlett, Dilco, Gallup, all of which are considered members of the Mesaverde group. Those members are not traceable for any parti-

cular distance northeast into the San Juan Basin, but are there then classified into the overall major groups of Cliffhouse, Menefee and Point Lookout.

Now we go to the final outcrop, which is located in the southeast portion of the Basin. There is a total of 1,298 feet which is similar to the other outcrop measured before. It is primarily sand, shale and some coal.

Q Have you prepared, and are you ready to present to the Commission an Exhibit which has been marked Exhibit 1-B?

A Yes. In order to further clarify the actual situation of the Mesaverde group in the San Juan Basin and then to go into the Blanco-Mesaverde Pool, we constructed an electric log cross section which shows the general characteristics of the Mesaverde group, starting off from 21 North, 13 West and 20 North, 10 West to 21 North, 9 West to 27 North, 4 West to 29 North, 11 West in the Blanco Mesaverde Pool proper, southeast into 30 North, 6 West and 29 North, 5 West.

Those electric log cross sections portray approximately the same thing on the first exhibit, whereby you have an overall large group of rather poorly developed sands interbedded with some shales. The entire area or zone is called the Mesaverde group. The Lynn Oil Company Hoxie State Number 1 has some more definitive sand and shales. It is, here it is broken down in the Mesaverde, the Allison, Gibson, Bartlett, Dilco and Gallup sandstones.

When we approach the southern end, or very close to the

Blanco-Mesaverde Pool proper we start to develop the general overall features of what everybody considers for this discussion. The Mesaverde group.we are starting to reduce in overall section, the sands appear to be coming somewhat more abundant, and at the base of the Mesaverde group is a massive collection of sands which has been designated the Point Lookout member in some instances. The O. J. Lily Well; H. K. Riddle Number 1 in Section 7 of Township 27 North, Range 12 West has somewhat similar characteristics. Then we go into the actual field proper, where we actually define the Cliffhouse member, the Menefee member or the Point Lookout. In that particular definition there has never been any attempt to trace one sand to another, but we are merely agreeing to the point that at the top of the Mesaverde group there is a series of sands divided from the lower group of series of sand by a primarily shale coal sequence. Notice that although the Cliffhouse appears fairly well developed in this particular area that it is not recognizable a short distance away.

As we go further northeast--- southeast into the Basin proper, we go to Phillips Mesa - 6 Number 1-9, which on that particular gamma ray neutron log it is almost impossible to define the so-called Cliffhouse, Menefee and Point Lookout, but actually is a sandy zone left in the Mancus shale. As you go further northeast the sub-surface Mesaverde group is almost entirely gone.

Q Mr. Gorham, you have undertaken to demonstrate that the Mesaverde group within the Blanco-Mesaverde Pool varies in its physical characteristics. Do you have any further evidence indi-

cating that the Mesaverde group varies in the recoverable gas reserves?

A Yes, I have Exhibit Number 2-A and 2-B.

Q At this time would you take Exhibit 2-A and state what it is?

A Exhibit Number 2-A is a cross section of gamma ray neutron logs of the Mesaverde group in the Blanco-Mesaverde Field proper. Superimposed upon these gamma ray neutron logs are temperature surveys. This particular procedure was instigated, approximately, six months ago to a year, when it was decided that in the open hole it is quite possible that we could decide or determine which particular sands were productive, by a cooling from the normal temperature grade. In other words, when dropping the temperature sound in the hole we could expect a normal temperature increase to the right as with depth. However, a deviation to the left or a cooling would be apparent opposite those zones which are producing or were producing gas in the well bore.

Q Now, at this time, Mr. Gorham, are you directing your attention to Pubco wells?

A In this particular exhibit, this cross section shows wells owned and controlled and operated by Pubco Development, Inc. only.

Q You have personal knowledge of these wells regarding which you are now testifying?

A Yes, I do. The first well is Pubco Development State Number 15, located in Section 36, Township 32 North, Range 12 West. It has been our customary practice, as it has been with the majority

of the operators who have acreage wells inside the limits of the Blanco-Mesaverde Pool to complete their wells in the base of the Luis shale and leave open to the well bore all those sands which could contribute gas down to the top of the Mancos shale. This particular temperature survey would indicate that we were getting a small amount of gas or at least some gas from a portion of the overlying sand group of the Mesaverde group and that we were also getting a certain amount of gas from individual sand lenses in the so-called Point Lookout section, and possibly some in the so-called Menefee section.

I would like to emphasize that the reason the section was set up on a common point at the base of the Luis shale, which is an electrical marker which could be readily identified from one well to another and is what our company uses for structural interpretation of the area. We have found that we cannot trace from one well to another any particular individual sand over any particular distance. In most cases this cannot be traced from one well to another. In some instances they can be traced for a period of one or two wells, but cannot be used as a structural marker.

The second well is the Pubco Development Johns Federal Number 2, which also has a temperature survey superimposed, and shows a rather large amount of gas being produced in the upper sand zone, which is certainly a different structural zone or a different sand than the well which is located to the west of it. Again we show a rather large, extremely large probable increase of gas in the upper part of the sand and a rather massive entry of gas in the

lower zone.

The next well, Pubco Development Johns Federal Number 1, which is a direct offset of Section 18, Township 32 North, Range 11 West, shows that in the so-called Cliffhouse zone at thetop of the Mesaverde group, that we apparently have two gas entries as compared to the Point Lookout where we have one overall gas entry. Apparently all of these individual sands are contributing where, to the offset well there was certainly a void zone.

This particular well, Pubco Suter Federal Number 3 of Section 14, Township 32, Range 11 shows the gas entry in the Cliffhouse and what apparently is a gas entry in a large number of sands in the Menefee formation.

Further east, is Pubco State 13, in Section 36 of Township 29, Range 8, shows three specific gas entries in the Cliffhouse zone. Little or no gas is apparently entering the well-bore in the Menefee zone, however, the basal sand of the Point Lookout is contributing a large amount of gas.

Further to the east, Pubco San Juan Number 11, producing gas from a particular zone in the Cliffhouse, apparently either the basal Menefee or the upper Point Lookout and a large amount in the lower section.

A direct offset well, Pubco Development, San Juan 28-7 Unit Number 10 in Section 26, 38, 7, shows a variation from the normal temperature gradient in the Cliffhouse which is almost not comparable to the offset well and shows two specific gas entries, what looks like apparently could be

a cooling effect in various portions of the Menefee zone and a slightly heavier entry in the so-called Point Lookout zone.

Q Have you prepared another exhibit which will amplify your statement?

A Yes, Exhibit Number 2-B. This exhibit shows four wells in the so-called Glade area of the western-most part of the Blanco-Mesaverde Pool, but well within the field limits. On the west is the Southern Union Hubbard Number 2 well, located in Section 11, Township 32 North, Range 12 West and shows that this particular well casing was set at approximately a depth of 4700 feet, well through the so-called upper member of the Mesaverde group, which in that particular area has been found to contain either non-commercial amounts of gas or gas associated with water, or found to be from a practical point of view, non productive.

This section is set up again on a common point in the Luis shale, which from a structural viewpoint can be correlated from one well to another.

To the east a half mile from the first well, Southern Union Chamberlain Number 1, in Section 14, Township 32 North, Range 12 West, again it was found necessary to set the casing at approximately 5,000 feet or what apparently -- or what definitely is in the lower Menefee zone, and the Cliffhouse upper sand zone is believed to be, and known to be in that particular area as non-productive, and in most cases water bearing.

To the east approximately a mile and a quarter, and this particular well has no intervening wells, incidentally, Pubco Development,

Johns Federal Number 2 in Section 18 of Township 32 North, Range 11, West, a completion was made at the top of the so-called Cliffhouse section, or in the basal Luis the entire zone was drilled with gas and we ran a temperature survey. The temperature survey, without a doubt, shows a gas entry in the Cliffhouse zone, a gas entry in the Point Lookout zone. It is quite obvious that, since in these two wells it was necessary to case this particular zone off, that this well has more reserves than the offset wells, by the mere fact that the entire section is opened and at least three major zones are producing gas, as compared to possibly one or possibly two zones in the basal Point Lookout and the wells to the west.

Again further to the east, but a direct offset to this well, Pubco Development, Johns Federal Number 1 in Section 18, Township 32 North, Range 11 West, was completed in a similar fashion whereby the casing was set above the Cliffhouse sand zone and a gas entry was shown to us by the temperature survey in both the basal and the upper portion.

It is well to point out at this time that those wells which have only a small comparable zone open, show an initial potential open end flow of 268 MCF and 900 MCF as compared to 4,050 MCF and 3,090 MCF, portraying the fact that with the larger reserves, with the larger amount of sand that one can expect, and one should have and does have a much higher potential or deliverability.

In summary, this exhibit or cross section that I have discussed shows wells drilled in the so-called area of the Blanco-Mesaverde Pool. It demonstrates, by the use of temperature curve, the entrance

of gas to the well bore and specifically shows in certain wells that gas is produced from the entire Mesaverde section where neighboring wells have found only the basal Mesaverde productive or to contain recoverable gas reserves.

It further shows that well potential or deliverability is a function of recoverable gas reserves. I should like to emphasize that this cross section does not portray an isolated instance where only two wells in the Blanco-Mesaverde field are completed in the basal member of the Mesaverde group, but that this situation of small sand section and accompanying low reserves and deliverability occur in 142 wells completed within the field limits. These submarginal wells represent 20 percent of the total 704 completed wells at the present time. Any proration formula which would subsidize these wells would do so at the expense of average or better than average successful completions, and would tend to promote and accelerate the completion of many additional small reserve wells which are actually economic failures. Only those companies which derive their major revenue from gas transmission and marketing could possibly afford to absorb the low and questionable economic return of submarginal Mesaverde gas wells. A proration formula which included any other factor than deliverability would only subsidize the weak wells at the expense of the average and larger reserve wells. Such a policy would deprive the incentive to the producing company or independent, and would force him to invest his risk capital in other basins or areas.

Q From time to time during your testimony, Mr. Gorham, you have

mentioned "recoverable reserves." Please state to the Commission what you mean by that term and amplify it.

A The Mesaverde group is known to contain gas well beyond the limits of the Blanco-Mesaverde Pool, but in most instances either in non-commercial quantities, or associated with large amounts of water. Therefore, I have used "recoverable reserves" in those instances where the gas could be produced at the well head as compared to gross reserves which gives consideration to so-called gas reserves which will never be produced.

Q There has been some indication in the testimony that large potential wells with high deliverabilities are, in fact, draining reserves beyond the established spacing pattern and the high deliverability is not indicative of higher reserves. Do you have any additional information which would indicate to the contrary, in your opinion?

A Yes, I do. Exhibit 3.

Q At this time I will ask you to take Exhibit 3 and discuss it with the Commission.

A This Exhibit Number 3 shows four wells which are operated by Pubco Development, Inc., which are direct offset wells. The first well is Pubco Development, State Number 8 in the southwest quarter of Section 36, Township 32 North, Range 11, West. The second well is Pubco Development, Inc., State Number 9 located in the northeast quarter of Section 36, Township 32 North, Range 11 West. The third is Pubco Development Inc., Hamilton Federal Number 1, located in the southwest quarter of Section 30, Township 32,North, Range 10

and the final well is Pubco Development, Inc., Hamilton Federal Number 2 located in the northeast quarter of Section 30, Township 32 North, Range 10 West.

This exhibit portrays the gamma ray neutron logs in those particular wells. It will be pointed out by others that at the uppermost portion of the Mesaverde group a series of sands exists, which can be called the Cliffhouse in between which, or below, is a so-called Menefee group and at the basal portion is the so-called Point Lookout. Our company, in all sincerity has never been able to utilize any particular sand as a marker bed for structural purposes because such sands do not exist from one well to another. The overall characteristics of a massive series of sands at the top and at the base definitely are there, but those sands are not connected from one well to another. They are absolutely over a short period of distance and will die out. For example, let's take this particular group in here (indicating). This thinning has been set on what could be considered the base of the so-called massive Cliffhouse, but we have found that it is very simple to go over from one sand leg to another and end up with improper structural period. This particular two sands group devoted into two, possibly in here (indicating), but thinning, become unrecognizable within direct offset wells.

The important point of this exhibit is that all four of these wells were completed at approximately the same time, and have been producing over six months, and liquid samples were taken from the wells as they were producing. These liquids are produced in association with the Mesaverde group gas. In this first well, Pubco

State Number 8, we are producing 61.7 degrees A. P. I. gravity distillate, which is transparent in color. In this particular Well, Pubco State Number 9, a direct offset, we are producing 63.1 gravity distillate which has a slight physical change to a yellow cast. A direct diagonal offset, Pubco Hamilton Federal Number 1 is producing 55.8 gravity oil which is non-translucent, it is, obviously, has great physical difference than so-called distillate produced southwest of it. This particular well, Pubco Hamilton Federal Number 2 is producing 41.8 gravity oil. That oil is used currently by a large number of operators in sand frac process, because of its entirely different characteristics than distillate produced in surrounding areas.

Our company has concluded that since we are producing oil in this particular well associated with the gas and since we are producing distillate with entirely physical differences in characteristics of the liquid in this particular well, that the gas that we are producing with this oil is totally unconnected with gas that is produced with the distillate.

Q The summaries now on what you have just testified to, Mr. Gorham?

A In summary this cross section shows wells which are direct offsets, and although the general sand groupings are similar, the individual sands cannot be traced from one well to another. For conclusive proof that the wells are draining only, or less acreage than that assigned to the wells (320 acres), and that the sand reservoirs are not connected, we collected on the same date the non-retrograde

hydrocarbons produced in association with the Mesaverde gas. Although these wells have all been producing for approximately six months, all physical characteristics of the fluid produced are different. Core analyses and other reservoir data, other than gamma ray and neutron logs, are not available as the wells were completed in the accepted practice, with dry gas as a drilling fluid medium. Since detailed reservoir data is available on only rare instances throughout the entire field, I believe that the only conclusive and reliable function of recoverable reserves which all operators have at this time is the well potential or its capability to produce. Therefore, the proration formula should be entirely based upon this factor. It is quite possible that future well performance will supply additional valid reservoir data. At such time, the formula should be examined for possible modifications.

Q In order to clarify our position, can you state it in brief form, please summarize at this time, for the Commission, the facts which you have submitted?

A First, regionally the Mesaverde group is not a blanket sand, but a series of individual discontinuous sands interbedded with shales and coals within the Mancos shale.

Second, this transition can be easily noted within the limits of the Blanco Mesaverde Pool.

Third, different areas within the Blanco Mesaverde Pool have different recoverable gas reserves.

Fourth, initial potential, or deliverability, is the only valid reservoir characteristics in the Blanco Mesaverde field which

is generally known at this time, and which is directly related to the reserves under the well.

Fifth, there is apparently no drainage between wells as evidenced by dissimilar fluids produced with the associated gas.

Therefore, in my opinion, an equitable proration formula will reflect the recoverable reserves under each individual well-site, and such a formula at this time should be entirely based upon well deliverability.

MR. KELEHER: At this time we would like to offer in evidence before the Commission, Exhibits 1-A, 1-B, 2-A, 2-B and 3.

MR. SPURRIER: Is there objection? Without objection they will be admitted.

MR. KELEHER: That is all with this witness.

MR. SPURRIER: Does anyone have cross examination of Mr. Gorham? Mr. Weiderkehr?

MR. WIEDERKEHR: Mr. Weiderkehr, Southern Union Gas Company.

CROSS EXAMINATION

By MR. WEIDERKEHR:

Q Mr. Gorham, in your exhibit Number 2-A, I guess you have shown here a cross section, do you have a horizontal scale on this? In other words, is there a horizontal, are they scaled up horizontally, or are they just thrown in?

A They are put down with no particular horizontal scale, but there is a map of the particular cross section, showing the location of the particular wells on the cross section.

Q So, actually between well Number 3, and what is this, 13 down here. Between this well and this well, it must be between these

two there is a considerable distance, is there not?

A That is correct.

Q Conversely between this well and this well and this well, (indicating), they are very close together, aren't they?

A That is true.

Q Were your temperature curves run prior to treatment --

A (Interrupting) These temperature surveys were all run at total depth prior to treatment.

Q So, actually they do not reflect where the gas might be coming from at this particular time, not necessarily?

A Yes, we believe they do because we have reliable information to the effect that other companies had run temperature surveys both before and after treatment and had found very little to no change.

Q That is information from other companies, that is not your personal knowledge?

A It is not my personal knowledge.

Q As a geologist, is it your opinion that you can't correlate this sand and this sand (indicating)?

A That is true.

Q You don't believe they are the same? They are not connected?

A I do not believe they are connected.

Q Are these wells on production?

A I believe that they should be on production.

Q Referring to your Exhibit Number 2-B, I note that you have

used two Southern Union wells to show that they are cased off below what we commonly call the Cliffhouse sand member and you made come various statements with regard to the possibility of productive gas within the upper interval. I might say that those wells do have gas. We drilled a lot of those wells with cable tools. There definitely is gas there. We admit there is water there and that we would prefer to complete in the lower member, eliminating the water problem. The wells, as you note, are low deliverability. One question I would like to ask is, did you look to see if you might find some wells in this same category with initial potentials of, say, three or four million, with only the Point Lookout, as we call it, open?

A Yes, we did. We examined the particular so-called Glade area with the idea of attempting to find wells that were completed only in the basal member, which were the closest wells to the two existing wells we have in the Glade area, where we have the entire section open. I believe you will agree that actually there is only a small number of wells in the Glade area which are completed with the entire section open today.

Q Right. What I was getting at, is it not a fact that there are wells in the Glade area completed with only this section open which have I. P. comparable to this ?

A It is possible. We chose to use these because they were the closest wells we could get to the existing wells. We could go from one side of the area to the other and show discrepancies. We felt

by using adjacent wells we would have a clear picture.

Q Didn't you further say that you had more reserve through here because you had a higher I. P.?

A I stated that we apparently had much higher reserves in those two particular wells as compared to the two operated by Southern Union, and that in association the deliverability was much higher and was indicative, or is indicative to me that the deliverability or the initial potential of the well is directly related to the reserves thereunder.

Q What if I had a well that was completed right here in this same section, with only the Point Lookout open, that has the same I. P. here then, would I have the same amount of gas that you do?

A I think it would be quite possible that if you did have an I. P. that was equivalent of higher than, undoubtedly you had high porosity, possibly less percent conate water than we did, which would add up to higher reserves. Therefore, higher deliverability.

Q You said porosity and conate water, do they have any effect on deliverability?

A Yes, they do.

Q To what extent?

A In that reserves, in my opinion, are directly related to initial potential and that the ability of the gas, the productivity of the gas will reflect the actual reserve situation. I would prefer, however, not to go into the true petroleum engineering fundamentals,

in that. We will have testimony in just a few moments on that.

Q One other thing. You mentioned 142 wells, did you say that the 142 wells are completed only in the Point Lookout?

A They are completed below the Cliffhouse member.

Q Below the Cliffhouse member?

A Someplace below the Menefee or on top of the Point Lookout.

Q On your Exhibit 3, did you have temperature logs on these wells?

A No, we did not. They were completed prior to the time that it was decided by the various members of the industry that temperature surveys could be of some value.

Q You don't know but what maybe these wells might have gas coming from a little different interval than these last wells over here, you don't have any idea as to where the gas is coming from from these four wells?

A The only thing we do know is that the gas is coming from below the casing point to the top of the Mancos shale.

Q There is no Mancos open in these two wells?

A It is questionable as to where we find the top of the Mancos. As I have attempted to point out, you will have a large amount of sand toward the base of it. We chose to believe that the top of the Mancos is an arbitrary point, and have not attempted to stress it here.

Q Isn't it knownthat the Mancos shale in this particular area carries crude oil?

A It has been rumored to that effect.

Q You don't know that to be a fact?

A No, we do not.. We have reason to believe that in some of our wells it is coming from the basal Menefee.

Q But, in these particular wells then, you don't, you wouldn't make a guess as to the fact that a good probability is that your oils might be coming from this area where you have apparently more of the shale area open there by giving you an area of production that would produce oil rather than gas condensate?

A No, because quite frankly we have no idea in the world as to where the crude oil petroleum is coming from, other than our idea that it is produced with indigenous gas.

Q You think it is produced, it is coming from what is known as the Mesaverde series?

A That is our belief.

Q In your first two exhibits here you attempted to prove that the Mesaverde sand was not a blanket sand and I think did very well in proving that over many, many miles it could not be, the sand was not continuous, or that various members of it could not be traced. I would like to get back here to this one a little bit, though, with regard to Exhibit 1-A. At the same time, I recall that under here you had the exposed sections from which you varied considerably between the top of the Cliffhouse and the Mancos shale. In this particular cross section, you have shown gas coming from two primary areas, have you not?

A That is correct, with the exception that a certain amount of gas in certain areas is being produced from an intermediate zone known as the Menefee, or with all three of them totaling the entire Mesaverde group.

Q Areyou familiar -- Let's go back one step. I believe you stated that you do not think there has been any drainage in the San Juan Basin, due to the fact that each well is producing from supposedly a different zone. You don't think there is cross drainage?

A The best information that our company has would indicate that no drainage is occuring at this time, and probably will not be seen.

Q Are you familiar with Pubco State Well No. 6?

A Yes, I am.

Q Do you know approximately what the original shut-in pressure was, 1114 pounds?

A How much?

Q 1114 pounds, according to the records in the Oil Conservation Commission on 8-12-'53 when you ran a deliverability the well shut-in was 1061. That is 53 pounds pressure drop. During that ensuing period of time, according to Oil Conservation Commission records, 1,000,000,397 feet of gas were produced. If my division is correct, that is 26,371,000 cubic feet of gas perpound of pressure drop. If I multiply the original pressure by this MCF per pound of pressure drop, I come out with a gas in place in Pubco State 6,

originally of 29,000,000,000 feet of gas, which on 320 acre unit is 91,500,000 cubic feet per acre. Do you in your reserve working figure that you have, have 91,500,000 cubic feet of gas in place under your 320 acres under your Pubco State 6?

A As a matter of fact, I am not too sure of that particular well, as to the total amount of reserves under that well. However, within the Blanco-Mesaverde Pool we have shown as high as 30 to 1 ratio in recovery of gas per acre within the Blanco-Mesaverde Pool.

Q Recovery of 30 to 1 per acre. What do you mean by that exactly?

A Well, the reserves in our opinion are directly reflected by the initial open flow of the deliverability, or the capability of the well to produce.

Q Well, I am going to take exception to that, of course, in that I think the reserves are based on the amount of gas you have in place and not with the I. P. You are saying that there is a 30 to 1 difference in I. P. then actually, not a 30 to 1 difference between actual reserves in place?

A Quite frankly I would prefer that you would postpone these petroleum engineering questions to the engineer who will follow in our testimony.

MR. WEIDERKEHR: Very well, thank you.

MR. SPURRIER: Anyone else have a question of Mr. Gorham?

By MR. SMITH:

Q Have any interference tests been run by your company with

respect to the pressures that exist from one well to another?

A I am not prepared to answer that.

Q Is your succeeding witness--

A (Interrupting) As a matter of fact, I do have before me two wells, Pubco State Number 12 in the southwest quarter of Section 36, Township 29,8; Pubco State Number 13 in the northeast quarter of Section 36, Township 29, 8 which are diagonal offsets. The initial potential of State 12 was 3,400,000. The initial potential of State 12 was 3,400,000; the initial potential of State 13 was 3,210,000. The initial shut-in pressure on the first well taken after 14 days, State 12, was 1017 pounds; State 13 was 986 pounds after 11 days. After 120 days -- Incidentally, the reason we have this shut-in period is that there was sometime before it was possible to put these wells on the pipeline; as a consequence, we were able to get in shut-in pressures over a rather long period of time. After 120 days, State 14 had a shut-in pressure of 1,100 pounds-- State 12 did; State 13 had 1,077 pounds. After 180 days for the State 12 it remained at 1,100 pounds, and State 13 had 1,079 pounds, showing that although those wells were shut-in for a period of 120 to 180 days, that pressures did not equalize, although they were on offset wells and that the change, the difference in pressure is quite obviously due to the reservoir characteristics.

Q Are those your surface pressures or bottom hole pressures?

A Those are surface.

Q There is some origin of error on your surface pressures with respect to what the bottom hole pressure would be. They would

vary your atmospheric conditions?

A That is true.

Q There is a close comparison, however, from a standpoint of possibility of the bottom hole pressure having equalized?

A That is right.

Q Will one of your succeeding witnesses have information on the respective pressures in these wells that you have shown by Exhibits?

A I believe that information may be available, I am not positive.

Q You don't have the information yourself?

A No, I do not.

MR. SPURRIER: We will take a short recess.

(Recess.)

MR. GREINER: I would like to ask a few more questions on behalf of Southern Union.

By MR. GREINER:

Q Referring to your Exhibit 2-A, Mr. Gorham, and the wells there indicated, do you have any data as to the deliverability from those wells?

A They are available in the company files. It is quite possible they will be presented later. I do not have them with me here.

Q As I understand it you are using this Exhibit as part of your rationalizing that deliverability is the key test. I

am just wondering how it happens that the matter of deliverability in these wells is so unimportant that you haven't concerned yourself with these deliverabilities to see whether it did or did not fit in with the propriety of the formula that you were suggesting? It seems to me if you are going to base it on deliverability data we ought to know something about the deliverability of the wells you are basing your philosophy on.

A The particular Exhibit that we used to stress that particular point on was Exhibit 2-B. Exhibit 2-A was an attempt to point out to the Commission that although you have the general sand groupings of the Cliffhouse, Menefee and Point Lookout, that the superimposed temperature survey would indicate that gas is coming from specific sands within that overall sand group and that one well will vary from one well to another by apparent reserves on the basis that individual sands are contributing gas and that those individual sands are not necessarily easily traceable in the area.

Q Well, I understand that. Maybe I just don't follow your chain of logic, but somehow or other you get from that to the proposition that the sands aren't traceable and therefore, that deliverability is the sole and only test, and we haven't seen any studies yet on what the deliverability of these wells are with relationship to their probable reserves or feet of productive sand, and I am wondering whether you or this engineer witness who is going to follow you does have any information along those lines at all?

A Yes, we will have additional evidence. However, I would like to point out that we have put on that particular exhibit, the

initial potential, which by experience has shown us the deliverability in most instances, I believe, is proportional to the initial potential or roughly 20 percent of the initial potential.

Q It is on this, just general thought, that there is a rough relationship there that you go from initial potentials to deliverability?

A That is not a rough estimate, because I believe that the sub-committee working on this problem have agreed that in the absence of deliverability that 20 to 22 percent of the intiial potential is close enough to be used as a deliverability in the formula and until such time as deliverability is actually taken.

MR. GREINER: That is all.

MR. SPURRIER: Anyone else have a question of Mr. Gorham?

MR. ARNOLD: Emery Arnold with Oil Conservation Commission.

By MR. ARNOLD:

Q I understood you to testify that each separate drill block in your opinion was a separate reservoir without any communication with the offset reservoir?

A I am not quite sure of the record on that. The intention I had was to state that as far as we are able to determine there is no communication between wells and that the individual sands are very difficult to trace from one well to another and in most instances they cannot be traced.

Q What then is your theory as to how the gas got into the drill block originally?

A Well, I believe that you are talking about the source of Mesaverde gas.

Q Yes.

A That, as we all know, is a highly argumentative subject, but I believe the very nature of the depth situation of the Mesaverde group, which is a near shore depth situation, in some cases continental and in some cases marine, that in all probability the gas was generally associated directly with the reservoir that the interstitial shales and coals probably contributed the majority of gas to the overall Mesaverde group.

Q You think that the gas originated in place in each drill block?

A I have no reason to believe to the contrary.

MR. ARNOLD: That is all.

MR. SPURRIER: Anyone else?

MR. UTZ: Elvis Utz, Oil Conservation Commission.

By MR. UTZ:

Q Mr. Gorham, do you have a reserve figure of your own for your State Number 6?

A I don't believe I do here.

Q You have never computed that reserve at all?

A That has been computed.

Q Do you recall about what it is per acre, or for a 320 acre drilling block?

A A consulting geologist has been used at various times for Pubco in order to determine reserves, as a disinterested party. He

has, to the best of my knowledge, used over a hundred million cubic feet per acre on that particular well. Such belief, as I understand it, was accepted by high authority.

Q Do you happen to know what kind of porosity or conate water you used in your core analysis?

A That well was not cored because at that time we were using gas as a drilling fluid medium, and the actual usage of gas would prohibit the coring process. As a consequence the cores were not taken.

Q Can you tell me what your interpretation of the net pay is in that well?

A The net sand thickness?

Q Well, the part of the open well bore that is producing gas that you consider net pay?

A That is of Pubco State Number 6.

Q That is right, yes, sir.

A I do not have that particular specific well. However, in my opinion, as I recall, it probably is in excess of 400 feet of effective net sand.

Q Total Mesaverde section is what?

A The effective net sand in the overall Mesaverde group, Cliffhouse, Menefee and Point Lookout, all of which we believe to be effective net sand, exceeded 400 feet.

By MR. ARNOLD:

Q What basis did you use to determine what was net sand?

A Well, the only basis that we had to go on, other than the gamma ray neutron log was the mere fact that an offset well to the southwest, Turner State 1, set pipe on the base of the Luis or the top of the Cliffhouse, and in the completion process of drilling in with gas there was a very very gradual increase of gas to the point of 20,000,000 -- I believe that was 23,500,000, is that correct? -- 20,300,000 on top of the Point Lookout. In fact the well was making so much gas naturally that it was impossible to finish the completion of the well through the so-called basal member. As a consequence, we feel that in that particular area the massive sand built up in the Menefee is very definitely contributing gas to the well bore.

Q Have you ever constructed a log cross section across the Turner State to see if the sand section does show?

A We have not exactly prepared a cross section, but have superimposed the gamma ray neutron log of Turner State 1 directly on top of the State 6 well, and have shown physical characteristics that very definitely compare.

Q Was there a log run on the Turner State Number 1 itself?

A I am not quite sure of that point. I believe there was, there might not have been.

Q I don't believe there was, it was making so much gas they couldn't get the log down.

MR. SPURRIER: Does anyone else have a question of Mr. Gorham?

BY MR. FOSTER:

Q What do you regard the efficient and economic drainage area of a gas well in this Blanco Pool?

A As far as I can determine, it is possibly less than 320 acres.

Q How much less?

A I have no idea.

MR. FOSTER: That is all.

MR. SPURRIER: Anyone else? If no further questions --

MR. SELINGER: I would like to ask one.

By MR. SELINGER:

Q I understood you to say on direct examination, Mr. Gorham, in your qualifications, that you have been with Pubco, Incorporated since its inception, is that correct?

A That is correct.

Q How many years has that been?

A Since June 4th of 1951.

Q 1951?

A That is correct.

Q At that time were there any wells in the Mesaverde field?

A There were.

Q Did Pubco have any wells in that field?

A Not at the time.

Q Does Pubco, Incorporated operate any gas properties under proration?

A They do not.

Q We don't have proration in this field now, is that true?

A I believe that we have what you might consider a pipeline proration.

Q I will rephrase my question. We don't have any proration by the State in this field at this time?

A No, sir.

Q We are meeting here for the purpose of determining rules and regulations for such proration, from here on out, is that correct?

A That is true. However, I believe it is subject to appeal and subject to modification as additional reservoir data is obtained.

Q Initially we are here for proration purposes, is that correct?

A That is correct.

Q Since you do not have any experience in proration of gas on what do you base your statement that the allocation formula should include deliverability?

A Because I believe that it is generally accepted that a proration formula, as per your company's testimony, also should evolve around the reserves under the particular well.

Q That is a conclusion, but on what experience do you base your conclusion, that is what I am trying to get, not your opinion but your experience of proration of gas. On what do you base your conclusion. I know your conclusion all right, but I want to know on what you base your, what experience do you have to base your

conclusion?

A Well, the only experience I have is three full years of working in the Blanco-Mesaverde Pool proper, following very closely all operations up there and while on the actual wells, have come to what I consider to be logical conclusions in regard to the reserves under those wells.

Q And, hence, you have come up with the conclusion that deliverability is the best reflection of reserves, is that correct?

A That is my opinion.

Q How do you determine, how do you go about determining reserves under a well, under a lease, under a pool? I will give you your chance later.

A I would prefer not to answer that question in that that is primarily a petroleum engineering function, although the geological department contributes information towards the end.

Q Although you prefer your engineers testifying, you did present your Exhibit 2-B in which you came up with a conclusion that the two wells on the right had better reserves than the two wells on the left?

A Don't you agree?

Q I am asking you. I will let you make your comments as you wish, but you have come up with the conclusion that the two wells on the right have better reserves than the two wells on the left?

A That is correct.

Q How much reserve do you estimate for those two wells?

A The exact figures for those four wells are not available. We have attempted --

Q (Interrupting) I am just asking about your two wells on the right, are those your two wells?

A Those are our two wells on the right.

Q Have you estimated the reserves under those two wells?

A The reserve estimate has been made of those two wells and in so doing we included the upper sand section of the Mesaverde group, commonly called the Cliffhouse.

Q What are the reserves under those two wells, if you know?

A The particular figure under those particular wells at this time are not available to me.

Q Do you, or do you not know the reserves under those two wells? Can you give us a specific figure?

A Not at this time.

Q You are not prepared at this time to give the reserves, but you are prepared to give us the conclusion that the reserves under the two right hand wells are larger than the reserves under the two wells on the left?

A I am in that position to say so, yes.

Q Since you brought up the question of reserves, how do you go about determining reserves of a well?

A Well, there are several methods by which that can be determined.

Q Name them.

A The first one is the volumetric method which has been generally in usage in the Blanco-Mesaverde Pool because almost all of the data available for such an estimate is available. Other methods which would include decline curves have not been used, or should not be used because the field is relatively new.

Q Would you kindly explain what you mean by the volumetric method of determining the reserves?

A The volumetric method of determining reserves involve the following data and the following formula: Cubic feet of gas per acre foot at base temperature and pressure equals 43,560, which is the number of cubic feet per acre foot times the porosity expressed as a decimal fraction, times one, minus interstitial water, expressed as a decimal fraction in parenthesis, times the reservoir pressure in pounds per square inch absolute, divided by the base pressure pounds per square inch absolute, times 460, plus the base temperature degrees fahrenheit divided by 460, plus the reservoir temperature degrees fahrenheit, times one over the compressibility factor at pressure of the reservoir.

Q In other words, in the volumetric method you have used a pressure three times, have you not, in your calculation?

A I am not too sure.

Q Well, Mr. Gorham, let me ask you this before you answer that question. What are you reading from, a prepared statement?

A Yes, I am.

Q Now, can you answer that question as to how many times you used pressure in your calculation on the volumetric method?

A It has been used twice.

Q That is one method. Now, what is the second method before you use that method, because you lack production history on this new field before we get or to that?

A That is correct.

Q What is the second method?

A This is the only method we have used.

Q You said there were several. What other methods are there available for calculation of reserves, if you know?

A Well, --

Q (Interrupting) If you don't we will pass on to the engineer.

A Well, first of all there is the decline curve method which was just previously mentioned.

Q What is the decline curve method?

MR. TURNER: We are going to object to that line of testimony, Mr. Chairman, that brings in collateral issues. The witness has testified over and over again and to go into what the decline curve method is and all that before an expert body such as this, is just time consuming.

MR. SELINGER: It isn't time consuming. If the Commission please, the man has testified as to the reserves. I am going to ask him what methods there are of determining such reserves, and what method he used, what methods are available.

MR. TURNER: He told you what method he used. You are

asking him to explain something now from a book somewhere.

MR. SELINGER: I would rather have him read it from the book.

MR. SPURRIER: Objection overruled.

Q Will you kindly explain then the second method of determining reserves, which you said our witness had testified before?

A Well, the second method would involve pressure decline versus volume of gas produced.

Q That is used, is it not, Mr. Gorham, in a field where you have production history? Is that correct?

A That is correct.

Q Which of the two methods are superior in determining more accurately the reserves?

A I believe it is generally concluded that the latter method is.

Q Should the field have sufficient production history behind it, would you be agreeable to utilizing the second preferable method rather than the first?

A I think it should be very carefully considered.

Q In the second method you use pressure decline, do you not?

A Yes.

Q Plotted against accumulated production?

A That is correct.

Q In no instance in that second superior method so you use deliverability in any way, shape or form?

A Well, I am not quite sure of that point. It is quite

possible that deliverability definitely enters in as a function.

Q If you are not sure I will defer that question to the engineer.

A Thank you.

MR. SELINGER: That is all.

MR. SPURRIER: Anyone else have a question of Mr. Gorham? If not the witness may be excused.

(Witness excused.)

D. W. R E E V E S ,

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

DIRECT EXAMINATION

By MR. KELEHER:

Q State your name.

A D. W. Reeves.

Q What official position, if any, do you occupy with the Pubco Development, Incorporated?

A President of the company.

Q For what length of time have you been president?

A Since its organization in June, 1951.

Q Since the date of the organization of this company, have you personally managed it in the field, directed it?

A Yes, sir, I have personally discharged the duties of president and directed its operations.

Q What, if any, degree do you have in engineering, and from what school?

A I have two degrees from New Mexico A and M State College, One, a BS in engineering, the other a professional degree in electrical engineering and am registered as a professional engineer in the State of Texas, Oklahoma, New Mexico.

Q State to the Commission the experience you have had in the oil and gas fields in New Mexico and elsewhere.

A Well, my first experience was a production engineer for the Union Sulphur Company, at the time we were operating about 18 rigs in Louisiana, a number of years ago. Then I served for about three or four years as a member of the Committee passing on oil and gas leases and drilling, for Oklahoma Natural Gas Company in Tulsa. Since that time, of course, with Pubco.

Q Are you personally familiar, to a considerable extent, with the problems pertaining to the proration of gas in the Blanco-Mesaverde field of San Juan County, New Mexico?

A Yes, I think I am.

Q Have you had occasion to make a study of the possible variation of recoverable reserves on 320 acre Mesaverde leases in Blanco-Mesaverde field?

A Yes, sir, I have made a study to determine the possible variations and recoverable reserves on 320 acre Mesaverde leases. The study is general in its character, but indicates the possible variation between a minimum well and a maximum well in my opinion.

Q Would you say that gross sand thickness is one factor that properly pertains to that study?

A Yes, sir. I have prepared a statement here in which I

deal with all the matters which I consider is involved in determining the reserves under the 320 acres, and attempt to find out what the variation possible is.

Q Would you please discuss the various problems referring to your memorandum, from time to time, if you so desire?

A In order to be accurate in what I say and be sure that I don't make any error, I am going to stick pretty close to this prepared statement.

Grosssand and thickness exposed to the well bore varies from about 100 feet minimum for wells which are productive only from the Point Lookout to some 450 feet in better areas of the field where the Cliffhouse, Menefee, and Point Lookout are all productive. In the northeastern part of the field, the entire Mesaverde sand group is poorly developed. It is therefore evident that reserves can vary in the order of 4.5 to 1, taking into account only gross sand available.

Porosity, of course, is important. Previously Mr. Gorham, Chief Geologist for Pubco, has submitted data in support of his opinion that the Mesaverde group consists of numerous interbedded sands and shales, the individual sands of which cannot be traced with any certainty from well to well and which vary greatly in thickness and characteristics. In some areas sands are relatively clean and others contain a large percentage of shaly materials.

It has been my observation on the few wells that have been cored, and information received from other operators in the same field indicates that porosities of individual sands vary from below

4.6 percent to above 15.4. The use of gas for drilling in wells at the time the large wells were completed prevented coring of any of those wells. Thus information on porosity is lacking on the better wells. Information in our possession indicates that porosities in the Mesaverde can run as high as 28.4 percent, and with this data in mind, it is my opinion that the porosities in the better wells will average at least 20 percent. It is, therefore, evident that reservoir capacity due to variations in porosity will vary in the ratio of 4.35 to 1.

Connate water also has something to do with it.. The percentage of pore space occupied by connate water in productive Mesaverde wells varies from 20 percent to 60 percent, or the percentage of pore space occupied by gas is from 40 to 80 percent. This would indicate possible variation in reservoir capacity due to connate water of 2 to 1.

The initial shut-in pressures on wells completed by Pubco in this field vary from 933 to 1102 pounds per square inch gauge. This would indicate a variation in reserves in place in the ratio of 1.18 to 1, neglecting the supercompressibility factor. This variation also supports the contention that well is producing gas from a separate reservoir, separate at least to all practical purposes.

Summarizing those factors, we find that the reserves under any given lease can vary in the ratio of 46.4 to 1. I want to be sure that I am clear in that. In other words, your sand thickness can vary 4.5 to 1, your porosity 4.35 to 1, Your

reservoir pressure or your connate water, 2 to 1, again a multiplier. Your reservoir pressure, 1.18 to 1 and the product of those is 46.4 to one.

My conclusion, and I think that most proration orders, in fact the basic idea behind proration is that it must be on the basic concept that each operator is entitled to the same percentage of the market as the operator's gas reserves are of the total reserves involved. Now, the question is to find a proration formula which will achieve this result. It is my opinion that deliverability is a measure of the gas reserve under each well. Deliverability of initial potential are the only known and incontestable facts which are available over the entire field and which reflect all of the factors, sand thickness, porosity, permeability, and other reservoir characteristics under uniform spacing.

It is our belief, therefore, and mine, that the formula should be based upon deliverability times acreage and that this will result in each well sharing in the market in proportion to the reserves underlying the well. Using acreage as a multiplier will correct for certain minor deviations from the uniform spacing pattern.

It has been shown that it is possible for gas reserves to vary in the ratio of 46 to 1. The variation of initial open flow potential, and here I am taking, as a base, what I consider to be not a commercial well, but marginal about the deliverability of the minimum factors that I have talked about of 750,000 MCF,

initial potential, if you want it in deliverability, apply your factor of 20 percent. The highest well that I know of on the initial potential is 23,500 MCF. That is a ratio of 31.3 to 1 as compared to a possible variation of 46 to 1, if in some area you got all of the favorable factors, as we apparently have in the larger wells.

Let me again reiterate that in my opinion, the formula of deliverability times acreage is reasonable and will result in each well being allocated market proportional to recoverable reserves under each well.

Q Mr. Reeves, do you consider acreage alone or as an additive factor?

A Well, sir, if the Commission will bear with me I would like to go into that in some detail. In other words, first of all if we take 100 percent acreage, that means that we totally disregard any difference in reserves between various areas of the field and if that is done it violates the basic concept that the operator is entitled to a market in proportion to his reserves.

Another way of looking at an acreage proration, the best acreage in the field, which is obviously, some of it is better than another, is worth the same as the poorest acreage in the field.

The next point that I would like to make is, that to use acreage, if you used 100 percent, then all wells have the same and quite obviously don't have a deliverability quite as high as their allowable under an acreage factor. We bring it back to 50 percent acreage and 50 percent deliverability and we are committing only half the crime. We bring it down to a quarter and we are taking a quarter off.

The other point is that, that is, I have touched on it there. That is, if we adopt an acreage formula of 25 percent, even that small, that then you have a number of wells in the field in which you have an allowable above their deliverability or their capability of delivering and thus put into effect a proration formula which in the end isn't workable and you have to reallocate the gas that the small wells couldn't produce. On the other hand, the deliverability times the acreage is fairly, it allocates the reduction to everybody and doesn't load it on the better wells.

Q So, you take your stand on behalf of Pubco and your professional opinion that the formula deliverability times acreage is reasonable and should be the formula used?

A I do, and I would like to again point out that deliverability or initial potential, and it would be more or less interchangeable, are the only factors that we have without question available for every well in the Blanco-Mesaverde field. It is the only one factor we have available for every well.

Q Were you here this morning at the session, Mr. Reeves, and did you hear Mr. J. D. Cooper of Skelly testify?

A Yes, sir.

Q What, if any, comment do you wish to make on the formula that he recommended on behalf of Skelly?

A Well, if you took your rock pressures after a 7 day period, 14 day period or 30 day period or 60 day period, you would get an entirely different result on the formula. To me, acreage times pressure is another way of saying acreage proration with modifi-

cations.

MR. KELEHER: That is all with this witness.

MR. SPURRIER: Does anyone have a question of Mr. Reeves.

CROSS EXAMINATION

By MR. SMITH:

Q Mr. Reeves, Mr. Gorham testified awhile ago about his lack of knowledge of the respective pressures, except in two instances. On the two instances, I think he stated on certain periods of shut-in, that the wells were shut-in, that there was not appreciable building up of pressure in the well which had a lower pressure. I think it did gain two pounds. I would like to ask if you know whether or not there has been a marked differential in pressures from well to well, to the various locations that you are familiar with?

A You mean initial pressures?

Q Initial potential, and then I would like to know, after production, if you show any marked dissimilarity?

A I might refer to -- First of all I don't know that I am directly answering your question. You referred to Pubco State No. 12 and Pubco State 13, the offset wells, around that we have a list of nine wells in a general area around those that were producing for a period of 180 days, while these two wells were shut-in due to failure to get connection. We didn't take the tests for the purpose of that. It does illustrate, during that period we had these other wells producing here, these two wells in the center of the area, the initial shut-in pressure was 1100 pounds, after 180 days the

tubing pressure was 1,080 on Pubco State 12, 1078 tubing pressure at the end of 78 days. Pubco State 13 was 1,060 as against 1,064, both tubing pressures. I would be inclined to say that any variation there was due to errors in the taking of the pressure.

Q Atmospheric conditions?

A Which indicates very little drainage under the conditions existing.

Q The nine wells producing, do you have figures on what decline in pressures occurred in those wells?

A No, sir, I have not. I have not.

Q They could, very easily, be roughly equivalent. In other words, you could have produced the amount of gas you did produce with perhaps only two or three pounds drop of pressure in that time?

A I wouldn't dare attempt to guess the answer. I wasn't thinking in angles of reducing pressure on those nine offset wells. I was thinking more of the point that this showed that the offset wells being produced, while the others were closed, in Pubco State 13 was only 120 days. All I wanted to show was that it didn't pull down the pressure on those wells, indicating little if any migration to the offset wells.

Q The testimony of Mr. Gorham indicates that he considered each 320 acres of assigned acreage to each well to be separate and independent reservoirs. Is it your opinion that those facts do actually exist?

A It is my opinion that you can take any set of sands here and trace them through all of these wells. Now, I think that you

will probably find one sand maybe that you, maybe it is in two or three wells, but to all intents and purposes they are separate. Now, undoubtedly, some of those sands do overlap. It would be a rare thing if there wasn't some overlapping.

Q Where would be some communication that would result in communication throughout the entire field, but imbedded by reason of your lenticular condition?

A That is right. My point is, to all practical purposes there is no drainage existing at the present time as between wells.

Q In other words, there is probably communication, but it takes a longer period of time for the pressures to equalize than would be the case if there were one continuous sand of equal porosity and permeability?

A That is right. Another thing that possibly would illustrate what I mean, I think there is varying resistance between flow in different locations. For instance, we have in certain parts of the field up there and I think maybe it is actually several fields, 933 pounds initial potential, as against, I believe, 1144. I had 1102 as a maximum, which would indicate even of the acreages, that field hasn't entirely equalized as between it, and there is no communication of any majority. Now, possibly you will find points of some intercommunication, but, in other words, I don't think that any of us can say now that one sand may not overlap between two or three wells, but fieldwise, no, and not all of the sands. I can visualize that as a lot of lenticular reservoirs.

Q In your opinion, then, as far as the Mesaverde formation in the Blanco field is concerned, it is a common source of supply?

A The Mesaverde section as a whole furnishes it, yet there are numerous small interbedded sands in there contributing to one well. Maybe the one sand doesn't contribute to any other well. We can't tell. We know that we are getting gas in the individual wells. The evidence we have indicates very little communication.

Q You would say there is some communication throughout the entire field?

A I would not, not the entire field, but I would say between areas of it. In other words I have in mind, looking at Skelly's Exhibit 2 this morning, to me it looked like there was possibly three fields connected by some very relatively impervious sands. In other words, to me that substantiated our conclusions that it is a lot of little reservoirs with comparatively little minor connections in between them.

Q It is not your recommendation that you draw a fence between each 320 acre unit and call it a reservoir?

A No, sir. I made a crack in one of the -- I stated that we build a cast-iron 320 and there wasn't going to be any gas get in or out. Somebody took me seriously. Suppose you got a lenticular, the tail-end of it may be on somebody else's lease, the tail end of his sand may be on yours, but there is not enough connection to allow drainage as proven by these figures here of a general condition of the field.

Q Of course, all your statements in addition to your lenticular condition, is colored by the fact that there is a variance of porosity throughout the entire field?

A Yes, sir, very much.

Q The reason I asked you about the common source of supply is to get before the Commission, since it is their duty under the statute to regulate each source of supply separately. I asked you in your opinion, if that condition did exist, wouldn't it be possible for the purchasing company to make a nomination for each well and have the entire field prorated, well by well?

A I think you could argue the point that each one of those constitutes a little separate reservoir. On the other hand, from a practical standpoint I think you have got to arrive at some point that will give some indications of the reserves under each one of the leases, base the formula on that and I think you will get fair and reasonable results by considering it all as one field. I don't think that certainly, for practical purposes that this 1114 pounds, down here (indicating) and the 913 pound initial potential well is, by any means, interconnected or over the ages that pressure would have been equalized. The difference in depth, if it was a common reservoir, still doesn't account for the difference in pressure. There is some variation. Maybe the one over the 933 is leaking a little, but not fast enough to maintain it.

MR. SMITH: Thank you very much, Mr. Reeves.

MR. SPURRIER: Does anyone else have a question of Mr. Reeves.

MR. JONES: Trevor Rees Jones, representing Delhi Oil Corporation.

By MR. JONES:

Q I was interested in your testimony concerning the wide variation in recoverable reserves. I believe you compare variations in porosity, reservoir pressure, connate water and sand thickness?

A Yes.

Q I believe your result was there could be a variation of 46 to 1?

A That is right.

Q Would you illustrate very briefly for me, by an example, perhaps, how you would reach that?

A With the Commission's permission I would like to make a mark or two on Exhibit 2-B on the side. This has nothing to do with it, This is a cross section with a 320 acre site. I said that the total depth varied from 450 feet, that is gross sand, to 100 feet. I said that the ratio was 4.5 to 1, so I am going to adjust -- that looks like it ought to be about the proper place, so there is one 320 acres and then a hundred feet of gross sand section. Here is another 320 acres, 450 feet of gross sand section.

Now, it is quite obvious that you can have, at the same pressure, same porosity, same what have you, four and a half times as much gas in this big 320 acre block as you can in this little thin one.

Going a step further, the next thing I mentioned was porosity. It so happens, still sticking to our reservoirs, that this little block here (indicating) is 80 percent, that was 4.6, that there is only about, there is 93.4 of thisfilled up with sand in here. Now

then, and the same thing would hold down here -- if we put more porosity, more holes in the sand, if you please, up to 20 percent, you would come up with 4.35 times as much gas in that reservoir then. In other words, if the porosity is greater, you get twice as many holes in one as in the other, you got twice as much gas, if your block is four and a half times its product.

The next point I made is connate water. If some of the pore space gets filled up 60 percent with water there is only 40 percent of space left for gas. Likewise, if you have only 20 percent filled with water you would have 80 percent left for gas. So that you would have twice as much on connate water.

The reservoir pressure is simply Boyle's Law, taking one of the boxes that you want and if you put a pressure gauge of 1,002 pounds gauge on it and another box the same size, with a 933 pound pressure gauge, you end up with 1.18 to 1 more gas in the box with the higher pressure. Of course those are all cummulative, they are multiples. You multiply all of the possible things together which exist in some sands in the Basin. You can get any combination of them, you can come up with 46 times the amount of gas.

Q I see, in the ideal location, which had all the --

A (Interrupting) The low connate water, the high sand thickness, all in one well. You could have 46 times as much as I think the minimum, which would be 750, yet we haven't got but 31.3 to 1.

Q In other words, --

A (Interrupting) In other words, the point I am trying to

make, Mr. Jones, is simply this, that from what we know of the individual sands in that Basin, from the fact that they vary widely from one end of the Basinto the cther, that you can get any combination of the factors you want. When we get a well with 23,500,000, it is not unreasonable because you could get a nice favorable set of sands, nice water conditions, nice porosity.

Q The prior witness gave a definition of the volumetric method of determining reserves. As I remember that, the method included the various things you talk about, connate water, sand thickness -- I don't believe you included compressability, I am not familiar with it.

A That is a little devil of a factor that gets into an engineering argument.

Q I wonder if you are considering the very things you have considered here in reaching your 46. to one result?

A That is right. The factors that I have taken and considered here are the factors that you use in computing volumetric estimate of reserves.

Q And is it correct to say that those factors are factors which are considered when you are talking about deliverability, are they functions of deliverability?

A They all go up to make deliverability. I concur with the Kansas Commission in their statement on the Hugoton field, in which they said that not withstanding, there was no argument about it being a common reservoir, it was a common reservoir. They made the statement that deliverability constituted the best measure. I have the

book letter here if it would be of any help to read their conclusions. We have a separate reservoir up here (indicating). It is different from any I know anywhere else.

The mere fact that there is 150 fields in Texas that are prorated on an acreage basis, and only two on acreage times deliverability proves one thing to me, that acreage formula didn't fit the other two fields, and is the reason the Commission changed it and wnet to deliverability times acreage. In other words, we have a condition up here in this field and I don't think there is another one like it in the United States. I could be wrong.

We have got to take the facts on this Basin as they exist and arrive at the formula that does. What gives each man market in proration to his reserves and the only measure of reserves that we have is deliverability, that is the only measure that we have that is applicable to every well in the field.

MR. SPURRIER: Anyone else have a question of Mr. Reeves? Mr. Foster?

By MR. FOSTER:

Q Mr. Reeves, is it your contention that these large capacity wells won't drain gas from other areas?

A It is my contention, Mr. Foster, that they are not. It is my contention that, taking into account the various factors that go to make up reserves, it is perfectly possible that they have 46.4 times as much gas under those wells as the well with 750,000 I. P.

Q Then it would also be your contention, would it not, that

the low capacity wells couldn't possibly drain the large capacity wells?

A If you shut in the high capacity wells and you produce the low capacity wells, you lower the market, that is what is concerning me, no matter whether they are draining or not.

Q I understand. I am talking about drainage.

A I am not talking about the drainage of the little wells, I am talking about taking the gas from the field and giving it to marginal wells.

Q If the little wells aren't going to drain any gas, how are you going to take the gas away and give them to the bigger wells?

A Let's say that we make it 100 percent acreage and it so happens that is an average of 200,000 MCF per day. We make it average so all of the wells produce 200,000 per day. Where is the market for your wells that will make 10,000,000 deliverability?

Q I am not talking about market, I am talking about drainage.

A I am not worried about drainage, I am worried about market. I am worrying abour market proportion to the reserves under those wells.

Q I appreciate what you are worried about. The problem that we have is to design a formula, as I understand it, that will most nearly keep in proper relationship the factors that are indicative of reserves in place. That is a correct statement, isn't it?

A If I understood you, Mr. Foster, and I think I did. May I repeat to be sure I understood?

Q Yes.

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A If I understood you, Mr. Foster, and I think I did. May I repeat to be sure I understood?

Q Yes.

A You said your problem is to determine --

Q (Interrupting) That is the problem before the Commission.

A Let me see if I understood you. Our problem is to develop a formula that will enable each well to market gas proportionally to the gas reserves attributed to that well. Is that what you said?

Q No, I didn't use the term "market".

A Produce then, allowable.

Q What I understand our problem to be is to keep the factors of reserve in such relationship so that each well will be permitted to produce in the proportion that its reserve bears to all the reserves in the field.

A I think that is exactly what I said, except I said market instead of produce.

Q All right. If the little wells can't drain the big ones and the big ones can't drain the little ones, it doesn't make much difference what kind of a formula you have, does it?

A Oh, yes, it does.

Q Why?

A Oh, yes, it does, I wish I had a blackboard. All right, then, suppose each well had 300,000, that is average. In other words, we are going to take full acreage for illustration to answer your question. So 300 is all you can make, that is the allowable because it is on an acreage basis and that provides up to that. So what do your wells capable of producing get, they get 300. What does the little guy get with 300, he gets the full capacity, not with

any relation to the reserves. This guy is producing the 300,000 with nominal reserves. The fellow with no reserves at all is trying to produce his 300,000. I said 46 to 4 is possible and he is producing the same as the other. Where is the ratio and where is the proportioning of reserves on that kind of thing?

Q I am producing my well on one tract and you are producing on another tract, and regardless of the rate at which we produce the wells, I don't get any of your gas and you don't get any of mine. What else have you got for a formula?

A That if we spend $85,000.00 on a hole in the ground and we complete a well with reserves sufficient to justify it, that we want to sell that gas and get some of that $85.000.00 back. The other guy over here with a well that can't produce it. Hell, there is a dry hole at the beginning, he should abandon.

Q You are talking about rates of production and not reserve?

A Oh, yes, I am talking about reserves. I am talking about the guy over here with the low deliverability hasn't got the reserves that the high deliverability well has. I think I have demonstrated the possibility of that by going through the facts or the factors that go into make up the reserves.

Q You are talking about this ideal situation where you finally arrived at this 46.4 to 1 variation? What odds do you think that there would be that you would find that ideal condition?

A So far as there is 704 wells in the Field and no one has hit the 46.4 to 1 yet, the odds are pretty bad that you are going to get ideal conditions in all of them. You can get good conditions

under given conditions, with increased reserves.

Q In the method of completing your wells there in the field, you shot them or acidized them?

A We have generally shot our wells, yes, sir, drilled in with gas and shot.

Q Do you increase their deliverability by that practice?

A Yes, certainly.

Q Does that increase the reserves?

A I think it is a measure of reserves with a few exceptions where you have got --

Q (Interrupting) Shooting a well don't put any more gas down there, does it?

A No, but it opens up more holes for the gas to flow into. All of your wells are opened up for it to flow into. In other words, this well here was probably shot with a pretty good charge, but it didn't open it up, it didn't have any gas there.

Q You testified, as I understand you, that deliverability is directly proportional to reserves?

A It is the best measure, it is the best measure of reserve under a given well that we have at the present time, and the results, s, using that give ratios lower than possible theoretically.

Q Well, I don't agree with you that is the best measure. I do agree with your statement that it is the only common denominator that we now have actual knowledge of, that we can apply to the various wells in the field.

A That is right.

Q What I am getting at is that it doesn't follow from that, that reserves are directly proportional to the deliverability, does it?

A Mr. Foster, I would say that it is the only thing that we have, the only common denominator which is approximately right, and you and I could argue the matter of degree.

Q I am not arguing with you at all. I agree with you it is the only common denominator. It is the only thing we can see to apply to these wells.

A As to the degree that it follows the proportional.

Q I am saying that it doesn't follow from that fact, although you apparently contend that it does, that reserves are directly proportional to the deliverability?

A Mr. Foster, I would say this, that theoretically taking the variations in sand thickness, the porosity, connate water and pressures, that it indicates that on the ideal you could have a much higher ratio with favorable conditions than you have got actually with wells in the field. That is the point I am contending, that it is a reasonably close approximation. I wouldn't attempt to say it is exact.

Q Sometimes you shot a well and you increase its deliverability, and then you shot one and decrease it. Isn't that what happens sometimes?

A I think you can find any kind of a condition on individual wells that you think of in the San Juan, including one that we have got enough iron to start an iron mine. If we can just get it out.

Q Is that an answer, "yes" to my question?

A It is a qualified answer, yes, that you can find isolated conditions of anything you want to think of in the San Juan.

Q It is common, isn't it, that you don't increase the amount, same amount in the same shot in the same well, isn't it in different wells?

A Oh, yes, you would get different increases after shooting.

Q Or decreases?

A But that is probably a result of having different sand lenses.

Q You wouldn't contend, would you, that if you got a deliverability, just to use the figure of ten, whatever that represents, before you shot it, and that that ten represents a reserve of 50, and after you shot it you got a deliverability of 20, and therefore, the reserve, that represents a reserve of 100. You wouldn't contend that, would you?

A I wouldn't contend anything of that sort. I contend only this.

Q That answers my question.

A We have the uniform denominator, that is what I referring to. They call that out of contention, don't they?

Q I don't know.

A I claim that it is the common denominator and that it is the best indication of reserves that we have.

MR. SPURRIER: We will recess for ten minutes..

(Recess.)

MR. SPURRIER: The meeting will come to order, please. Does anyone else have a question of Mr. Reeves?

MR. GORDON: I would like to ask Mr. Reeves a question. Mr. Gordon with Tri-State.

By MR. GORDON:

Q Mr. Reeves, if all the wells are put on the same allowable, based on acreage, some of the stripper wells and we will call them marginal wells, would eventually play out, would they not?

A I would assume so, yes, sir.

Q Well, then, how long would it take the good wells on that same proration to produce their reserves? It would take them quite a few years, would it not?

A I am not sure I follow, or that I understand.

Q If everything is based on acreage --

A (Interrupting) Yes.

Q (Continuing) It might take some wells maybe 30 years, 30 times as long to produce their reserves as some of these marginal wells, is that not right, according to your figures?

A If it was on acreage, and that would be the same gas for every well, quite obviously 20 percent of the wells, we will say, drop out, it would serve to increase the average a little bit, but it would still leave the good wells with no incentive, worth just the same as a mediocre well in the field. Of course, as their failure to produce was added on to the others, you would get a little build up for the other wells.

Q But it would take a longer time for the good wells to produce their reserves?

A To get enough gas to recover the investment in them or to get any market for the reserves they had under them.

Q If the allowable were stepped down to the marginal wells, the pipeline companies couldn't get out what they want to take out of the field daily, could they?

A Oh, no, in other words, if you allocated below the average for the field, in other words, if you got a demand of so much gas in the field and you divide that by the total number of wells, which you do on a full hundred percent acreage factor, even though low average would be above what some wells could produce. On those wells you take what they couldn't produce and have to allocate it to the other wells that could make their allowable in the field.

Q You would have to give it to the other wells?

A That is right, you would average out the other wells and maybe raise it ten percent.

Q To break away from the acreage?

A Yes, because the acreage is impractical in the first place.

Q That is what I wanted to bring out.

A Yes, sir, the acreage is impractical in the first place.

MR. SPURRIER: Before we go any further, I think the Commission should make themselves clear again. Mr. Selinger, I believe, did not exactly state what the Commission visualized when

they set this hearing. In the first place we felt that, from the knowledge of our own records, ratable take wasn't in effect in the Basin, but we are here to determine if it is not, and if proration is then necessary, and if so by what formula.

MR. SELINGER: That is true, Mr. Spurrier, and I believe I made a statement at the last time this matter was brought up, that as far as Skelly Oil Company is concerned, we would rather have the State allocate and then prorate than the pipelines.

MR. SPURRIER: That is all I have. Does anyone else have a question of Mr. Reeves?

MR. GRIENER: A. S. Griener.

By MR. GRIENER:

Q Mr. Reeves, you were talking during your testimony, about the various factors which needed to be considered in a determination of recoverable reserves and I believe you stated those factors were gross sand thickness, porosity, connate water, and initial pressure, is that correct?

A Gross sand thickness, connate water, reservoir pressure, yes, sir.

Q Are there any other factors which need to be considered in a reserve determination?

A That is correct, exceptof course, you have got to refer to certain pressures. In other words, basic units.

Q That is right. Initial pressure, I believe, was one of the components?

A That is right, but I mean the pressure of the unit of

measurements.

Q Yes, that is right. Do those same factors come into play in the determination of deliverability, that is to say, do all of them effect the deliverability of gas from a well?

A Yes, sir.

Q Are there any other factors besides these which may have an effect upon deliverability, which, according to your prior statement, would not have an effect upon reserves or would not be needed for a computation of reserves?

A Yes, there would be one item, permeability.

Q What I am getting at is just exactly that. Now, if we go to deliverability, do we take into account the variances, if any, in permeability as between wells in order to make this formula really work out on a fair basis? We have one extra factor there then, is what I am getting at, in the deliverability which isn't and shouldn't be present on the reserve side. What are we going to do about the permeability aspect of it?

A That is one of the many items, and a have checked as many of the available core analysis as I could. I find that there is, so far as I could determine, no unreasonable increase in permeability with prorosity and for that reason it is the one factor that is rather up in the air, but based on the information I have there is no reason to expect any large increase in permeability, with a slight increase in porosity. In other words, they seem to run parallel to each other, contrary to some comments during the Sub-Committee discussions of this subject.

Q But you know of no wayof determining with any degree of accuracy, that the permeability conditions surrounding any particular well, as to whether they are more or less favorable than average or just about average?

A You have a few cores, Mr. Griener, and those cores, I plotted some of them, and permeability or porosity generally run along together with no out of proportion rate of increase on permeability, which would throw it off. So, I think that you are perfectly safe in assuming that permeability isn't a major factor in this.

Q But, it is a factor which is present in deliverability, but is not present in normal reserve calculations?

A That is right. That is the reason that I used the term recoverable reserves in here. For instance, we know that we have some gas out on fringe areas.The permeability is such that there is no gas produced and it is not recoverable. In other words, the reserves, unless you can recover them, they must have --

Q (Interrupting) I think we have the point which is the fact that there is one factor in your formula which does not relate to reserves?

A That is right, permeability in there.

MR. GRIENER: Thank you very much,

MR. SPURRIER: Anyone else? If not the witness may be excused.

MR. UTZ: I would like to ask the witness a question, please.

By MR.UTZ:

Q On this core information that you speak of, can you tell me how many cores you used to arrive at your minimum and maximum?

A I had three cores, two of which were in the Basin and those cores were given to us on a confidential basis. One outside of the Mesaverde area, that is, the present Mesaverde or the Blanco Mesaverde field, what was in one of the sands. I believe that was Point Lookout in one and Cliffhouse in the other, which I was basing my comments on porosity up to 28.4. We did not have any core information on the big wells, because they were drilled in with gas and we couldn't core them, so I don't know what the porosities are in those better wells.

Q I understand that. These averages, in other words, was 4.6 and 15.4, an average of the whole core or was it local areas in the core?

A That was individual sands. In other words, individual sand stringers. In other words, this stringer 4.6, this 1.14 this 1.9, it was not an attempt to get an average, but to show how the lenticular sands don't carry between wells, have different porosity. If you happen to get sands with good porosity in one well, how you could increase the reserve under that one well. I don't know whether I made myself clear or not.

Q Did you compare the possible local areas in one core against the possible higher areas in the other cores, is that my understanding?

A Let's take these here. Suppose that in your core analysis that you ran here from, oh, five up to ten, and what I tried to do is see what these individual lenticular sands that seemed to exist in the wells would run, and then I said that if you get the maximum porosity in a series of these sands, there seems to be no rhyme or reason where they occur, that then you had a well of high average porosity. Is that clear, my thinking on that, Mr. Utz?

Q No, it is not clear. On your shut-in pressures now, do you have a record of how many days this 933 pound shut-in pressure, how many days the well was shut-in on the 933 pound pressure?

A Those could be dug out, Mr. Utz. However, those pressures were based upon pressures taken prior to I. P. official test.

Q You don't know for either pressure just how long the well was shut-in?

A No, sir, I couldn't say, they were approximately comparable times.

Q Then it is possible that the 933 pound pressure was a maximum build up?

A There is a possibility that it could have built up to 940, 945, there was still a difference there, I am sure of that.

Q I would still like to get back to some sort of a reserve figure on your State Number 6. Do you happen to have that information?

A At the time that we filed a registration statement a year or so ago, these figures are from memory, they are approximately correct, but originally that was over 100,000,000 per acre, and

then as I recall, in arguments with S. E. C. Geological staff, I am probably violating some law, of quoting what S. E. C passed on, and those figures were not passed on by S. E. C. In other words, they admitted our registration statement, but in discussion, as I remember, we talked anywhere from 80 to 100 million an acre on that. An independent geologist estimated over 100,000,000 an acre.

Q In other words it is pretty high?

A It is plenty high, yes, sir.

MR. SPURRIER: Mr. Macey?

By MR. MACEY:

Q In connection with your estimation of 450 feet of gross pay, what is your definition of gross pay?

A That is all sand, without an attempt to determine whether or not it is productive.

Q Does that same figure apply to the use of the 100,000,000 figure?

A Yes. What I was trying to do was get a relationship between the available storage space. It was my thought that the sand containing proportion reserves, which would give you the 4.5 to 1 factor in any case.

Q Do you maintain there is a well in the Basin that has 450 feet of pay?

A No, I said gross sand.

Q You don't use gross sand in calculating reserves, do you?

A That is right, but that is net sand. Now, my thought was

that when you start picking net sands, that then you get into an argument between geologists as to which sand is net and productive. The point that I was trying to make in this was show maximum variation between wells and I think that the gross sand overall would be proportional to the net sands, after you picked them out.

Q In other words, as I understand both your answers to Mr. Utz' question and to mine, you have taken the absolute extreme cases, which theoretically could exist if all the conditions were ideal and then you have compared those. Well, what have you compared them to?

A Mr. Macey, I think that I have been rather liberal in taking my limits. I am glad that you asked that question. I think you could very well drop your porosity below 4.6 for some production in there. If you did that and then I pointed out that we had 28.4 -- in other words, two into that is 14 times on the multiplier instead of the four, so I would end up with 150. What I tried to do in picking my minimum was a condition with thin sand where I would get about -- in my opinion 750 I. P, or 150,000 deliverability. Is it clear? In other words, you could drop -- For instance on that figure this morning, if some guy had plugged a dry hole it might have had a deliverability of 1 MCF and then you had a ratio of 10,000 to 1. If you say a dry hole, you get a smell out of it, you say the ratio is infinity. You have to arrive at some reasonable point of productivity.

Q You feel that your minimum figures are a reasonable point?

A Yes, sir, I think so, within limits, Mr. Macey. I am trying to arrive at some overall guides as to what could be expected.

Q You compared your -- If I remember correctly, you came up with a variation in deliverability of 33 to 1, or approximately that, did you not?

A I came up with a possible variation on these factors, approaching it from that angle of 46.4 to 1. Now, assuming that any well below 750,000 I. P. or 150,000 deliverability is non-commercial, marginal and should never have been drilled in the first place. That is your minimum gas well and that is the one that the minimum factors, I would take, would produce. The biggest well you have in the Basin is about 23,500,000, if I remember, and that is 33.1 to 1 as compared to the possible 46.4 to 1, with all the factors at best, which indicates that that deliverability in that well is not unreasonable compared to what you could have in reserves if your factors were right.

MR. MACEY: That is all.

MR. SPURRIER: Anyone else?

MR. UTZ: I have one more question I wish to ask on this porosity.

By MR. UTZ:

Q In figuring reserves, Mr. Reeves, you would not necessarily pick for any one sand stringer, which I understand is the way that you arrived at the minimum or maximum. You wouldn't necessarily pick that one sand stringer and call that the average porosity for

the net pay in that well bore, would you?

A Oh, no, sir. In other words, you have to arrive -- Let's take this well here (indicating). You have entries all up and down the hole. Now, to figure reserves you have to figure an average porosity in there. The point I am getting at is the individual sand stringers have shown porosities at various places, 4.6 to 20. Some of these wells undoubtedly have an average porosity of 6, 8 or what have you. That effects the deliverability. It has some effect on it and it also determines your reserves.

Q In other words, if you were figuring your reserves on any well bore up there, one of which might happen to have 4.6 minimum, you would probably use a higher porosity in actually figuring the reserve?

A In other words, you could have a well with an average of 4.6. There are a lot of porosities there down to, oh, 2 percent, for that matter, but you would come up there and you would average it out, and that would be your reserve, the base of your reserves, the figure that you would use in the formula.

Q Did I understand you to say you think there is an average porosity as low as 4.6?

A I think there is porosity that low. I think there is on the average poor well where you get the sand pitts.

Q Is there, as you say there is 100 foot of those sands?

A As a matter of fact, here the Point Lookout well 268 might be -- I don't know what the porosity is in that.

Q Likewise would you say that any well that I wanted to

figure reserves on, or any well that you figured reserves on, you would use an average porosity as high as 15.4?

A On State 6, I think your porosities could well be figured above 15.6. I think on the Turner State 1 that they are above that.

Q For your information we have a number, of more than three available, and we don't have a range higher than 7.17 percent.

MR. SPURRIER: Anyone else have a question of Mr. Reeves?

MR. DAVIS: Quillman Davis, Aztec Oil and Gas Company.

By MR. DAVIS:

Q Are you familiar with the gas reserves estimates per acre that have been made by the Federal Power Commission in hearings relating to the San Juan Basin?

A I have at o e time. I don't recall the figures.

Q Would you be surprised if those estimates were under 20,000,000?

A Oh, I understand that some of those have been taken into account, the whole basin, poor areas along with the good, that the estimates have been as low as seven to eight million. I might point out that Pubco, at the time that Southern Union filed an application or registration statement, and I believe you showed 7,000,000 at that time, about two or three years ago. At that time our average that was passed on, the acreage we had which was in the area where there were high reserves, I think, was 18,000,000. Might I check that? 18 to 22,000,000, so that has been passed.

Q There is a rather wide difference of opinion as to the reserves. If you get between 80 and 100 million reserves for your so-called State 6 well?

A No, sir, I wouldn't say so. I think we are talking about different things. In other words, if you take a whole area in here (indicating) with a dog-gone good pasture in the middle and a bunch of overrun pasture around the sides, you are going to get a low average of 7. The guy that based the average of 7 on the whole thing may have determined that by getting 5,000,000 down here and 20,000,000 up here. It doesn't necessarily follow that the geologists were wrong on their estimates.

Q Maybe I misunderstood your earlier testimony. You kept referring to the two factors that we know about in the Basin, as to the wells, one of which was the I. P. and the other the ddiverability.

You don't intend to imply that we don't also know or could determine these other factors that are being proposed as an allocation formula? In other words, you can determine the other factors, too?

A Yes.

Q We certainly know the acreage, too. I didn't know whether you were implying those were the only two we knew or not?

A I implied certain other things about the acreage factor as a multiplier with pressure.

Q One other question, too. Some of these smaller wells you were bringing out awhile ago the fact that if you did allow any other

factor other than deliverability that you would have a redistribution of your allowable, then in effect the pipeline companies are able to get the gas that they need from the area without being penalized. You don't have any penalty because of any formula, do you?

A Well, what it would amount to would be simply this, that you would say up to the point that the pipeline companies have got gas,every well here that two hundred would produce two hundred thousand, three hundred thousand, four hundred thousand. Then, all they needed on the rest would be 450, so you would end up with 450 against this well with deliverability of 10,000,000, andthis guy with 450 would get all of it. He would get all he is able to produce.

Q You are not suggesting the small wells be plugged?

A Well, I think, as a matter of fact, if your money is in there, I think it is perfectly evident that any man that gets an initial potential of less than 2,000,000 a day is going to wait a long long time to get his money out. If it is a potential of a million and a half or three hundred thousand a day I don't think there is a possibility he will ever get his money out, let alone profit.

Q You should let him have the opportunity to get as much as he could out?

A The wells are drilled, but they should be allowed to produce the gas, but not to detriment to where it would hurt the good wells. No one is going out there and drill if they are going to have to

sell four hundred to five hundred thousand out of the well. It just don't make sense. There is better places to spend your money.

By MR. FOSTER:

Q Are you saying that all the high potential wells --

A (Interrupting) Without the hope of wells, better than two and a half million to three million, I don't think anybody would drill in the Basin, certainly I wouldn't spend my company's money on it.

MR. SPURRIER: We will recess until 9:00 o'clock tomorrow morning.