BEFORE THE
NEW MEXICO OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
August 3, 1977

EXAMINER HEARING

IN THE MATTER OF: Case 4962 being reopened pursuant to the provisions of Order No. R-4538 which order established temporary pool rules, Roosevelt County, New Mexico.	CASE 4962

BEFORE: Richard L. Stamets, Examiner

TRANSCRIPT OF HEARING

A P P E A R A N C E S

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For Amoco Production Co.	Antone L. Peterson, III, Esq. Attorney at Law 500 Jefferson Building P. O. Box 3092 Houston, Texas
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I N D E X

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EXHIBIT INDEX CONTINUED

MR. STAMETS: The hearing will please come to order. At this time we will call Case Number 4962.

MS. TESCHENDORF: In the matter of Case 4962 being reopened pursuant to the provisions of Order Number R-4538, which order established temporary special pool rules for the Peterson-Pennsylvanian Associated Pool, Roosevelt County, New Mexico.

MR. STAMETS: Appearances have already been entered in this case. However, we do have an additional appearance here today and so for the record I would like to have entries of appearances again.

MR. PETERSON: Antone Peterson for Amoco Production Company and also the file, I think, contains an appearance letter of New Mexico counsel, Atwood, Malone, McMann and Cooter.

MR. STAMETS: All right.

MR. PETERSON: Amoco will have two witnesses.

MR. LOPEZ: Owen Lopez of the Montgomery law firm in Santa Fe. I am the new appearance and we will have one witness.

MR. STAMETS: Are there any witnesses who will appear today and were not sworn at the original hearing? Will they stand and be sworn at this time, please.

(THEREUPON, the witnesses were sworn.)

MR. PETERSON: If Amoco may proceed first?

MR. STAMETS: You may.

MR. PETERSON: Amoco is here again today to urge the Commission make the temporary field rules for the Peterson-Penn Field permanent. We will have two witnesses. Mr. Jim Pease will present testimony essentially relating to core data logs and core analysis and Mr. Howard Rice will give the findings of his reservoir fluid property study.

J. E. PEASE

was called as a witness and after having been first duly sworn, testified upon his oath as follows, to-wit:

DIRECT EXAMINATION

BY MR. PETERSON:

Q. Mr. Pease, have you testified before the Commission or one of its Examiners previously?

A. Yes, I have.

Q. And your qualifications were found acceptable?

A. Yes, sir.

Q. What is your major field of expertise just for the record, Mr. Pease?

A. Petroleum Engineering.

Q. Are the witness' qualifications acceptable, Mr. Examiner?

MR. STAMETS: They are.

Q. (Mr. Peterson continuing.) Mr. Pease, I would like for you to look at what has been labeled Amoco's Exhibit Four and explain, generally, what that exhibit is intended to show?

A. Yes, sir. This is a map of the Peterson Field area and the well which has penetrated the Pennsylvania have been denoted by large circles.

There is one omission and this is over in Section 16, the Amoco State EU Number One, and it also penetrated the Pennsylvanian.

This map is not accurate as to ownership and it should not be used for that purpose. The map that we presented in the hearing in June is accurate to the best of our knowledge.

Q. Were any of these wells cored, Mr. Pease?

A. Yes, sir. Amoco has cored six of the wells which it has drilled and starting at the bottom in Section 30, the well there in Unit B, it was the Lambirth Gas Unit and would be the Lambirth Gas Com Number One, it was cored.

In Section 19, the Peterson Number One, now called the Peterson Gas Com A Well Number One and located in Unit B, it was cored.

The Amoco Swearingen Number One, now called the Swearingen Gas Com A Well Number One, it is located in Unit J and it was cored.

MR. STAMETS: That was in Section 19?

A. Yes, sir. Both wells in Section 19 were cored.

Q. (Mr. Peterson continuing.) Go ahead.

A. In Section 20 the Amoco Swearingen One B located in Unit F, it was cored.

In Section 18, the Amoco Peterson C One located in Unit I, it was cored.

The Amoco Swearingen C Number Two located in Unit M, it was cored.

Our scout reports reflect, also, that Phillips Petroleum cored the Pennsylvanian in their Peterson One D which is located, I think, in Unit A of Section 18. I do not have the core analysis for that well.

Q. Could you explain the markings that you have made on this exhibit?

A. Yes, sir, there are three lines of sections shown here, A-A Prime, which is an east to west log cross section, and B-B Prime, which starts out from the west and goes northeast and turns to the southeast, and C-C Prime, which is mislabeled here but the actual log sections will start out C Prime at the Wainoco-Graves and run to the southwest and then to the south.

Q. All right. Turning your attention, then, to the first cross section that you mentioned, which will be Amoco's Exhibit Five, could you explain the wells shown on

that exhibit, please?

A. You might want to put this up on the wall --

MR. STAMETS: You might as well do that with the others if they are about as large --

Q. (Mr. Peterson continuing.) All right, Mr. Pease, if you would give us the wells that you have indicated on that exhibit and tell us what you have done insofar as the markings on that exhibit are concerned?

A. Okay. Exhibit Five is a cross section of A-A Prime and on the left-hand side we have a porosity log on the Radcliff Gas Com Number One drilled by Amoco. It was a dry hole and production casing was not set however a drill stem test was taken in the Pennsylvanian Age and the results of this test are shown at the bottom of the log.

The next well is the Swearingen Number One which is now called the Searingen Gas Com A Well Number One and the third log is the Swearingen B Number Three which is the name of the well when it was drilled and it is now called the Swearington D Number One. It's an oil well in the Pennsylvanian.

The Swearingen B Number Four is an oil well in the Pennsylvanian and the Swearingen B Number One which was plugged and abandoned and the production casing was set on this well and the Pennsylvanian was tested as shown.

On the cross sections they are hung on sub-sea

datum of minus thirty-one hundred feet. We have correlated across the top of the Cisco which in this area would be the top of the Pennsylvanian. We have also labeled the Cisco main pay and right below the main pay we have some dotted lines and the top one represents the top porosity in the Cisco main pay.

The bottom represents the bottom of the porosity of the main pay zone. We have labeled on this the gas-oil contact at minus thirty-three ten and the oil-water contact of minus thirty-three thirty-four and then we have labeled the top of the Canyon Zone which is very thin here and then the top of the Fusselman.

Q. Any further comments regarding that cross section?

A. Well, on the Swearingen Number One it shows here where it was cored. The coring actually started within the main pay zone it was cored down to almost the top of the Canyon Zone.

The Swearingen B Number One, to the right, it also was cored -- you can see that the main pay interval was cored, and a substantial amount of laboratory work has been performed on the cores in this well.

Q. If you would then direct your attention to the next cross section labeled B-B Prime which is on the map, basicially, as you mentioned west to east and turning southerly.

If you would give us the wells that you have placed

on that cross section and I assume that the markings insofar as the horizons and the gas-oil contact are the same?

A. That's correct, sir. All of these wells were drilled by Amoco as the operator, the Swearingen Number Two, and the Swearingen C Number One, the Peterson Gas Com Number C-One, and the Radcliff Number One, and the Swearingen B Number One.

Q And a test datum is also shown for those wells?

A That's correct.

Q Any further comments regarding that cross section?

A. I would like to point out here that on my copy of it the Peterson C you can see that the entire Cisco interval and the Canyon was cored. Not all of the cores were analyzed but it was all cored.

Q. Then, if you would turn now to the last cross section which you mentioned?

A. All right.

Q Being the cross section from north to south through the field and would you indicate which wells you have shown on that cross section and again I assume the markings are similar and that you put the test data on the exhibit?

A. That's correct, sir. On the left we have a well drilled by Wainoco-Graves Number One. It was a dry hole and casing was not set. However, the Pennsylvanian and the Wolf Camp were drill stem tested.

In the center of this Peterson Gas Com Number One -- I hope all copies have been corrected -- the top interval there was the drill stem test and this would go down to seventy-seven hundred and twenty-four feet and from that point below the well was cored.

When this well was drilled that was the first show of gas at seventy-seven hundred feet and we drilled on down to seventy-seven twenty-four and then conducted the drill stem test.

The results of the test are shown down at the bottom of the log.

Q. You have shown the cored intervals. Do you have any core samples from those wells?

A. Yes, sir. The cores were slabbed and I have portions of the slabs from them.

The first core sample here, the core depth was seventy-seven hundred sixty-two point eight feet. There is a four foot correction to agree with these logs. You would add four feet tothe core depth to agree with the log depth, so, this would be at seventy-seven hundred sixty-six point eight feet on the log.

Q. That was in the --

A. Peterson Gas Com Number One, which, when it was drilled was called the Peterson Number One. The purpose of showing the sample is that the logs in this interval show

about four percent porosity. However, you might notice over on the gauge the caliper of the hole it shows a wash out and this is an S.N.P. log and it is susceptible to showing porosity where you have washouts.

This sample was analyzed by the core lab and has less than one percent porosity.

The next sample is from seventy-seven hundred and forty-six feet on the core which would be seventy-seven hundred and fifty feet on the log.

Again, this was indicated to have some porosity on the log and here is the sample. It also had less than one percent porosity by core analysis.

Q. We have six samples and they have been labeled 7A through 7F.

A. The third sample from the Peterson Number One is at a core depth of seventy-seven hundred twenty-nine point six feet, which on the log would be seventy-seven hundred and thirty-three point six feet.

Again, this was an interval that was indicated to have about four percent porosity on the log and the core analysis indicated that it had less than one percent porosity.

The other core samples that I have are from the Swearingen Number One. There is about a two foot correction to have the core depth agree with the log depth. You would subtract two feet from the core depth to get the log depth.

The first sample of core depth was seven thousand seven hundred and fifty feet and on the log, then, that would be seven thousand seven hundred and forty-eight feet.

As you can see on the caliper along this hole it was washed out pretty badly in this interval, too.

The fifth sample is from seventy-seven forty feet on the core and seven thousand seven hundred and thirty-eight feet on the log. This, also, was in an area that was indicated to have some good porosity on the log but that is due to the washout of the hole.

Our sixth sample is from in the main pay zone which is seventy-seven hundred and twenty-one feet on the core or a log dept depth of seventy-seven hundred and nineteen feet. As you can see this interval has good porosity, about thirteen percent by core analysis.

Q. Any other comments with reference to these core samples?

A. No, sir.

Q. Do you have any core data on any of these wells?

A. Yes, sir, I have. This is Exhibit Eight, and this is an analysis of the cores from the various wells that Amoco operates.

On the first well, the Lambrith Gas Com Number One I was unable to find the detailed analysis but I did bring along the plot which was made by the core lab which does show

the permeability and porosity of the oil saturation.

I think it would be safe to assume where there are no plots of permeability and porosity the sample was not analyzed. It was just suspected.

The other wells where we have core data here would be the Peterson Number One which is now the Peterson Gas Com Number One, the Peterson C Gas Com Number One, and the Swearingen Number One which is now the Swearingen A Gas Com Number One, the Swearingen B Number One, and then, the Swearingen C Number Two.

Q. Would you now direct your attention to what has been marked as Amoco's Exhibit Number Nine and explain what is shown by that exhibit, please?

A. On Exhibit Nine, we have taken the data from these wells, except for the Lambrith, and plotted up a core permeability it would be the log of core permeability versus core porosity and this should be a curve for five wells.

Q. Any other comments before we move on to Exhibit Ten?

A. No, sir.

Q. If you would look at Exhibit Ten and explain what you have shown on that exhibit, please?

A. On Exhibit Ten, we have arranged the core values in increasing values of core porosity and then computed the percent of core porosity feet.

This, then, is a plot of core porosity percent versus core porosity feet. In our log analysis to follow we selected a porosity cutoff of three and a half percent and the purpose of ten and eleven is to compare this porosity cutoff to permeability cutoff value which would probably be a more proper cutoff.

So, on Exhibit Eleven, we have arranged the core values in terms of increasing permeability and have plotted here logs of core permeability versus percent of core porosity feet and entering Exhibit Eleven from the bottom where you can see we had forty percent of our porosity feet and on Exhibit Ten had porosity less than three and a half percent.

Then, on Exhibit Eleven, you find that this corresponds to permeability cutoff at about point three-three millidarcies.

I would consider this a low cutoff, normally, for oil reservoirs -- usually you cutoff around a half to one millidarcy.

Q. So, this is an arbitrary cutoff but it is arbitrary only to the extent that you had to pick a cutoff? It is a very optimistic cutoff point for your curve there?

A. That's correct.

Q. Do you have any further comments on either Exhibits Ten or Eleven?

A. No, sir.

Q. If you would please look at Exhibit Twelve and show what you have demonstrated on that Exhibit, please?

A. On Exhibit Twelve, we took the core data and the porosity data and digitized it and as you can probably see from the exhibit some of the samples were where analysis covered maybe a foot to a foot and a half to two feet and here we have converted all of these to one foot by interpolating between and then we compared these values to what we calculated off of the logs.

This would, then, be on the left-hand side and we have a core porosity and on the bottom we had a log porosity. The line drawn through here is generated by a computer to be the best fit through the point.

Ideally, we would like for that to have a slope of one and in this case the slope was point nine seven six. This type of a scattering of points is what you see on this type of a plot.

Q. All right. If you would now look at Amoco's Exhibit Thirteen and please tell us what that curve, the curve shown on that exhibit, indicates?

A. As I mentioned previously the cores from the Swearingen B Number One were shipped to our research center in Tulsa and a substantial amount of laboratory work was done on these cores.

This is a plot of some of this data. It is a formation factor F and first is the log of porosity and the various core samples were saturated with simulated brine and they were subjected to a confining pressure and the formation factors were measured for each of these samples. This is the plot.

The slope of this line as drawn here is -- excuse me -- the equation for the line is drawn here in terms of formation factor and in terms of A divided by porosity to a power and the values for A is nine point three and the value for the power M is one point five-five.

Normally, in log analysis values for A would be one and M would be either two or two point two for carbonate rocks.

Q. Do you have anything further to discuss regarding Exhibit Thirteen?

A. I have some photographs of the cores that were analyzed in the research center. I don't have authority to release the photographs but if you would like to see them you are welcome. They are scan electron microscope photographs of four core samples, I believe.

MR. STAMETS: I don't believe that they should be a part of the record if you are not able to leave them here. But off the record I would like to look at them.

A. The photographs show that some of these samples

have quite a bit of micro-porosity in them and what we believe to be the reason for this, the divergence.

Q (Mr. Peterson continuing.) Do you have any water saturation figures while we have this exhibit in front of us?

A. Yes, sir. Using this value for this curve for formation factors and using the water resistivity value which was measured on a couple of samples and one of them from the Swearingen B One and the other one from the Swearingen B Number Four, RW's was measured to be about point oh four two on the reservoir's temperature and we took all of the logs that we had where we had a complete set of logs and digitized them foot by foot from the top of the Cisco to the top of the Fusselman and we calculated porosity and water saturation. Water saturation was calculated for intervals that had porosity above three and a half percent, our porosity cutoff.

Four, the number of points that were up in the gas cap area on the four wells, I believe it was three wells that penetrated the gas cap, the Swearingen C Number One, the Peterson A Gas Com Number One, and the Swearingen Number One, which is now the Swearingen A Number One, and the average water saturation in the cap was twenty point five percent.

The well that has penetrated the oil column using the same approach the arithmetic average of all of the values

measured within the oil column was thirty-one point five percent.

Q. Now, look at Exhibit Fourteen which is styled Correlation Chart Data and would you give us an explanation of the various columns on that chart and just the general explanation of the exhibit?

A. This is a tabulation of the data on the main pay zone in the Cisco.

From our log analysis we found that this is essentially the only zone that had any porosity within the Pennsylvanian Age in the wells that are producing.

There is a two-foot interval in the Swearingen Number One above where we perforated that was calculated to be productive and it has not been perforated.

On the left-hand side we have the operator name and the lease well name and the well number.

The next column is the Kelly bushing elevation correction.

The next column, then, is the correlative top of the Cisco main pay as shown on our cross section and on the left-hand side would be the log measured depth and the next column would be where we have converted it to sub-sea.

The next column lists the depth or the log depth of the first porosity point within the Cisco main pay. Beside it in parenthesis would be the sub-sea depth

corresponding to the log depths.

The next column, then, reflects the distance from the Cisco main pay top down to the first porosity within the main pay zone.

The next column reflects the base of the porosity within the Cisco main pay zone and we have shown the log depth and the correlative sub-sea depth.

The next column gives the interval from the top of the first porosity to the base of the first porosity for each of these wells.

The last four columns give a porosity feet value and the feet values are in percentage of feet.

The left-hand column there is where it is labeled total and that is the total porosity feet above the three and a half percent cutoff.

In the case of the Amoco Peterson C Number One the core values gave a little higher porosity values than the logs and this number reflects the core data. The rest of the values reflect the log data.

We have, then, subdivided this porosity up into intervals within the oil column and intervals below the oil-water contact and in intervals above the gas-oil contact and, again, in each case we show the porosity in feet and beside it would be the footage.

So, in the oil column numbers those numbers of feet

would represent the feet of net pay.

Q. Anything else on this exhibit?

A. No, sir.

Q. Look at Amoco's Exhibit Fifteen and explain what that shows? I think, again, the ownership on this map is incorrect, am I right?

A. That's correct, all of the maps introduced today --

Q. Exhibit Number One should be relied on for ownership?

A. That's correct. This is a contour map of the total porosity feet and the contour interval is twenty so at ten percent of porosity value this would represent two feet of net pay.

The two wells to the south, The Lambrith well in Section 30, the main pay zone is shaled out and I believe that is shown on one of our log sections. This is also the case in our Amoco Peterson B Number One which is there in Section 29.

Q. All right. You have a similar map, Amoco's Exhibit Sixteen and would you tell what it shows, please?

A. This is a contour map of the Peterson-Penn Field of the gas isopach area and again the contour interval is twenty porosity feet. The zero line on the left and right represents the gas-oil contact and the top of the porosity and the zero lines to the top and bottom represent shale

lapse of the main pay zone or non-porosity development.

Q. Do you have a similar exhibit, Amoco's Exhibit Seventeen, another map, and would you please tell us what that map demonstrates?

A. This is an oil isopachous map for the Pennsylvanian Zone for the Peterson Field.

Again, the contour interval is twenty porosity feet. This maps indicates that most of the oil column in this field is located over on the east side and the largest accumulation in the vicinity of the Amoco Swearingen C Number One when originally drilled was called the Swearingen Number Three.

Perimetering this map we find that about ninety percent of the oil column is located on the eastern side and about ten percent over on the western side.

Q. Any further comments regarding Exhibit Seventeen?

A. No, sir.

Q. In your opinion, Mr. Pease, has this field been well defined by development and in your study have you found that there is adequate control in this field for the conclusions which you have reached?

A. Yes, sir.

Q. In your opinion will the granting -- pardon me -- will the establishment of permenant field rules along the lines of temporary field rules prevent waste and protect

correlative rights and promote the general interest of conservation?

A. They will.

Q. Any further comments, Mr. Pease?

A. No, sir.

Q. One more thing, were exhibits four through seventeen inclusive prepared by you or under your supervision?

A. They were.

Q. That's all of the questions I have of Mr. Pease.

CROSS EXAMINATION

BY MR. STAMETS:

Q. Mr. Pease, we have looked at a awful lot of exhibits here and cross sections and what not and I would like to get back to the cores and the porosity and in just looking at the logs that you have up on the wall here, in general, what we see are very low porosity?

A. That's correct.

Q. Now, you showed this one core this morning from the Exhibit Seven -- Seven F, from the Swearingen Number One at a log depth of seventy-seven nineteen, this core exhibits considerable porosity, vugular type, porosity.

Is the production from this field primarily from rock which looks like this or from rock like these other cores that we have here?

A. I believe it would be primarily from a small interval that represents that exact zone that we have correlated across, in our opinion.

Q. In your opinion does this exhibit a very good interconnection between the vugs -- would that be indicative of very good lateral communication in the reservoir?

A. Yes, sir.

Q. How about vertical communication as well?

A. As far as that one zone is concerned.

Q. What about the cores, do they exhibit vertical fracturing or horizontal fracturing?

A. There were a few vertical fractures in the cores and they have been sealed up. The cores were broken when I saw them -- I saw them a couple of weeks ago.

Q. Is the primarily method of production through in-fill -- through porosity as opposed to -- this type of porosity as in this core as opposed to through fractures?

A. I believe it is primarily that one porosity zone. It's the only interval in which we have made a commercial well.

Q. The point to your exhibits nine through thirteen then was to develop the basis on which you then established the parameters which you have set out in fourteen?

A. That's correct.

Q. And these are the ones that you think are really

significant as far as being indicative of the production capacity of any particular wells in the field and of the field in that particular area?

A. Yes, sir.

Q. Okay. In your opinion is there good intercommunication between the producing wells in the field?

A. Yes, sir.

Q. Do you feel that the field will be adequately drained by the wells therein on the current spacing patterns?

A. Yes, sir.

MR. STAMETS: Any other questions of this witness?

MR. LOPEZ: Mr. Examiner, if I could have a moment with my client?

MR. STAMETS: Yes.

CROSS EXAMINATION

BY MR. LOPEZ:

Q. Mr. Pease, I believe at the last hearing Mr. Rice testified about the communication in the zones and was going to come back with some further information with respect to fracturing data either through core analysis or your log analysis.

I was wondering if you could elaborate on this? Today, I believe, you are saying that the communication in this particular zone is due to its porosity and there hasn't

been any testimony with respect to facturing?

A. There are fractures in the cores. But it's my opinion where the production is coming from is from this main pay zone which primarily has good porosity.

Q. Is the reason you do not feel it's through the fracturing is because either your core analysis or your logs justify an opinion on that point?

A. Well, Mr. Rice will discuss more on the data from the wells, the pressure buildup tests on the wells, we don't see that data.

Q. But you do agree with his testimony which is that this is a carbonate limestone reservoir?

A. Yes.

Q. And would you agree that generally speaking that this type of formation is considered a tight formation and low porosity and permeability?

A. Yes.

Q. And won't that generally suggest a lack of communication rather than easy communication in the zone?

A. It could suggest lack of verticle communication if you had porosity zones spread out vertically as well but this does not appear to be the situation here in the Pennsylvanian Zone.

The only real porosity development we see is this one interval that we have correlated as the main pay zone.

Q. Would you say in looking at your logs that the logs do indicate other zones capable of pay that have not been perforated?

A. Well, I believe I mentioned the Swearingen Number One and there is a zone slightly, maybe, fifty feet above and maybe you can see it -- it's at seventy-six hundred and seventy-nine feet to seventy-six hundred and eight-one or two feet and that had some porosity calculated at twenty-eight percent water.

This zone was tested non-commercial down in the Lambrith Gas Com Number One and I believe that is the basis for it not being perforated here.

Q. I was wondering if you could tell us what the contact -- water content was in the cores?

A. Do you mean the water that was measured in the cores, we furnished that.

Q. I think what we are trying to get at is what method or how you determine in your core analysis as to what the water content was?

A. I did not make that determination. The water analysis that I quoted was from log calculations.

MR. LOPEZ: No further questions.

MR. STAMETS: Anything on redirect?

MR. PETERSON: I don't think so, Mr. Examiner.

MR. STAMETS: The witness may be excused.

(THEREUPON, the witness was excused.)

MR. PETERSON: Amoco's next witness will be Mr. Rice who has been previously sworn.

H. H. RICE, JR.

was called as a witness and having been previously sworn, testified upon his oath as follows, to-wit:

DIRECT EXAMINATION

BY MR. PETERSON:

Q. Mr. Rice, Mr. Pease showed how the core volume study was made and you made a fluid properties study of the reservoir have you not?

A. Yes, sir.

Q. Do you have a summary of the results of this study.

A. Yes, I do. The results of our study of the fluid properties are summarized on Amoco's Exhibit Number Eighteen. You will see there are three curves all plotted against absolute reservoir pressure on the bottom scale.

The first of those I would like to discuss and demonstrate how we arrived at the upper most curve and that is a reservoir volume factor which is the reservoir barrels per stocktank barrels.

We know, at least, at initiation the one point. We

know that a zero pressure, absolute, that curve has to come through one point zero. We are also able to determine our uppermost point through a Bordon correlation.

From that we derive a value of one point eight-six six at our initial reservoir pressure at twenty-seven hundred and twenty P.S.I.

Now, to do a Bordon correlation you must know your gas-oil ratio, initial gas-oil ratio, for which we knew at fifteen hundred and that fifteen hundred, approximate number, was taken from the initial gas-oil ratio produced in the Peterson C Number One and the Radcliff Number One Oil Wells.

You need to know your gas gravity and our gas gravity is point seven-three and you need to know your A.P.I. gravity of your crude which in our case was forty-six and you need to know your formation temperature which in our case was, we know, one hundred and forty degrees.

Now, to derive the shape of the curve between the two end points since we did not have actual fluid analysis of our crude oil in this field we had to rely on similarities.

In our search for fields which were geographically close to the Peterson-Penn we found that we had to go some distance to find production which was similar.

What we settled on was the Empire-Abo in Eddy County as being similar and we also compared to the Three Bar Devonian production which was similar in Andrews County, Texas.

Now, those crudes demonstrated similar gas-oil ratios and the reservoir pressures were similar and our geologists tell us that as a source of the accumulation in all cases we had the Woodford Shale.

So, from those correlations we derived the shape of the curve connecting the two end points.

The next curve that I would like to discuss is the second one down from the top and that solution gas-oil ratio again is plotted versus pressure.

As I said, we knew our starting point of pressure of twenty-seven hundred and twenty-three P.S.I. That was approximately one point five. Now, the scale is on the extreme right, there.

We also know that that curve that has to go through point zero, zero on this plot. From correlation, again, with the shapes of these known curves from the Empire-Abo to the Three Bar Devonian, we derived the shape of our curve.

The final curve, is the compressibility factor and the scale for it is a smaller scale which is shown on the right-hand side, not quite on the right-hand margin.

We use the standing and gas correlation to derive our compressibility factor. To use the standing and gas correlation you need to know your reservoir temperature and your gas gravity which as I have already mentioned we know. They are one hundred and forty degrees Fahrenheit

and point seven three respectively.

Q. Do you have anything further on the curve constituting Exhibit Eighteen?

A. No, sir. I might just mention that of these three factors and they are all important to the additional work we are going to show the one which might vary which we might show by any significant amount would be the reservoir volume factor.

The one point eight six-six is somewhat on the high side. We are going to show the sensitivities later on and we will use a value somewhat lower than that than our initial reservoir volume factor.

Q. Let me direct your attention now to Exhibit Nineteen and explain what you have shown with those calculations, please?

A. Exhibit Number Nineteen consolidated the work which Mr. Pease discussed and also consolidated the formation fluid properties which I have just discussed.

It shows our pore volume calculations of original oil in place and original gas in place.

From the work which Mr. Pease demonstrated where we had the oil and gas isopach maps we were able to perimeter those and with the water saturation that Mr. Pease also mentioned, thirty-one point five, in the oil rim and twenty point five percent in the gas cap we were able to calculate

original gas in place in the gas cap of slightly more than three point eight B.C.F.

The original oil in place in the oil rim we calculated at six hundred and ninety-five thousand barrels, stocktank oil.

Now, the solution gas in place which we can arrive at by taking the six hundred and ninety-five thousand barrels of oil in place and multiply that by the original gas-oil ratio and that would yield a value of slightly over one B.C.F. for a total original gas in place and the summation of our solution gas and our gas cap gas is four point eight-five two B.C.F. per our calculations.

Again, the oil in place originally was approximately six hundred and ninety-five thousand barrels of oil.

The final item shown on Exhibit Number Nineteen is total reservoir and it encompasses twelve hundred and ten productive acres.

Q. You have an exhibit labeled Amoco's Exhibit Twenty and it is styled reservoir pressure data and would you please explain that exhibit?

A. Yes, sir, this is a tabulation of the bottom hole pressure data which we obtained in the field since discovery. Now, we discovered this week that there is one omission and I'll tell you what those numbers are and demonstrate that that does not effect our use of the numbers shown here.

We have in this tabulation in the far left, the first column, it indicates the date that the bottom hole pressure was taken. The second column was the well in which it was taken and the third column is the depth of mid perfs or sub-sea datum in which the pressure was read and the fourth column is the gradient at that depth, this is the gradient inside of our pipe and the fifth column is the pressure at mid perf or datum P.S.I.G., pounds per square inch gauge, and the last two columns are used to correct the bottom hole pressures read at various datum and the common sub-sea datum of minus sub-sea datum of thirty-three ten which coincides with our gas-oil contact.

The first of those last two columns is the actual -- well, it's actually it's the pounds per square inch guage and the final column is the pounds per square inch absolute. The only difference there being the atmospheric pressure.

In order to do the material balance calculations which I'll be getting to in a minute I needed to establish what bottom hole pressures as far as various points in time and tie that to cumulative production as those points in time. For an original reservoir pressure we have chosen to average the Peterson A Number One bottom hole pressure obtained in August of 1971 and the December '72 pressure obtained in the Peterson C Number One and you will recall that this field did not go on full scale production until June of 1976.

The only production which occurred between those two pressures which we collected there was a very small amount of production in the Peterson A Number One when we potentialed it.

In addition approximately five thousand barrels of oil and the associated gas was produced from the Peterson C Number One on potential before we shut it in, also.

MR. STAMETS: How many, five hundred barrels?

A. I don't know offhand what that number was -- excuse me it was between five and six thousand.

MR. STAMETS: Five and six thousand?

A. Yes. It was shut in December 30 of '72, and that well produced eleven or twelve thousand barrels of oil in December of '72 and January of '73, about half in each month.

You will note that those two pressures that we are averaging account for the initial reservoir pressure agrees with one another within forty-seven pounds. This is pretty good agreement and we think that the equipment that we use in the field probably is accurate within half of one percent of the range of pressures read. And the average pressure I should probably point out we arrived at has deviated less than one percent from either of those two pressures that went into the average.

I should probably point out that here in the case

of the Peterson C Number One this was -- we arrived at the reservoir pressure here by extrapolation of bottom hole pressure buildup data.

That is indicated by the star beside the column five along by the twenty-six seventy-eight value. The star indicates an extrapolated pressure.

You will note by the pressures that we have obtained in the field todate that five of them were extrapolated pressures and the other three are dip in pressures after a shut-in pressure of some time.

Now, we have attached to and made part of Exhibit Number Twenty our extrapolation to the static reservoir pressure and in each case what you will find is a curve -- it is a method that we used, is the Horner method, where you plot your T plus delta T divided by delta T against bottom hole pressure.

Now, the T is producing time and the delta T is shut in time and then the delta T in the denominator is also shut in time.

Horner developed the technique of extrapolating this to the point where T plus delta T divided by delta T is equal to one.

We recognize that, if anything, this may give us a slight optimistic estimate of what static reservoir pressure is at these points in time.

If I may just back up here for a minute and discuss the Peterson A Number One, the first bottom hole pressure obtained in the field, that was after ninety hours of shut in time. The only production as I previously mentioned was what we produced on potential. That, again, was after ninety hours and we had a pressure after forty-one hours, it was twenty-seven thirty-nine corrected to the sub-sea datum of thirty-three ten.

So, what we have, then, is that bottom hole pressure for the last forty-nine hours that the well was shut in built up only seven more pounds. We feel very comfortable with that number.

Going down our list, the March 1976, pressure obtained in the Radcliff Number One oil well measured twenty-six eighty-three after ninety-six hours shut in. The only production from the Radcliff Number One was approximately one thousand barrels of oil and two million cubic feet of gas produced prior to that shut in time. Again, we are still dealing with time before the field went into production.

So, the other wells were all shut in. The April 13th shut in pressure on the Swearingen D Number One was obtained when it was potentialed or immediately after we obtained the potential test. After seventy-eight hours the pressure measured there was twenty-six seventy-nine. It varied by only four pounds from the pressure read from the Radcliff Number

One of the previous month.

We averaged those two points to come up with another datum point which we are going to use in our material balance calculations and that is shown there as four one seventy-six.

The next pressure that was obtained in the Radcliff Number One was in February of 1977. That bottom hole pressure or our estimate of bottom hole pressure was obtained by extrapolation using the method I previously discussed and corrected to absolute pressure at the gas-oil contact which we obtained the nineteen oh six values then.

The next two bottom hole pressures on the Peterson A Number One gas well and the Swearingen D Number One which is an oil well both were shut in on March 5th. The pressures extrapolated and corrected to the gas-oil contact are sixteen fifty-seven and seventeen thirty-nine or seventeen thirty-six, excuse me, respectively, and were averaging those two points to arrive at an average pressure as of 3/5/77.

The final bottom hole pressure data we collected was in the Peterson C Number One oil well. We shut that well in June 25, 1977, and from extrapolation of an extended buildup curve we came up with a static reservoir pressure of fifteen hundred fifty P.S.I. at that time.

Q. You mentioned earlier an omission from this exhibit and I don't know if you clarified that or not, Mr. Rice.

Would you tell us about that, please?

A. Yes. The pressure which was omitted was the pressure we obtained on the Swearingen A Gas Com Number One, the second gas well drilled in the field -- the second well drilled in the field, in fact.

This is corrected to the common sub-sea datum and was twenty-seven forty.

Now, we chose to not go back and re-do our exhibit when I discovered the omission this week because it doesn't make much difference. We would have included that in the average of our original pressures and it would have made a five P.S.I. difference in our average. So, we elected not to try to re-do all of our exhibits at that late date.

Q. Thank you. Anything else on Exhibit Twenty which consists of the tabulation on the front sheet and the appended plots of these various wells?

A. No, sir.

Q. All right. I would like for you to turn your attention to Exhibit Twenty-one, please, and tell us what you have demonstrated with that exhibit?

A. Twenty-one, again, is the bottom hole pressure data which we collected in the field. What we have chosen to do here is plot versus time the bottom hole pressure that we calculate for the field.

We have shown the years 1976 and 1977 here and I

want to make sure everyone understands that the initial pressures shown in one and two in the extreme upper left-hand corner were actually obtained prior to 1976. We have shown the dates of those along side those values.

Points three and four -- let's see, going back up again -- on and two, again, one, the Peterson A Number One gas well and number two is the Peterson C Number One oil well.

The next pressures which we obtained were in March and April of 1976 and those were in the Radcliff Number One and the Swearingen D Number One, both oil wells. Now, we did see some draw down in reservoir pressure between those two points. It only amounts to about thirty-one P.S.I.

During the interim that had been approximately thirteen thousand barrels of oil and thirty-five million cubic feet of gas produced and that's all.

The next pressures we obtained were grouped and we obtained pressures in all four of the wells shown here, the one gas well and the three oil wells, at the times indicated and what we are seeing here, of course, is extremely rapid decline in reservoir pressure as we complete this limited reservoir.

We have since initiation of full scale production experienced about a hundred P.S.I. drop in reservoir pressure per month. We have gone from something in the order of

twenty-seven hundred pounds to something in the order of fifteen hundred pounds in approximately twelve month's of production.

It is also significant to note that the oil wells or the one oil well shown here -- the three oil wells shown here and the one gas well shown here are on the same pressure decline indicative that they are probably tied-in to a common pressure source which is an indication, of course, of good communication.

Q. If you would look now to Amoco's Exhibit Number Twenty-two and explain the material balance calculations that you have made on that exhibit?

A. Our first attempt to estimate original oil in place and original gas in place was to assume that we had a volumetrically controlled oil reservoir for the gas cap which is what we believe we have got. All of our data indicates that we have.

Shown on this tabulation are the dates of the pressures which we talked about before and in some cases they are average pressures and some are one-well pressures.

The third column is compressibility factors that coincide with the reservoir pressures at those times.

The fourth column is reservoir volume factors which coincide with those pressures.

The fifth column is the solution gas-oil ratios,

again, coinciding with those pressures.

Now, columns three through five were taken directly from the Exhibit Number Eighteen which we have previously discussed.

The next two columns are cumulative oil and gas to the times shown and the final column on the right is our estimate from this data of the original oil in place from this reservoir.

You can see from our numbers, they vary from a low of seven hundred seventeen thousand barrels of oil to a high of eight hundred and thirty-five thousand barrels of oil.

We have chosen to average the last three points to come up with our best estimate of the oil in place using this technique.

The reason we eliminated the data that had been generated to April 1st, 1976, is because of the very small cumulative numbers that had been produced at that time.

Recognizing that we have an estimate of seven hundred nine-one thousand barrels of oil originally in this gas cap we are able, then, to calculate our solution gas as being our gas-oil ratio times the original oil in place and we come up with slightly less than one point two B.C.F. of solution gas.

Out of the gas cap, we are able to calculate knowing from the work that Mr. Pease presented earlier that we have a gas cap pore volume to an oil column pore volume of two point five

nine four three-three and we are able to multiply that times seven hundred and ninety-one times are various parameters and come up with, first of all, the amount of cubic feet occupied by the gas under reservoir conditions and then converting that to the amount of gas at standard conditions we come up with four point three three-five B.C.F. gas originally in place in the cap.

Adding the solution gas to the cap gas we come up with slightly more than five point five B.C.F. of gas originally in place.

Q. Anything else concerning the calculations on Exhibit Twenty-two?

A. I don't believe so.

Q. Do you have another exhibit, Exhibit Twenty-three which is also a material balance calculation and would you explain that, please?

A. This is a different form of material balance shown on Exhibit Twenty-three.

In this instance what we did was assume that we had a gas reservoir without an oil rim and that it was volumetrically controlled.

Now, we do recognize that we do have an oil rim here but we also recognize that with the ratio of the cap size to the oil rim size and also the ratio of the compressibility of the gas versus the compressibility of the liquid hydro-

carbon that it should give us a ball park estimate of what was originally in place.

We use the same pressure points and the same times and shown in column three are our compressibility factors and in column four is shown the cumulative gas production to those dates and our calculations, then, of the four estimates of original gas in place is shown in the far right-hand column. They vary from a low of slightly over four B.C.F. to a high of approximately five point three B.C.F.

Again, we average the last three points and come up with an estimate of five point zero zero-seven B.C.F. of gas originally in place by this method.

Q. Exhibit Twenty-four is a comparison which you have made and would you explain that, please?

A. Okay. Exhibit Twenty-four is in tabular form and shows the comparison between our pore volume estimate of oil and gas in place and our two material balance calculations of oil and gas in place which we don't have any oil in place under the gas material balance case because we assumed that we didn't have an oil rim.

So, primarily we would just like to concentrate on the first two columns there and notice the comparison between our pore volume estimate and the oil material balance estimate.

Total gas in the case of the pore volume is four point eight five-two. In the case of the oil material

balance is five point five two-nine. Oil in place six ninety-five as compared to seven ninety-one thousand.

The deviation of fourteen percent between the pore volume and the oil material balance is unusual agreement. The fact that our oil material balance shows as much oil as gas in place, in fact slightly more, than the pore volume estimate is indicative, again, that all of our pore volume is tied together and in the pressure data and the performance data it's being generated in this field is very conclusively indicating that this reservoir is one pot and all of these wells are straws in that one pot.

Q. You mentioned earlier, Mr. Rice, sensitivity studies and could you give us the results of the studies that you made with regard to sensitivity?

A. There were two areas that we wanted to check ourselves out on and I mentioned one previously as being the reservoir volume factor.

The one point eight six-six which we used in our calculation to this point is a little bit to the high side. We elected to try a calculation of oil in place using one point seven value which I think I previously mentioned was right in line of what we saw in the Empire-Abo and what we saw in the Three Bar Devonian which were the similar fields that we looked at.

We found that changing the reservoir volume factor

to one point seven increased our material oil balance in place by approximately six percent but relatively insensitive to changes in reservoir volume factor within any sort of a reasonable range.

The other sensitivity that we ran, I mentioned that the method we used to extrapolate to static reservoir pressure from our buildups might be giving us a slightly optimistic value.

To make a comparison we took the data that was generated by the most recent long term buildup on the Peterson C Number One and that well was shut in in June -- June 25th, of this year. We used the Miller, Dies, and Hutchinson method which is another acceptable method of extrapolating reservoir pressure and we came up with a static pressure of thirteen forty-seven P.S.I. absolute compared to fifteen-fifteen that we had by the Horner method which we discussed previously.

The difference there was approximately -- well, it is exactly one hundred and sixty-eight pounds was the difference that it made and the change in our oil in place by the material balance was thirteen percent. It decreased it by thirteen percent. In fact, it gave us a number which was even closer to our estimate by the pore volume method.

Q If you would turn now to Exhibit Number Twenty-five and you have plotted cumulative oil production and

cumulative gas production and would you explain the significance of these calculations that you have made?

A. Yes, sir. What we were attempting to do here is to get some handle on what our ultimate recovery might be.

This technique here is documented in the literature and I have indicated a reference on Exhibit Number Twenty-five as the A.I.M.E. Transaction of 1956, in an article by Mr. J. J. Arps.

What we have is a plot of cumulative oil production versus cumulative gas production both on a log scale and according to Mr. Arps' work we should be able to extrapolate that line to our ultimate gas recovery and define what our ultimate oil production is going to be.

Now, what we have drawn here -- this vertical line that we have drawn here is the gas which we are calculating as being originally in place by our material balance method.

What this shows us is that if we could recover one hundred percent of that gas we would recover approximately four hundred thousand barrels of the original oil in place.

Now, realistically, we don't expect to get one hundred percent of the gas in place but in this reservoir we expect to get ninety-nine point five percent easily. So, we will probably recover something on the order of -- instead of five point five B.C.F. about five B.C.F. in which case we would expect to recover something on the order of

three hundred and eighty thousand barrels of original oil in place.

We have gone ahead through the calculation here of what percentage of the oil that we are going to recover and it is going to be in the neighborhood of fifty percent. This is an extremely efficient recovery mechanism and we can attribute that to primarily about three factors.

We have got a very large gas cap with respect to the oil column and we are getting the benefit of that energy in the gas cap.

We have a high solution G.O.R. and had a high solution G.O.R. originally of about fifteen hundred and we also have a very volatile oil, about a forty-six A.P.I. gravity which all of these factors tend to help us in the recovery of the oil from the oil rim.

Todate, this is as of July 1st, we have recovered thirty-three percent of the oil in place in this reservoir.

From that way we are able to say the maximum oil that we would anticipate being able to recover from July 1st forward would be in the neighborhood of one hundred and thirty-seven thousand barrels of oil. That, again, is if we were able to deplete the reservoir to absolute zero pressure which we are not going to be quite able to do.

Q At the hearing on June 22nd, the question was posed as to whether you selectively shut in any wells and monitored

pressures -- have you atempted to secure any of that kind of data since the June 22nd hearing?

A. Yes, sir. We have not run any interference tests which seemed to be the type of test that was of most interest.

What we did is we did shut in the Peterson C Number One oil well for an extended buildup time on June 25th. Taking the data generated by the buildup we were able to calculate a radius of investigation at six hundred and four point five hours -- after six hundred point five hours, we were seeing by one method a radius of twelve hundred and twenty-five feet which equates to a drainage acreage of one hundred and eight acres and by another method a drainage radius of sixteen hundred and twenty-two feet which equates to a drainage acreage of one hundred and ninety.

The average of those two calculations is one hundred and forty-nine acres.

Now, for reference as to the technique of the equation we used here we would refer anyone interested to the S.P. Monograph Number One, page 116, and for the second one an article by Hurst, Haney and Walker on page 62, in the August 1962 Petroleum Engineer.

Q. And you set out your calculations in Exhibit Twenty-six?

A. Yes, sir, they are shown there.

Q. You also testified at the June 22nd, hearing as

to the economics of drilling a well through to the Pennsylvanian formation in the Peterson field. Have you refined those calculations since that time?

A. Yes, sir. We have, with our new estimates of oil in place and gas in place, we are able to do that. Our cost to drill and complete a well remains three hundred thousand dollars. The cost of pumping equipment remains at twenty-five thousand dollars and I don't recall if it was mentioned on the twenty-second or not but we had included one thousand dollars a month operating expense and assumed that a well to be drilled would produce for two years giving us a total operating cost of, for the two-year period, of twenty-four thousand, giving us a total cost to drill a well and operate it for two years of about three hundred and fifty thousand dollars.

Using the reservoir parameters that we have discussed previously the average PH of point three of four for the oil column and average water saturation of thirty-one point five percent and average recovery in the order of fifty percent and a reservoir volume factor at original reservoir pressure of one point eight six-six, we are able to calculate that our recovery per acre of oil would be eleven hundred seventy-six barrels.

Associated with that oil we would expect to get about ninety percent of the solution gas that was originally

in place. I might need to clarify that. We only expect to get about fifty percent of the oil but if we draw the reservoir pressure down we can get the gas to come out of solution and we expect a high efficiency in the recovery of the gas.

The associated gas, then, -- excuse me, may I back up here and correct myself -- the oil recovery per acre should be four hundred and thirty-three and the gas recovery per acre is eleven seventy-six M.C.F.

The value, then, of the hydrocarbons which we would produce by draining one acre at today's prices is approximately fifty-seven hundred dollars.

We have next divided the fifty-seven hundred and seventeen dollars, actually, into the three hundred forty-nine thousand dollars which we would need to invest and we have come up with sixty-one acres is what we would need to drain in order to get our money back with no return on our investment.

Now, just as a matter of interest we have corrected that by the ratio of our pore volume to our material balance and come up with a value of fifty-four acres.

Q. Any further comments on the economics of drilling wells in the Peterson-Pennsylvanian Pool?

A. No, sir. I might just mention that through all of our work we would be at a loss to know where we could drill

where we could expect to find anything that would approach fifty acres of undrained reservoir. All of our work indicates this is one reservoir and is being drained very adequately by the existing wells.

Q. You also testified at the June 22nd, hearing that making the temporary pool rules permanent would prevent waste and protect correlative rights and serve the interest of conservation. Do you still feel that that would be the case, Mr. Rice?

A. Yes, sir, I do.

Q. Were Exhibits Eighteen through Twenty-seven, inclusive, prepared by you or under your supervision?

A. Yes, sir.

MR. PETERSON: That's all the questions I have of Mr. Rice but I would like to request that Amoco's Exhibits Four through Twenty-seven, inclusive, be admitted into evidence.

MR. STAMETS: These exhibits will be admitted. Are there any questions of this witness?

MR. LOPEZ: Mr. Examiner I am sure that we will have many questions but since it is approaching lunch time I wonder if we could take a break for lunch and come back afterwards?

MR. STAMETS: I was really planning on finishing this up before I eat -- however, in light of the tremendous

amount of material that has been furnished by Amoco in this case we will return at one o'clock.

(THEREUPON, the hearing was in recess.)

MR. STAMETS: The hearing will please come to order. are there any questions of Mr. Rice?

MR. LOPEZ: Yes, Mr. Examiner, I am interested in prsuing Mr. Rice's costs of the actual wells that have been identified back at the time they were completed.

CROSS EXAMINATION

BY MR. LOPEZ:

Q. Do you have that information?

A. No, sir, I do not.

Q. If I suggested a figure of about two hundred thousand back in 1971 and '72, would that be about right?

A. That would probably be in the ball park. There has been considerable escalation in costs since that time. I would have to look to be sure if that was right, though.

Q. If I further suggested that as of this date a million dollars has been recovered from the Peterson C Number One would you feel that was accurate?

A. I haven't checked those numbers. I have no reason to argue with them.

Q. Right. I think when we were discussing economics

we need to look at the actual costs that were incurred and somehow project how it would cost in today's market. I was wondering if you have any additional supporting data as to why you would think you could drill one of these wells today in the Peterson Field and it would cost you three hundred thousand dollars?

A. I am talking now from memory now but what we did in the starting point of estimating cost to drill a well today was that we looked at the last two or three wells that we drilled. We drilled some wells and completed them in '76, and if my memory serves me correctly those wells cost us on the average of two hundred and sixty to two hundred and seventy thousand dollars apiece to go on line.

With the escalation in costs that we have seen over the last year or so the three hundred thousand is a number that we can stand on pretty firm.

Q. When you say to go on line is that without pumping equipment?

A. The three hundred thousand dollars is without pumping equipment.

Q. So, the two hundred and sixty thousand dollars you suggested does that include pumping equipment?

A. That was just the drilling.

Q. And in your opinion what price did you get for the gas today if it was produced?

A. New wells?

Q. Yes.

A. We would get a dollar seventy-five per M.C.F.

Q. Do you know what you are getting on the old wells?

A. On the first three wells that were drilled in the field we are getting sixty-three or sixty-four cents a M.C.F. On the wells drilled subsequent to that we are getting a dollar seventy-five. My numbers were as of about a month ago. I don't think they have probably changed since then.

Q. On the barrels of oil what price are you getting on the barrel of oil?

A. If you will refer to Exhibit Number Twenty-seven we are showing it at eleven dollars and sixty-five cents a barrel.

Q. Are you getting -- are you separating your condensate distillate from your oil and getting a separate price?

A. No. I think I am correct when I say this that this is for the liquid hydrocarbons would be the average price of the hydrocarbons.

Q. You are not separating them out?

A. We are separating them out and our gas is processed through a plant and I am not sure of the agreements that are involved in us getting a share of the liquids that are extracted from the operation. But I can't pinpoint, I guess, for you a price that we are getting for the condensate.

Q. It would be more if you were getting a different price?

A. It would be more, yes, sir.

Q. Well --

A. It would be very close -- we have got -- most price determinations are based on the gravity of the liquid. We are talking about a high gravity crude and a likewise high gravity condensate. So, there is not much difference there so I wouldn't expect that there would be a great deal of difference in the cost for the price that we are getting for it.

Q. In arriving at your material balance calculations what did you estimate to be the water encroachment in the material?

A. None.

Q. Isn't it a fact that these wells are actually making water?

A. Yes, each of the four oil wells is making some water. The majority of the water production, sixty to seventy percent, comes from the Swearingen B Four which has produced water since completion.

The only porosity in that well was a very limited amount which is kind of split half above and half below, approximately, our water-oil contact. So, it has produced water since its initial completion and continues to produce

the majority of the water in the field.

Now, each of the other three oil wells are completed very near the water-oil contact and each of those is producing a small amount of water, that's true.

Q. Isn't it, in arriving at your material balance customary to have some estimate of the water encroachment?

A. If water encroachment has anything to do with the producing mechanism, it is. It has nothing to do with our producing mechanism in our opinion. It is not aiding us in maintaining reservoir pressures.

MR. LOPEZ: No further questions.

CROSS EXAMINATION

BY MR. STAMETS:

Q. Mr. Rice, are the pressure buildup times on these wells long, short or average?

A. Well, in most cases they are in the seventy to one hundred hour range and that may catch all of them, I am not sure. I would characterize them as fairly long-term buildup.

Q. Would you attach any meaning to this length of time for pressure buildup?

What does that mean to you as an engineer?

A. Maybe I don't understand your question --

Q. What does the relatively long period of time for pressure buildup to occur in this reservoir, what does that

mean to you as an engineer? What does that tell you about the reservoir?

A. Oh, you mean if the pressures continue to build at the end of these times?

Q. Yes.

A. That would indicate fairly low permeability.

Q. Is there any indication to you that you were not thoroughly draining the reservoir?

A. No, sir, the work we have done doesn't give us any doubt that we are thoroughly draining the reservoir.

Q. All of your calcuations indicate that the oil and gas are nearly gone?

A. We have produced up through July 1st, about two and a half B.C.F. and, again, our gas in place calculations is about five and a half so we have produced about half of the gas and we have produced better than thirty percent of the oil which we have calculated to be originally in place. This reservoir is not going to have a very long life.

Q. Your production curves tie in pretty well with your theoretical ultimate recovery projection?

A. We have not made an attempt to project our cumulative production but you know to see if we could somehow make that tie but they are declining consistent with the declining reservoir pressure and the oil production is drying up and is consistent with the depletion of the limited oil rim.

Q So, what you show on Exhibit Twenty-five is still just a calculation and does not reflect what you actually predict from production decline curves?

A. Well, from the production data I wouldn't call this a projection of production decline curves but it serves the same purpose. I think we are getting hung up in terminology and I thought you were talking about projection decline curves of the wells.

I was thinking of one thing. We are taking the performance data and we are projecting ultimate maximum possible recovery by this technique here.

Now, there is still a question as to what abandonment pressure will be in this reservoir. We think it will be very low because of the excellent communication we see. But I can't tell you that we will get five B.C.F. of gas or five point eight B.C.F. or four point eight B.C.F. of gas when we ultimately abandon the last well.

Q So, you are saying as part of the response to this question you have got good communication and low permeability and this is going all to have an effect on what the ultimate recovery is going to be at the end?

A. Yes, sir.

Q Do you feel that the pool could be economically developed on any closer spacing?

A. No, sir, absolutely not.

Q Do you feel that closer spacing would result in significantly increased ultimate recovery from the pool?

A No, sir, I do not.

MR. STAMETS: Are there any other questions of this witness? The witness may be excused.

(THEREUPON, the witness was excused.)

H. W. BENISCHEK

was called as a witness and having been previously duly sworn, testified upon his oath as follows, to-wit:

DIRECT EXAMINATION

BY MR. LOPEZ:

Q Would you please state your name and residence again for the record?

A Okay, H. W. Benischek, 1216 Morningside Drive, Albuquerque, New Mexico, 87110.

Q Mr. Benischek, I believe you testified at the earlier hearing of which this hearing is a continuation and were sworn?

A Yes, June 22nd.

Q I believe at that time your qualifications to testify were essentially from the point of view of an interest owner in the Peterson Pool, is that correct?

A That's the way I understood it.

Q. For the record, have you previously testified before the Commission and had your credentials made a matter of record as an expert witness?

A. I have not.

Q. Could you briefly describe your educational and employment background?

A. Okay. I received a degree in Mechanical Engineering in 1937 from the University of New Mexico during the depression years.

I started out with Texaco as a roust-about and as an engineering trainee in the Hobbs area and in ninety days became an engineer with various duties which included bottom hole pressure work, gas-oil ratio work, and well completions and practices and geological studies and electrical logging and did some of the first work done by Slumber-J in this country when they arrived from Paris, France -- or came to Venezuela, and then Louisiana and then Hobbs.

Then, I moved to Ft. Worth after having been Assistant District Engineer in Hobbs for some period of time and Midland and in Hobbs I was the Assistant Division Engineer and worked on evaluations of reservoirs and made recommendations for drilling and then I was moved to the Wichita Falls area and later to the Pampa, Texas, area in connection with some special problems on pumping, mechanically, and pumping, hydraulically, and peraffin problems.

Now, I moved back to Ft. Worth after we completed that and I was Assistant Division Engineer and then I was transferred to Wichita Falls, Texas, as a District Engineer at which time I changed jobs and became an Assistant Equipment Engineer for Consolidated Valtise of Ft. Worth and I wrote specifications and recommendations for the purchase of jammer manufacturing equipment for some of the major military aircraft.

While doing that I had some outside evaluation work that I was doing, consulting work, and then I had a call from Shell Oil Company, Houston, Texas, and wanted to know if I would be interested in a job as a Senior Engineer.

I accepted a job as Senior Engineer with Shell in Odessa, Texas, and I stayed there for some period of time and then at that time I worked in the west Texas area which included the Fullerton Field, Seely-Smith, and some of the southeast New Mexico additional areas.

Now, upon leaving Shell, I became interested -- well, I did before I left Shell, I became extremely interested in making investments, myself in minerals and royalties and I had people in the family to go into business and so I went to work for an independent instrumental well logging company that operated primarily in Texas, California, Oklahoma and some in Louisiana. I also performed some evaluation work at that time.

But during that period of time while I was with the instrumental well logging company I had to do, of course, my own geology. The other work, of course, with Shell and Texaco was as a Petroleum Engineer.

Then, I went to the University of Oklahoma when I had a chance to start teaching and continue with my investments primarily because I didn't want to stay in California. I didn't want to stay in California.

The University of Texas offered me a job and so did the University of Oklahoma and I went to the University of Oklahoma as an Assistant Professor in 1947.

Q. An Assistant Professor in what?

A. In Petroleum Engineering, in Engineer School. I later became an Associate Professor and I was closely associated with Wilbur F. Cloud, one of the pioneers in Petroleum Engineering textbook work and then later Doctor John C. Calhoun, who was Chairman of the Department and is Executive Vice President of Texas A & M.

I then took his place as Chairman of the School of Petroleum Engineering at the University of Oklahoma and I conducted all of the business of the school, budget forecasting and part-time teaching and directing graduate students and being advisor to Ph. D. students.

In 1954, I took a leave of absence for health reasons. Texas Tech found out, the head of the department

there, I know most of the heads of departments in most of the major schools in the United States, or did then, and asked me to come over there and help them out for a year on a contract basis and so, I moved or started moving west for health reasons and I took a year's contract as visiting professor of Petroleum Engineering at Texas Tech which was not accredited at that time.

The dryer climate and lack of moisture, of course, induced me to move farther west after the completion of that one-year contract.

I came to Albuquerque in 1955, after resigning my position at the University of Oklahoma. They asked me to come back and I had to make a decision. The decision was hard to make but I had to do it for health reasons, so, Albuquerque -- I had no job and I went to work for Sandia Corporation and while there I continued doing some work on my own on evaluations and I lectured to a number of engineering departments within Sandia Corporation on deep hole drilling and the effects of pressures, temperatures, and well equipment for sub-surface nuclear devices.

This involved many disciplines as I lectured many disciplines and pictures that came into the room -- I mean different ones that would have answers for different problems that were involved. That, of course, went into shale work and methods of drilling and fracturing of shales and retarding

of tar sands and things like that which is being done down there now.

However, I retired from Sandia, took an early retirement, at my request and continued my work in petroleum and have done some work for Sandia Corporation since I left. I have also worked on estates for attorneys in connection with the evaluation of oil properties and I have been on my own ever since.

Q. When you say you are on your own, that is in the managing of your own investments in the oil and gas business?

A. Yes. I have my own interests in several states -- several with Amoco and several other companies. I should have mentioned, too, that I am also a member of many honorary and professional societies including Tau Beta Pi and Kappa Mu Epsilon which is mathematics and Pi Mu Tau which is petroleum engineering and a member of A.M.I.E. and A.S.M.E. and Who's Who in Engineering and a Registered Petroleum Engineer and I have held offices in several societies.

I could go on --

Q. Well, I think your qualifications are acceptable --

MR. STAMETS: The witness is eminently qualified in Petroleum Engineering.

Q. (Mr. Lopez continuing.) Thank you, Mr. Examiner. Mr. Benischek, now, I think towards to conclusion of the last

hearing the Examiner, Mr. Stamets, requested for you to examine the Lusk-Strawn, Indian Basin, Dagger Draw, and Empire-Abo Pools, is that not so?

A. Yes.

Q. And have you examined those pools?

A. Yes, I did.

Q. What did you find? First, let's discuss the Indian Basin Upper Pennsylvanian Pools.

A. Okay. The Indian Basin Upper Pennsylvanian gas pool in Eddy County is, as stated, a gas pool with six hundred and forty acre spacing and at one time Ralph Borowitz showed cause why one hundred and sixty acres per well was not adequate.

The depth of that reservoir is seven thousand three hundred and seventy-six feet and the spacing remains at six hundred and forty acres per well.

Q. It is not an oil pool?

A. I could not find anything that indicated that it was an oil pool. It is all gas and gas moves through formations better than oil and it is a permeable formation so I withdraw that out.

Q. Do you think it's relevant in any way to this hearing today?

A. I don't think so.

Q. Okay. Let's turn to the Dagger Draw Morrow gas

pool.

A. The Dagger Draw gas pool, Morrow gas pool, is also gas and it is on six hundred and forty acre spacing but three hundred and twenty acre spacing was considered at one time for Monsanto Chemical.

Q. Again, this is a gas pool and has no oil production to your knowledge?

A. To my knowledge there is no oil production in the records of the order that I examined, personally.

Q. So, in your opinion is this pool at all relevent to today's hearing?

A. I do not believe so.

Q. Okay. Let's discuss the Empire-Abo field. I believe it was also mentioned by an earlier witness today as being somewhat similar?

A. Yes. That was mentioned this morning and that is the first time I have heard the comparison by the Amoco witness and it's interesting because I have checked that carefully on my map and I have followed that field as far as development is concerned and according to the Commission's regulations and there is no order and so state rules apply and the spacing is forty acres per well. On a cursory check of my ownership map it also shows that some of the wells aren't extremely large volume wells -- one hundred and ninety-two barrels of oil per day initial potential. A lot of them,

according to my map, are incompleted for commercial oil rates.

Q. Very good. Now, I guess there are two other pools that we need to discuss. The Lusk-Strawn and the Dagger Draw Upper Pennsylvanian.

A. Okay. I'll take the Lusk-Strawn first. The Lusk-Strawn according to my examination is a deep reservoir, eleven thousand to eleven thousand two hundred feet deep. Also, it's a highly factured lime with some vuggy and some inter-crystalline porosity.

El Paso once had requested a one hundred and sixty acre well spacing and the Commission ordered eighty acre spacing and El Paso came in with new evidence, according to the Commission's records, and the Commission approved one hundred and sixty acre spacing for oil.

However, looking at my ownership map I find both forty and eighty acre spacing and low initial potential.

Q. Okay. Now, I ask you --

A. I don't think that it is analogous to our situation, the deeper horizons and the intercommunication and the inter-crystalline vugging and porosity.

Q. Very good. I am glad that you added that. Referring to the Dagger Draw Upper Pennsylvanian?

A. The Dagger Draw, let's see, that's under Order Number 4691 and 4691 C and that's one hundred sixty acre spacing for

oil and according to the map most of the wells -- I didn't check every well -- but I made a cursory check and a lot of them were completed from ninety-nine to one hundred and twenty barrels of oil a day and the significant thing is that the wells made water anywhere from one hundred to one thousand thirty-two barrels per day and this was at approximately seven thousand seven hundred seventy feet.

Now, here again, in this pool according to my information from the Commission, the formation is dolomite which is more porous and probably has more communication and also lime which probably has less communication. That's a general statement, of course.

Q. So, in your opinion this pool can be distinguished from this pool today, the Peterson Pool?

A. Yes, because of different characteristics in the formations that are concerned and we saw that this morning in the exhibits of the geological samples and the porosity and communciation, in my opinion, is much better.

Q. Okay. Now, I'll ask you if you examined the south-east New Mexico Associated Pool lists in Order R-5353, as requested?

A. Yes, I did.

Q. What did your study of that -- the pools listed in that listed order result in?

A. Order 5353 was the one that, as you stated, I was

asked to check, and it's on spacing and I will summarize quite a detailed study that I made of all of the twelve fields including the Peterson-Pennsylvanian that we are discussing today and cover in the summary only the spacing for oil because that is what we are more concerned with than the gas.

The number of fields that are -- a forty acre per well are eight, are eight pools. There are two on eighty acre spacing and one on one hundred and sixty which is the Peterson, the one under discussion today.

Now, if we leave the Peterson in there that means that we have sixty-six and two-thirds percent of the fields for oil on forty acre spacing.

If we take the Peterson out and eliminate it from the summary we have seventy-three percent of the fields on forty acre spacing.

Now, on the one field, South Dagger Draw Upper Pennsylvanian, I would just like to state that there appears to be some conflict in my research between Order 5353 and Order 4691 which states one hundred and sixty acres per oil well.

That would, again, completely change the picture here -- I would use the one hundred and sixty -- I did not ask the Commission about this but I found it in the files -- but I don't know --

Q. Well, regardless, I think the Commission can look this over, their own records, and see if it is one hundred and sixty or three twenty but are there any characteristics of the South Dagger Draw Upper Pennsylvanian Pool which distinguishes it from the Peterson Pool in your opinion?

A. Of course, the Dagger Draw is the one where we have wells completed, not flowing, completed on the pump and I believe we mentioned earlier ninety-nine to one hundred and twenty-five barrels a day and up to a thousand thirty-two barrels of water per day at seven thousand seven hundred seventy feet. It is a poor ecomonic field in my opinion whether it be on either one hundred and sixty or three hundred and twenty.

Q. Is there anything further you wanted to add?

A. I notice that some of these have high gas-oil ratio limits which rather surprised me particularly the one we are talking about the South Dagger Draw Upper Pennsylvanian and it has an eight thousand cubic feet per barrel gas-oil ratio limit which in my opinion is excessive.

There is another one here for forty acres has a ten thousand for the San Andres but of course the San Andres is in a different ball park when we are talking about the different reservoirs, normally, in pool-lites.

Q. Have you developed in additional data in the interim since the case was continued and I refer specifically to a

carbonate oil producing oil pools?

A. Yes, I have.

Q. Could you name the pool and furnish any available reservoir data with respect to it?

A. Well, the closest I could come to it and which I had information was the reservoir which wasn't far from the one that Amoco selected. It was the Fullerton Clear Forks carbonate which consisted of approximately nine producing zones and twenty-five to thirty separate porosity stringers.

I was a Petroleum Engineer involved in the drilling and development of this particular field in the early days from Shell Oil Company.

I have examined the formation samples, carbonates, in this particular field and the reason that I took it was because it has been subjected to extensive technical study.

Mr. Stiles, of Exxon Corporation, stated in paper number SPE 190, eight at eight six one nine eight, in 1976 that individuals stringers of porosity are difficult to map if -- at any one location.

Now, the porosity within the producing section like that of many carbonate reservoirs is not always continuous either throughout the field or from well to well.

Mr. Stiles further concludes among other conclusions that the Fullerton studies may have application in similar reservoirs. The study also indicated significantly a higher

oil recovery with closer spaced wells.

Q. It is your opinion that this Fullerton field is very analogous to the Peterson Pool that we are discussing today, isn't that so?

A. In my opinion, it is.

Q. Okay.

A. I think it is closer, maybe, than the two that Amoco picked. I am not sure but I have done some comparing -- yes, sir, I do.

Q And what is the spacing for oil wells in the Fullerton Pool?

A. In the Fullerton Pool the spacing is forty acres per well and infill drilling was commenced in 1970.

And also here, again, the close spacing strongly supports the non-communication in a carbonate pool. We know that waste would result on a one hundred and sixty acre spacing pattern as in the Peterson Pool which is similar and non-communicating -- I am repeating the same comment.

Q. Do you have any general geology on carbonates?

A. Yes, I do. I have done some research and I have worked with my geologist and I have worked with the logging people -- thickness, continuity and communication and poor space patterns are complex in carbonates.

A number of factors are involved in carbonate deposition. Pay intervals are often separated by impermeable

barriers that prevent communication.

Impermeable beds often have large aerial extent. We discussed this subject during the June 22, 1977, hearing here at the Commission and a number of papers have just recently been published on carbonate formations and all that I have read elaborates on the problems for more pore space study that relates to communication which spacing was stated it was forty acres per well or less.

Q. Now, I think I should refer you to what we have marked as your Exhibit Number One and ask you to identify it and explain it if you will?

A. Okay. Which did you ask?

Q. The Exhibit Number One, the top one --

A. You can all see this and Exhibit One, I think, is an excellent demonstration, a diagramatic sketch, of what we have in the Cisco carbonate formation.

You know, we have drawn, some structures or structural features and we have shown here in the dark areas in dots, I think it will look darker over there, areas representing oil and stringers and layers or whatever you want to call them containing oil.

Here we have a number of stringers. Here in this we show as a little gas cap. Here we show a well producing gas out of the gas cap and here we have a well going through a couple of stringers producing oil in the bottom stringer and

maybe we didn't find it on the electrical log -- electrical logs are extremely tough to interpret in this area.

A Slumber-J man told me that yesterday who came from Paris, France, and who has worked for Slumber-J for many years.

We have another one up here, an oil well, producing from a higher formation. You drill one over here and you don't get anything. In between, now, we have shale or a tight carbonate streak.

I heard this morning in the testimony that there are washed out areas on those logs. That ties in, also, with these shale streaks. These carbonate streaks, that's not porous and is not communicating --

Okay, this is from D. G. Harris from Exxon, Journal of Petroleum Technology, July 1977, is a current geologic concept of carbonate continuity pattern. This is up to date. This month.

The Peterson Pool is an abeyment of the Delaware Basin and the Fullerton Pool, from Exxon, is in the Permian Basin, carbonates on the east flank of the central basin platform.

We also show an oil-water contact which I didn't mention and that varies also as we well know in the Peterson Field -- we have water in some and some we don't.

So, I think that pretty well shows the stringers

and what happens in the Cisco and in the platform in the basin and this is generally accepted.

I believe in the past -- but I picked this recently because Mr. Harris is well established with Exxon and that is from his work.

Q Now, I refer you to Exhibit Number Two and ask you to identify it?

A. Okay. Exhibit Two -- I used this point and I will explain it -- it is not quite large enough to see across the room -- we have here a couple of wells in the Peterson Field and you can probably find them there on your map -- they are on each side of the Peterson C One where I have the major interest as a mineral royalty owner.

Peterson-Penn Field logs the two producing wells showing non-communication between separate pays in each well. What I am trying to do here is to show what we ran into in the Peterson Field going from this Exhibit One.

We have here the Swearingen C Number One, Section 18, 5 South, 33 East, which is the west offset and the acreage dedicated to the Peterson Southeast quarters of Section 18.

This particular well is a Fusselman well and has to be on forty acres, why, I don't know. It is a separate field, you will say, but I still can't see it. It is the same or similar situation.

We have here perforations in March of 1976, a

thickness of eight feet from seventy-eight forty-one to seventy-eight forty-nine and those perforations flowed two hundred and seventy-one barrels of oil per day.

The operator came back in later and in May of 1977, perforated nine feet from seventy-eight twenty-nine to seventy-eight thirty-eight and got one hundred and sixty-four barrels of oil per day, which proves that we had a non-porous dense zone in between -- as we show up here in this diagram -- a total potential of four hundred and thirty-five barrels of oil per day.

There may be more stringers in here, I don't know -- non-communication is verified. It is proven. There was approximately a three foot interval in this case of a non-porous dense zone -- okay --

We are going to emphasize that in the Radcliff Number One, Section 17, 5 South, 33 East, the east offset of the Peterson acreage.

This well is one hundred and sixty acres. In February 1976, the operator perforated eight feet from seventy-seven fifty-four to seventy-seven sixty-two in the Cisco. The well made two hundred and sixty-four barrels of oil per day. Apparently, they didn't find this other pay from their electric logs or else they weren't sure about it because they came back in later and in July of 1976 they perforated another seven feet of Cisco pay from seventy-seven

sixty-two to seventy-seven sixty-nine and that horizon flowed four hundred and twenty-eight barrels of oil per day. So, we have a total initial potential had it all been perforated at the beginning or at the time of completion we would have six hundred and ninety-two barrels of oil per day.

I think that definitely supports our theory of layering and our concept of the stringer concept and it seems to me that the common term is layering right now -- I don't know just why --

But it proves, again, here we had non-communication. We don't know what is in between there -- but surely you would have had some of this oil going into this horizon had there been communication.

That's all I have.

Q. Perhaps at this time it would be well digressing from our general outlined format to discuss the Peterson B Number One well located in the northwest quarter of Section 29, which I believe the exhibit this morning showed to be a dry hole?

A. Yeah, I think that is on a zero pay line -- that was Section 29?

Q. Yeah, the Peterson B Number One -- I think it is shown on Amoco's Exhibit -- to be an abandonment or a dry hole. I wish you would comment on this well?

A. Okay. That's the Peterson B One in the files in Section 29, and this is a very interesting well.

It was drilled in May of 1972, when prices were much lower than they are now and the operator -- I want to run through this so you will get the gist, the thrust, of this thing -- they operated -- perforated from seventy-eight thirty-three to thirty-six, two shots per foot, and acidized with a thousand gallons and swabbed forty-three barrels of water and no shows.

For some reason he perforated that horizon. I don't know if it was on core analysis or electric logging and then swabbed again and twelve barrels of water and five barrels of -- and squeezed and perforated at seventy-seven ninety-four to ninety-seven, two shots per foot with five hundred gallons of acid and flowed six barrels of oil in one hour and died.

Then, at the total depth of seventy-eight seventy-seven they merely plugged back to seventy-eight twelve and in June of 1972, that well pumped fifty-three barrels of oil and one hundred and seventy-two barrels of water in twenty-four hours and how that can be on a zero pay line I don't understand.

On June 23, 1972, it pumped thirty barrels of oil and one hundred and seventy-one barrels of water. On July 7, 1972, or 14th I am not sure which it is, fifty-five barrels

of oil and one hundred and fourteen barrels of water -- this is from seventy-seven ninety-four to ninety-seven -- this is the midsection but I don't know how many stringers are in there. I don't know how many they drilled through.

Then, fourteen barrels of oil on July 14th, pumped, and July 21, seven barrels of oil, and on July 28th, fifty-two barrels of oil.

Then, for some unknown reason they plugged back to seventy-seven eighty-four and squeezed and perforated the Cisco and acidized and swabbed dry. Acidized with eight thousand gallons and swabbed water and swabbed down seventy-seven eighteen fifty-eight and perforated the Upper Cisco again which definitely shows they didn't know where this was for sure -- seventy-five sixty-two to sixty-six and seventy-five eighty to eight-eight and seventy-five ninety-one to ninety-eight and seventy-six oh nine to fourteen and seventy-six twenty to twenty-nine and seventy-six thirty-two to forty-nine and seventy-six and seventy-six sixty to ninety-two and all of this was just two shots per foot and acidized with ten thousand gallons and swabbed one hundred and seventy-eight barrels of water with a good show of gas in four hours.

Then, August 25th, 1972, the roof fell in. They swabbed a half barrel of oil, three barrels of water in one hour from seventy-five sixty-two to seventy-six ninety-two and plugged back, then, from seventy-seven oh five and

temporarily abandoned the well. That is the end of the report and in my opinion that well should have been completed as a commercial well.

Q. Did the price of oil at that time have any effect on the operator's decision to complete the well as a commercial well?

A. Well, I think -- I would have to check the exact dates in my files but I think it was about three dollars and forty-five cents a barrel so that probably had some effect on it.

Another thing, if I recall correctly, I believe they plugged back above where they had the good show and they probably didn't want to spend the money to go back down and pick that oil up at three dollars and forty-five cents a barrel.

Of course, at eleven dollars and sixty-five cents a barrel I think that some independent operator might be interested in going in there and going after that. It is obviously the operators and I don't know if they dropped the lease on that or not. I didn't check the records in Portales.

Q. In your opinion does your sudy support your theory of layering or stringer theory whereas the El Paso witness would be more apt to say a lensing theory?

A. Well, I don't care what word you use, lensing or

layering or a number of words -- it supports it because they have come up the hole in a number of perforations and you can just look at the map up there and this is taken from Exxon and you put the depth on there on the cores and you can almost fit it to that sketch that we have up there on the board.

Q. Now, I hand you what has been marked as your Exhibit Number Three and ask you to identify it for the purpose of the record?

A. Okay, I have a paper entitled Synergism in Reservoir Management, Geologic Perspective, by D. G. Harris, Petroleum Engineer A.I.M.E., Exxon Production Research and by C. H. Hewitt, S.P.E., A.I.M.E. Marathon Oil Company and this is from the Journal of Petroleum Technology for July of 1977, and it is complete with a number of references on carbonate reservoirs and the problems associated with carbonate reservoirs -- it has many references -- plus other charts showing non-continuities -- many charts which I think as you say put in the record and also eliminates the one tank theory of the material balance approach.

Q. Now, how all of this study and description of the two exhibits plus the article we have just referred to, how does all of this information relate to the Peterson Pool?

A. Okay, we have looked at the Amoco Swearingen B One dry hole in Section 29 --

We go back to 20, now, this well in Section 20, the Amoco Swearingen B One, is shown as a dry hole on the map. This well was cored and I just couldn't remember all of the cores that the witness for Amoco brought in and what the depths were.

Nevertheless, I saw some good porosity in one of those cores and this well was cored from seventy-seven twenty-eight to eighty-five and it had good porosity and oil shows and it was cored from seventy-seven eighty-five to seventy-eight thirty-eight and it had scattered oil shows and porosity.

The cores from seventy-eight thirty-nine to seventy-nine lime and shale and no shows.

According to the records this well was shut-in and not plugged and part of the section was perforated and acidized. Now, we could go into a long discussion on that but it supports the theory of layering. In other words, there are two horizons there that had oil shows and good porosity and we had one with no shows. Of course, I am not sure what guidelines they used in recommending where to core. It was either on the basis of geological sampling or they had a instrumental well logging truck on the well in which they could determine whether any hydrocarbons were present and recommended coring -- I don't know -- but there was uncertainty anyway.

Q. Does your study of this particular well verify your position that there is this non-communication in this Peterson Pool?

A. It supports it, yes, sir, and we have more in Section 29.

Q. All right. Do you believe that in regard to this well that there are some stringers that were not penetrated or not tested?

A. It is possible.

Q. Now, let's turn to the Wainoco-Graves Number One in the northwest section of Section 17 --

A. Let's see -- we have already covered this well and so we will go to the Wainoco -- okay -- can I back up just a little bit on this Swearingen B One and make one other statement here -- I can't recall if you mentioned that we discussed the oil that was in that and it was stated on June 22nd that this well was off structure and very strongly advised that this would not make a well and that is when we talked about it that it had the oil in it and it did not appear to be off structrue, either, for that matter, the way I interpret the structure map of Amoco -- okay, that verifies non-communication.

Now, the next question you are asking is the Wainoco-Graves well and that's up in Section 17 and that well had some shows. It did run low. I talked to the

operator and had shows in the testing on that well.

Probably a more prudent well operator might have made a well out of that but I get the impression of talking with the operator that it was a promotional deal.

Q. Isn't it true that it is shown to be completely off the structure on the structure map initially submitted by Amoco?

A. Yes, I am glad that you brought that up, that's correct, it had a lot of oil in it -- apparently it had shows in it -- it was tested because of the oil shows -- so, I don't agree it's off structure.

Q. Now, if we assume the communication position as stated by Amoco during the prior hearing and assuming that there is good communication in the Peterson Pool what effect does it have on your interest in the Peterson C Number One in Section 18?

A. Okay. The Peterson C One would be between those two wells that we have up there in the exhibit and there would be a significant loss of reserves, in my opinion, in the Peterson A One in the northeast quarter of Section 19. That is twenty-seven feet higher on the structure on Amoco's map.

As we well know oil tends to go into the gas horizon where you have more flow or easier flow of materials in a gas horizon than you do in an oil horizon.

I didn't hear this morning from the reservoir people and I am surprised that they didn't come out and talk about wetting and they didn't talk about inhabition and they didn't talk about capillarity and I think that that was purposefully avoided.

As you wet the carbonate strains with oil going up structure to the A One you are going to lose reserves which is going to cost us and it is going to cost the State of New Mexico. It is going to cost Amoco.

MR. STAMETS: I would like to get back to this line of reasoning immediatley before this last statement. I was not clear -- you mentioned the Swearingen A One which you were going to insert between these wells and I would like to have that whole line of reasoning run through. I am not clear on where you started and what you said and what point you made.

A. Well, I think you are backing me up to the point where I said that the Peterson C One if it were on there would be in between. I didn't draw it.

MR. STAMETS: The Peterson C One, now, is the well in the southeast quarter of Section 18?

A. Yes, sir.

MR. STAMETS: Where would you say that lies on your Exhibit Number One?

A. Well, I didn't draw the line across there on the

exhibit and it would be in between there but farther up. I would have to draw the A-A Prime.

MR. STAMETS: Would you place a mark on Exhibit Number One where you feel it belongs?

A. Well, I don't have this in three dimensions. It would be in this vicinity close to this well.

MR. STAMETS: That says number two --

A. Right in here. Okay, I think I did make a comment but you could also look at it also from the standpoint of this which is Exhibit Number One.

MR. STAMETS: Now, where on Exhibit Number One, assuming that we are looking at a glass reservoir from the south where would you place the Swearingen -- Peterson C Number One?

A. Peterson C One as I recall was perforated in one horizon and I would have to check the log to be sure on that but I would place it probably like so.

MR. STAMETS: Over the right-hand green well on your Exhibit Number One?

A. Actually, you would be looking from the east because -- assume -- I did't say this but let's assume that the Peterson A One gas well and this is the Peterson C oil well.

Q. (Mr. Lopez continuing.) Mr. Benischek, so the record will reflect exactly where it is located on the exhibit you are saying that the gas well or what I think is referred to

as the Swearingen -- or the Peterson A One, the gas well, will be the dark line, completed in the gas cap on the left-hand side of your Exhibit One, is that right?

A. Yes, sir.

Q. Your Peterson C Number One would be the well located to the right --

A. It could be either one -- I said this one but it could be either one -- it was perforated and they drilled through layers --

MR. STAMETS: What you have said, Mr. Benischek, is that what you are drawing up there is analogous to the Peterson C One and the Peterson A One?

A. Yes, sir, it was not my intent to make this as those particular wells. It was only to represent an idea -- that was my point.

MR. STAMETS: Okay, I was not clear on the point that you were trying to make and I didn't want to miss it.

A. Well, I may have said Exhibit One awhile ago and I meant it was Exhibit Two. It was the other well in Exhibit Two back in here if you would have a three dimensional --

MR. STAMETS: I believe I understand that.

A. And if you look at this too, looking at it from the south you are going to be looking at this east to the west and what I said when you asked me the question was that I don't know if that is wrong or not -- when I was asked the

question about the loss of reserves I said yes. You have wetting by oil into the gas cap carbonate grains which maybe never will be recovered which is a loss to Amoco and to the State and me. That's common knowledge. Theoretically, this well should be shut in -- both gas wells should be shut in and conserve the energy and produce the oil because as this oil moves up into this gas cap, if you we do assume that this is the Peterson A One, which wasn't my intent but you kind of led me into this --

MR. LOPEZ: And if we assume good communication --

A. Yes, if we assume good communication -- I say that there isn't good communication, of course, but that is also interrelated with the layering concept, so, if you wet these grains you are going to have a problem. That's where your capillary inhabition and I can't remember all of the other factors -- I didn't hear anything about fluid landing or mathematical-molly studies or fission studies or isotopes -- they may have been done but from the information and the information may have been adverse, I don't know.

But I did see some beautiful lines at the break that had some beautiful porosity on it.

Q. (Mr. Lopez continuing.) Mr. Benischek, isn't it also true that this theory or this point that you are currently making about the oil migrating into the gas cap and being lost isn't that point or theory or position wasn't it supported

by Mr. Kerns at the initial hearing on this pool in Case 4962 on May 9, 1973?

A. It surely was. You have the quotes there, I believe. I don't have it in front of me. I can read it. I don't have it memorized but he did say that.

Q. I think that the discussion occurred at page 13 oc the transcript of that Examiner hearing. We will just note it for the Commission.

MR. PETERSON: If you don't mind reading it I would appreciate it.

MR. LOPEZ: All right.

"Q. Mr. Kerns, based on your study have you recommended rules which you feel will protect the gas cap and the oil column and prevent the migration of oil into the cap which could cause waste?

"A. Yes, sir.

"Q. How is that?

"A. Well, I think we probably have a pretty thin oil column here as compared to the gas cap and certainly the reservoir seems to have limited aerial extent and two of the wells are gas wells. We wouldn't want oil column oil to be sucked up and resaturate gas resaturated rock.

"So, with the recognition that the gas wells produce a proportionate oil well and gas limits we favor the oil well very slightly by the production of oil from that well not

being in the formula which should give it just slightly greater withdrawals than the gas wells would have and would therefore keep away from the prospect of oil migrating up structure and resaturating the gas cap."

A. That's pretty clear.

Q. (Mr. Lopez continuing.) Mr. Benischek in your experience if this pool were located in Texas would the Texas Railroad Commission shut in the gas wells?

A. They would shut them in.

Q. Okay.

A. I have production in Texas.

Q. All right.

A. If I don't get some more -- if I lose this I will have to go back to Texas.

Q. Okay. Let's get back to -- now, let's take another tack -- what do you estimate the oil reserves to be on this Peterson C One based on forty acre spacing and no significant loss of reserves to the Peterson A One which you have no interest?

A. I estimate three hundred and ninety thousand barrels based on the testimony of Mr. Kerns of Amoco.

Q. What do you estimate the oil reserves to be on forty acre spacing considering the testimony of Mr. Rice of Amoco on June 22, 1977?

A. Fifty-six thousand barrels.

Q. And how many barrels have been produced?

A. According to my statements that run from Phillips and Amoco, the total runs from June of '77, was seventy-two thousand eight hundred seventeen point nine-seven barrels which is in excess of the reserves computed during the testimony of Mr. Rice.

MR. STAMETS: What was the date that was covered to?

A. The total runs were through June 1977 that I gave and the figure was seventy-two thousand eight hundred seventeen point nine seven barrels and this is taken directly off of my statement of runs.

Q. (Mr. Lopez continuing.) Were some of these wells shut in --

A. Including Phillips because Phillips ran the oil at the beginning and then Amoco got in it and they got the one hundred and sixty acre spacing and cut me in half and that is when I found out what happened to me.

Q. Was some of the production shut in at the end of June?

A. Yes.

Q. I believe it was testified to this morning that in order to take bottom hole pressure tests some of the wells had to be shut in at the end of June, isn't that correct?

A. Shortly after the hearing on June 22nd, here at the

Commission the testimony this morning indicated that the wells were shut in up to some number of hours -- I think it was a little over seventy-two, I believe, which means, of course, that the wells couldn't be produced and put on line at that time.

I have another source of information for that, if needed.

Q. All right. Do you believe the investments in the Peterson C Number One to be economic?

A. Definitely yes.

Q. Okay.

A. Total oil and gas revenues for June 1977, for oil, May 1977 for gas, was nine hundred ninety-nine thousand one eighty-three dollars and eighty-six cents and it is now since the June gas runs would be in and July is over would be well over a million dollars, one well.

Q. So, of course, the well has clearly paid out by maybe as much as five times, is that not so?

A. That's possible based on the cost of the well at that time, yes, when it was drilled. It paid out a number of times after taxes and royalty and operating expense.

Q. Even considering Mr. Rice's testimony and accepting it, it will have paid out three times after taxes and royalty and operating expenses at today's prices?

A. Yes, even at today's prices.

Q Do you believe his statement that fifty acres is required for a well to break even is accurate?

A. I think it is an error.

Q. In your opinion, as you earlier testified, and in today's market would it be economical to complete and produce those wells and -- let's discuss specifically the Peterson B Number One in Section 29 which I think has been indicated to be a dry hole or an abandoned hole and the Swearingen B One in Section 20, which also has been shown to be a dry or abandoned hole?

A. There is no question about the well in Section 29 that it would be profitable and the Swearingen B One probably would be but for me to make a firm statement I would have to have some more information but it looks like it should be based on the contours and our layering concept which we have discussed earlier.

Q. Okay. Were you provided all of the information by Amoco as Mr. Peterson stated he would on June 22nd?

A. No, I was not.

Q. Did you request certain production data?

A. Yes, I did.

Q. And what was that?

A. On July 11, 1977, I did receive some information that I had requested, current production data, on oil and gas. I received in the mail a copy of the forms that go to the

Engineering Office in Hobbs with a letter dated July 12, 1977, and this covered data for oil and gas through April and May and June was withheld, it was not given to me.

Consequently, I did not request any additional or any other kind of data or anything or do I want anything else now. I have enough to satisfy me in concluding a case in my favor for forty acre spacing.

Q. Do you have anything else that you would like to add?

A. Yeah. I do. I want to emphasize that carbonate reservoirs are characterized by extreme heterogeneity and porosity and permeability often within a single pool.

They range from vuggy and fractured types to highly stratified and often vertically discontinued reservoirs. Separate stacked porous zones as we see up there are common and usually only a small gas cap is noted and a few structurally high gas wells which is per our example.

High initial production rates from wells in carbonate pools are common and the flow is then dependent on the reservoir mattrix permeability.

Q. Is it also typical of carbonate reservoirs that there is initial high potential with a falling off to more steady production rates?

A. Yes.

Q. In your opinion unless the order granting special pool rules for the Peterson Pool is recinded will correlative

rights be violated and will there be waste?

A. Yes.

Q. Were Exhibits One through Three prepared by you or under your supervision?

A. Yes, they were.

MR. LOPEZ: At this time I would offer our three exhibits into evidence.

MR. STAMETS: The exhibits will be admitted. Does that conclude your direct testimony?

MR. LOPEZ: Could I have a second -- that concludes our direct examination and I would like to make a brief closing statement.

MR. STAMETS: You are always entitled to make a closing statement and I would like to make a clarification for the record as to my part in Mr. Benisheck's study -- in the original hearing Mr. Benischek made a statement on page 25 that a carbonate reservoir does not normally have good horizontal and vertical communication and he went on at some length about that.

On page 40 I asked Mr. Benischek if he had -- I said you have discussed carbonate reserviors and did submit a paper concerning the reservoir data and then I asked him if he had studied any of the New Mexico carbonate reservoirs and I named some at that time and I don't find any place in here where I directed Mr. Benischek to make that study, so, I

would like to have that clarified for the record.

Are there questions of Mr. Benischek?

THE WITNESS: I took it as a directive.

MR. STAMETS: Be that as it may, are there any questions of the witness?

MR. PETERSON: Yes, Mr. Examiner.

CROSS EXAMINATION

BY MR. PETERSON:

Q. Mr. Benischek, I asked you in the first hearing, I think, and my first question was do you feel that the drilling of unnecessary wells constitute waste and I am not sure that you answered that question to my satisfaction and I would just like an answer to that if you could?

A. No, I didn't give you a complete answer on that at that time -- the drilling of unnecessary wells, I am going to reverse on you if you pull and flip-flop on me -- it can cause waste.

Q. All right, thank you.

A. In non-porous zones -- there is more to it. You made a general statement and I gave you a general answer.

Q. Good. Do you have any evidence of horizontal discontinuity other than your very general publication which is up to date, I will admit, but do you have anything with regard to this reservoir that indicates horizontal

discontinuity between --

A. Discontinuity?

Q. Yes.

A. I think it is pretty obvious from some of these preforations in these wells. Your diagram of the top of the Cisco pay, you have a drawing this morning -- I have got that memorized pretty well in my head -- the Cisco thickness as it goes across the field and there have been other horizons that have been perforated that produced oil. So, I think that is supporting evidence.

Q. Doesn't that go to your vertical theory -- I am at a loss to see where that shows that there is horizontal discontinuity between wells?

A. I have shown up here if that is what you are referring to in my exhibit up here that you have -- don't have continuity because of the stringers.

Q. How have you shown that? I understand where that came from but I don't understand how that relates to any study you have made of the reservoir -- I understand how it could apply but how are you so sure that that does apply?

A. It has to apply -- vertical has to apply -- we have it right there -- horizontal must apply because we have additional oil that we have found in new horizons Amoco has in new horizons in new stringers.

Q. And you still say that that is evidence of horizontal

continuity?

A. I don't like to mix apples and oranges.

Q. I would like to have them separated. Do you have anything that shows evidence of horizontal discontinuity?

A. I will repeat my same statement -- I have an expert who has a long background here --

Q. Well, you are the expert and I would defer to your opinion --

A. It's under my supervision I have been getting this information, Mr. Peterson, and it is pretty obvious that what you have re-perforated in a lot of these horizons and in the Fusselman in these wells that I talked about this B One -- as evidence of discontinuity --

Q. All right, thank you, Mr. Benischek. I am interested in your comparison between the Fullerton Clear Fork and this field and I am impressed by your expertise in the Fullerton Clear Fork but to me as a layman I don't see how that field could be remotely compared to this field. This field is so limited in area there are not any other proven zones besides from the Fusselman completion in one of the wells?

Do you think that it is valid to compare the Fullerton Clear Fork Field with the Peterson Pennsylvania Field?

A. We have a carbonate reservoir and we have a number

of stringers and similar deposition --

Q Your main point, though, is completion and spacing and you made a big point of the spacing of the Fullerton Clear Fork Field but that also relates to the number of zones plus it's, I contend, a completely different reservoir and that's a layman speaking, but I am just wondering how you happened to pick that field other than the fact that you are very familiar with it?

A. Well, naturally that is one of the reasons I picked it but it is also because I know what the reservoir is and in my opinion it is similar from a geological standpoint and from the producing characteristics of it and the drill stem tests and the initial production. Yes, a thicker horizon. I don't know how much horizon you have got there in the Peterson -- how many stringers you have got in that field -- sure, it's a small reservoir but maybe that reservoir is a whole lot bigger -- well, I won't get into that.

Q. Are you talking rank wild-cat now, Mr. Benischek?

A. Well --

Q We can always search for oil and gas -- nobody will argue about that but would a prudent business man think that there was some bonanza down there that Amoco hasn't found -- we are always out to make a buck and we would be glad to --

A. Yeah, I wish you would --

Q Okay --

A. If I were working for a major company, or an independent -- I would again take another look at the geophysics -- and I understnad that you have done a lot of geophysics in here -- I would first put another well right down here on me. It might be gas and it might be oil -- a good hunch is the oil -- I am not in one hundred percent agreement with your oil-gas contacts, either. I didn't get into that. But I am not in one hundred percent agreement because you don't have enough control on this map or did Mr. Rice, the last testimony.

Furthermore, some of these contours aren't right. You asked me the last time whether I agreed with this map --

Q We can all differ on contours --

A. We can differ -- this is wrong, this is definitely wrong here because these contours should come around -- you have got a thirty-four hundred and a thirty-four hundred over here and this should come around -- this is false -- as a matter of fact I think you have changed this from the map that we had this morning.

Q You have gone far beyond my question and I appreciate the elaboration --

A. Well, you asked me about drilling wells --

Q Well, you pointed to your neighborhood and I would like to -- you mentioned that you calculated that the

Peterson C One reserves were three hundred and nine thousand barrels. Do you have that calculation available or could you tell us how you calculated that -- this was back in your earlier testimony? I don't think we were quite on the same wave length --

A. I would like to preface my comments on this calculation because I think you are going to bring it up later anyway -- by the fact that your material balance calculation is inoperative on a stringer field. Mr. Craig of Amoco International has also written a paper in which he discusses the very subject -- for the materials balance approach has led to the layering approach in separate reservoirs as we have up here. I am sure that you know Mr. Craig -- he is the President of the Society of Petroleum Engineers. He and four other people, I think, of Amoco that I have reference --

MR. STAMETS: For purposes of brevity of the record I would like to leave out all of these chiefs and heads of societies and get right down to the facts. We are talking about one pool here and let's keep it on that basis, please.

A. Okay. I'll repeat that I stated this because Amoco used the material balance approach and it is not operative on a multi-layered reservoir. It is only operative on that one horizon of the Cisco plane or Cisco carbonate that Amoco has drawn on that map. It won't work on all of them. It works on a single tank as pointed out in this article and

I am sorry that I -- I brought that up for emphasis because it is in that article. Okay, so I will use the volumetrical approach and I notice that Amoco used both. They also did some mathematical modeling or simulation, I have forgotten which it was on the computer. In order to arrive at that as I have stated before at the last hearing I used twelve percent porosity as Mr. Kerns said and twenty-three feet of pay.

Q. Is this gross pay section counting every square half an inch?

A. I am not supposed to ask question but I assume that you perforate everything that is porous. That's what I would do if I was in the field.

Q. You are talking about sections and you are not talking about intervals are you?

A. I am talking about twenty-three feet perforated at porous -- good porous -- you wouldn't perforate -- your engineer wouldn't recommend perforating a non-porous section.

Q. Have you examined the core samples from the Peterson C -- the core data, pardon me, to determine how much of that you would deem to be porosity?

A. No, I didn't have the cores. I didn't call you back for additional information because I assumed that I wouldn't get it.

Q. I am sorry that I slighted you, Mr. Benischek, if

you would have let me know we would have provided you anything and I think we extended that invitation and I don't want to get into that -- if you feel hurt, I am sorry and I apologize.

A. For the record I didn't get what I asked for.

Q. Well, we have submitted it today and have you examined it?

A. I haven't examined what you have submitted today and furthermore -- well, I didn't have the opportunity to examine that. I didn't ask for the cores and I have looked at the information from the files and I have looked at the electrical logs and the electrical logs normally only provide one fourth of the information as stated by the Slumber-J expert and the other information has to come, of course, from core analysis that you are asking about or instrumental well logging and samples and drill stem tests. So, I have to take the twenty-three feet because I have nothing else to use and I assume that that is what your engineer recommended out in the field.

I'll try to stay on the subject so the Examiner won't be on me --

Q. You testified just a moment ago that based on Mr. Rice's testimony that on forty acres in the vicinity of the Peterson C One you could recover fifty-six thousand barrels of oil. Based on his calculations, but how did you arrive

at that figure?

A. The way I arrived at that he used four percent porosity and ten feet of pay, I believe it was, yes, ten feet of pay and I think this morning by one of your witnesses is that somewhere around a percent of porosity or a little bit less than that could throw it out and so you wouldn't even consider it and in your consideration of remodeling -- I don't recall -- you had so many -- that's what I used.

Q. Well, the production from the Peterson C One has greatly exceeded fifty-six thousand barrels has it not?

A. Yeah, I gave that --

Q. Where did that additional recovery come from?

A. I just said that I don't compute fifty-six thousand. I compute three and some thousand. I don't use the fifty-six -- I don't acknowledge that figure --

Q. You also mentioned a loss of reserves through the Peterson C One, what is your basis for that statement?

A. Let's see, I believe it's A One, I thought you said C One --

Q. I did, I thought you said Peterson C One --

A. Well, from the C One to the A One --

Q. Okay, from the Peterson C One? What is your basis for that statement?

A. My basis as I said up at the exhibit in that field we have separate gas caps and I don't -- this word associated

I don't want to be that technical but we have a separate horizon up there and as we well know from permeability studies gas flows much better through formations than oil does and you are going to have some oil moving up in that gas zone. That is very common and you are going to lose some of that to the Peterson A One well and it will not be recovered by the Peterson C One.

That's why I said a little while ago when he asked me and if he wanted to make some money to drill another well south of C One and you will make money, Amoco will make money.

Q. All right. You don't agree with the fifty acre pay out for using -- which Mr. Rice testified to -- what basis don't you agree with that fifty acre?

A. Well, I can't agree because based on my calculations you used four percent porosity and ten feet of pay and only get fifty-six thousand barrels and it just won't work because it has made seventy some thousand already.

Do you want me to elaborate on that?

A. That's all right. I would like to clarify one thing and again I don't want to testify but you mentioned Amoco compared the Peterson Pen Field with the Three Bar Devonian and Empire-Abo and I think -- we could have it read back -- but I think that the purpose was for the comparison of the crude in those fields and in the Peterson Penn Field. It

wasn't meant as a comparison in any other respect but because of the crudes in those fields.

I don't have any further questions, Mr. Examiner. I would like to redirect Mr. Rice on a couple of questions if I could?

MR. STAMETS: I have got a few questions and then we can have some redirect.

CROSS EXAMINATION

BY MR. STAMETS:

Q. I would like to know when the field went on production. Mr. Benischek, do you have that information or would one of Amoco's witnesses have that --

A. I can give that to you exactly if you will bear with me --

MR. RICE: Field wide production commenced in June of 1976.

A. That's field wide. There was production prior to that by Phillips, but field wide, yes.

MR. RICE: There was some small production in the wells which you have major royalties -- and small production for test purposes only in some of the other wells prior to that time -- I can give you an accumulative production as of April 1st, 1976, if that would be helpful to anyone --

A. I have got it here if the Examiner will --

Q. The records will reflect that and we can go back to those if necessary, thank you.

So, if we look now at your Exhibit Number Two, Mr. Benischek, at the right-hand side we see that the Cisco pay in the Radcliff well, the lower Cisco, and I use that term, is perforated, then, say within a month or six weeks after the field as a whole was put on production?

A. Looks like five months.

Q. I believe Mr. Rice said that the field went on production in June of '76, April, and this says it was perforated July 15th, '76 --

A. Okay, that's correct. If I understood your comment correctly that was perforated shortly after the field went on.

Q. Right. I wonder if we would expect to see any significant -- you had indicated that the production level was high enough in the perforated interval to indicate that there had been no drainage from the upper intervals and I was wondering if this field had been on long enough to cause any drainage from the upper zones?

A. It was produced. We have to get into Darcy's law and radial flow and some pretty fancy equations to figure that one out. Amoco may have it, I don't know.

Q. We don't have any figures before us on how much was produced out of this well before 7/15/76?

A. I don't.

Q. Again, the records will reflect that and we may be able to see that significant volumes were produced or were not, anyhow --

A. I have information -- I do have daily rates -- but you want cumulative?

Q. Yes.

A. I don't have that. That's in the records.

Q. As we look at these exhibits on the wall here for Amoco and there are other exhibits it would appear to me that you have got something on the order of seven wells perforated in this pool.

Looking at the exhibits all of the Cisco wells seem to be perforated in what they call the Cisco main pay with the exception of the Peterson A Gas Com Number One --

A. This one --

Q. And it seems to have some other Cisco perforations outside of the main pay --

A. I assume those are the perforations here, Mr. Rice?

MR. RICE: That's correct.

A. Yes, they do have some perforations outside the Cisco pay.

Q. So, of the wells we have producing we only see one where Amoco has actually perforated outside the main pay. Is

this indicative of many isolated layers in the area or is it indicative or not of many isolated layers in the area?

A. Well, we have got a few wells here and if you look at the records to define perforations in a number of different horizons in many wells that indicates that they had some reason for perforating them and we have five wells here.

I don't know how many wells they perforated. I read off one that made a lot of oil that was abandoned for some reason, I don't know why, and it was perforated in a number of horizons on this map.

Q. I believe Exhibit Number Four of Amoco's indicates that every producing well in the field is represented on the cross section?

A. Every producing well?

Q. I believe that is what the exhibit shows --

A. You used plural sections and some other places, different places -- I know these perforations in many horizons and I checked the records and I spent a lot of time in the office here and here are some of these other wells up here, I guess -- perforations here and here in the pay and I am wondering if they are all on here because I have many horizons perforated that I read off there awhile ago and using that well, that bottom well, as an example -- the south well -- I believe this one here is an example to

show -- is that this well?

MR. LOPEZ: It's not on the cross section, Mr. Benischek.

A. Okay, there are a whole bunch of zones that are not on that map, so, apparently Amoco doesn't have them all on this map -- you said producing wells, didn't you? I say that would have been a producing well. I say that that would have been a commercial well -- eleven dollars and sixty cents -- I am in the royalty business, I am not in the drilling business -- if I were I would talk to you.

Q. (Mr. Stamets continuing.) Let's get back to the question at hand is what you see on these cross sections that the zones that are perforated, is that indicative of many layers of porosity throughout this area or is it more indicative of very few layers -- maybe one layer that is pretty general and a few isolated layers in one well that are separate?

A. In my opinion they have -- I don't like to identify this diagram with this field, but it looks like it almost follows the layer that I have here which was made up before I saw this map. I didn't make one of these, so, there is a possibility -- I still think that quite a few layers because of the perforations in the number of wells, some of which were abandoned, which you said were producing wells, but we have abandoned wells that I repeat that had a lot of oil

lost -- I doubt that they were in this band because the perforations were so wide. These are pretty narrow bands in here, except this one here that you say is below the main pay.

Q. Let me ask you now about what is called the main pay.

Do vou feel from your studies that this is made up of a lot of discontinuous layers that will not be productive from well to well or is this more or less of a continuous layer in the field?

A. I wish I had the draw-down data from Amoco. I don't think they produced that today and I would answer that question.

You asked for that information and I don't believe we got it. I'll have to assume that we are talking about one stringer that is producing in this Cisco pay and there are probably other stringers that would produce as shown down here in the section down at the bottom, to answer your question -- I believe I answered your question, anyway.

If I didn't, I'll rephrase it.

Q. I wish you would because I didn't get an answer out of that.

A. Okay. It apperas that Amoco has contoured a pay similar to what I have got over here on this sketch which I will not say one hundred percent sure is continuous all of

the way -- they don't know -- nobody knows -- that's why I hate to compare that with this because this shows a continuous all of the way and it wasn't my intent to make that in the Peterson Field. It may be continuous but I am not confirming that.

Q. Now, have you made any calculations of fluid withdrawals both gas and oil from this pool which would indicate to you that oil is indeed moving upstructure and wetting reservoir rock?

A. There again, we need the tracer studies.

Q. I take it the answer to that question is no?

A. Base on my background I am sure that there is movement of oil upstructure to those high wells. I have worked in this business long enough to know that oil will move into a zone where you get a relative permeability curve and that you are going to have loss into that. But for this specific one, no, sir, I don't have the data and I can't answer that. I mean, I can't say that but in my opinion I think any witness that you might call on the stand would say the same thing.

MR. STAMETS: Are there any other questions of the witness?

MR. LOPEZ: I just have, maybe, two questions on redirect, Mr. Stamets.

REDIRECT EXAMINATION

BY MR. LOPEZ:

Q. Mr. Benischek, in your opinion is there any reason for the Amoco's Swearingen C Number One well which is located in the southwest quarter of Section 18, and which has forty acres dedicated to it, is there any reason for that well to remain on forty acre spacing while the rest of the wells in the Peterson Pool, i.e., those wells in the remaining portion of Section 18, Section 17, 19, and 20 -- I guess there are no oil wells in Section 19, so, the oil wells in 17 and 20, would remain on one hundred sixty acre spacing?

A. No, I don't understand it. They have done it because they say there is a gas cap here but to start out on forty acres per well and that is customary spacing and this is forty acres per well and I think that the others should be forty acres per well -- per oil well.

Q. I believe Mr. Peterson asked you about any evidence of horizontal discontinuity -- in your opinion does much of the evidence submitted by Amoco this morning with respect to low porosity result in their core drill studies would this indicate evidence of horizontal discontinuity?

A. Yes, it would because they had porosity that was real low. I had forgotten about that real low figure that some people throw out and permeability figures down to one or two millidarcies, I believe it was, and one or two percent

in some of those cores and that wasn't out in the middle of the field, that was in the cores.

Q. From your experience is it your opinion that a carbonate limestone reservoir is generally a tight or a reservoir that you would describe as a low permeability and porosity?

A. Usually -- the characteristics.

Q. Do you find anything today that has been submitted that would suggest that the Peterson pool is different than what is generally the case or is all of the evidence that you have studied so far indicative that the Peterson pool is a tight reservoir, that is, a reservoir of relatively low porosity and permeability?

A. I still think that that is the case and as you have pointed out the core information that is brought out today helps to support that, that thesis.

MR. LOPEZ: No further questions.

MR. STAMETS: Any additional questions of the witness? He may be excused.

(THEREUPON, the witness was excused.)

MR. STAMETS: Mr. Peterson, do you have something on redirect?

MR. PETERSON: Yes, sir.

H. H. RICE

was recalled as a witness, and having been previously duly sworn, testified upon his oath as follows, to-wit;

REDIRECT EXAMINATION

BY MR. PETERSON:

Q. Mr. Rice, Mr. Benischek testified and called attention to Mr. Kern's earlier statement in the initial hearing in this matter regarding oil encroaching, if you will, into the gas cap thus causing waste.

Do you have any comments regarding that and also perhaps in support of Mr. Kern's testimony?

A. Yes, I do. First of all, the way Mr. Kern's testimony was read gave the implication that he testified that there would be oil moving into the gas cap.

We have done some work with the cumulative production numbers that have been generated todate and if you will recall from our pore volume work we showed that the gas cap pore volume production was about two point six times the oil rim pore volume.

We have taken the cumulative withdrawals from the two gas wells and the cumulative withdrawals from the four oil wells and we compared them on a reservoir volume basis to see what their ratio is.

In our cumulative through April of 1977, was a ratio of one point six-six, that is if the gas wells removed one

point six-six times the pore volume removed by the oil wells.

This is considerably less than the two point six ratio of the gas cap pore volume to the oil rim pore volume and therefore supports the idea that the gas cap is not shrinking and we are not having resaturation but, in fact, the gas cap is expanding.

I might also mention that we ran a calculation for one month and we ran it for April as well and the number came out one point nine-four still well below the two point six, the ratio of the gas cap pore volume to the oil rim pore volume.

MR. PETERSON: Thank you, Mr. Rice, that's the only question that I have.

MR. STAMETS: Any questions of Mr. Rice?

MR. LOPEZ: No questions.

MR. STAMETS: The witness may be excused.

(THEREUPON, the witness was excused.)

MR. STAMETS: I believe you indicated that you had a closing statement, Mr. Lopez?

MR. LOPEZ: I don't want to jump ahead of Mr. Peterson if he wises to proceed?

MR. PETERSON: I'll reserve comment due to the lateness of the hour I am sure that mine will be rather brief.

MR. LOPEZ: Mr. Examiner, your last statement is probably as to how I will begin my statement and I do feel that Amoco has a substantial burden to carry in this case.

The general rules adopted by the Oil Conservation Commission calls for forty acre spacing and anything that does not comply with that spacing, I think, there is a substantial burden on the applicant to show otherwise.

I feel that our evidence today shows that typically a carbonate limestone formation is a tight reservoir. It does not have easy communication.

I think the evidence further shows that not only do we have lack of communication but as Exhibit One shows there is evidence that there are stringers, not from any of the wells on the diagrams, but from specifically that well in Section 29 which you had identified and which was completed in several horizons which have oil shows in each horizon which at today's market price would no doubt constitute a commercial well.

I also believe that Mr. Benischek has shown by studies of other pools or reservoirs where the spacing rules or the spacing requirements that vary from the forty acre spacing are different from the Peterson pool. Either there is good communication in those reservoirs or they are not carbonate reservoirs or the economics of the pool, that is, the depth and the pore initial completion and pore average

daily production do not justify drilling wells on more than one hundred and sixty or eighty acre spacing.

I feel that as we have shown in the well in which Mr. Benischek has an interest is at least five times paid out. We feel that if his theory is correct, which we believe it is, that other wells will certainly pay out especially at today's market prices which Mr. Rice has testified to be a dollar seventy-five per M.C.F. and eleven dollars and sixty-five cents for a barrel of oil.

With that, I would request that the order be rescinded and that the general rules of the Commission apply to the pool with respect to oil and gas.

MR. PETERSON: I'll keep it very short. I think we have here a divergence between the royalty interest owner and the expense bearing interest owner which is unfortunate, indeed, but it is a fact of daily life. Amoco, I'll give you every assurance and I hope that we have shown that we have our hand on the pulse of this reservoir and we have done a lot of work -- admittedly, we hadn't up until very recently -- but all of our initial indications, I think, have been born out by further study and intensive technical effort. Just a whole bunch of people have and I am very proud of that effort and I am sorry that we are in basic disagreement with Mr. Benischek. But, it's easy to spend other people's money and I think we have proven beyond a doubt that any other

wells in this field, if the acreage was diminished to forty acres would be unnecessary.

It is a short-lived deal and one hundred and sixty acre spacing is the only spacing and we would urge that the temporary field rules be made permanent as now constituted. That's all I have.

MR. STAMETS: I appreciate it. The case will be taken under advisement and we will take the next case.

(THEREUPON, the case was concluded.)

REPORTER'S CERTIFICATE

I, SIDNEY F. MORRISH, a Certified Shorthand Reporter, do hereby certify that the foregoing and attached Transcript of Hearing before the New Mexico Oil Conservation Commission was reported by me, and the same is a true and correct record of the said proceedings to the best of my knowledge, skill and ability.

Sidney F. Morrish, C.S.R.

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General Court Reporting Service
825 Calle Mejia, No. 122, Santa Fe, New Mexico 87501
Phone (505) 982-9212

BEFORE THE
NEW MEXICO OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
July 6, 1977

EXAMINER HEARING

IN THE MATTER OF:	
Case 4962 being reopened pursuant to the provisions of Order No. R-4538 which order established temporary special pool rules for the Peterson-Pennsylvanian Associated Pool, Roosevelt County, New Mexico.	CASE 4962 (Cont'd.)

BEFORE: Daniel S. Nutter, Examiner

TRANSCRIPT OF HEARING

A P P E A R A N C E S

For the New Mexico Oil Conservation Commission: Lynn Teschendorf, Esq.
Legal Counsel for the Commission
State Land Office Building
Santa Fe, New Mexico

MR. NUTTER: The hearing will come to order, please. The first case this morning will be Case Number 4962.

MS. TESCHENDORF: Case 4962 in the matter of Case 4962 being reopened pursuant to the provisions of Order No. R-4538 which order established temporary special pool rules for the Peterson-Pennsylvanian Associated Pool, Roosevelt County, New Mexico.

This case has been continued to the August 3rd Examiner hearing.

MR. NUTTER: Case Number 4962 will be continued to the Examiner hearing scheduled to be held at this same place at nine o'clock A.M. on August 3rd, 1977.

REPORTER'S CERTIFICATE

I, SIDNEY F. MORRISH, a Certified Shorthand Reporter, do hereby certify that the foregoing and attached Transcript of Hearing before the New Mexico Oil Conservation Commission was reported by me, and the same is a true and correct record of the said proceedings to the best of my knowledge, skill and ability.

Sidney F. Morrish, C.S.R.

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 4962 heard by me on 7/6, 1977.

, Examiner
New Mexico Oil Conservation Commission

Dockets Nos. 24-77 and 25-77 are tentatively set for hearing on July 20 and August 3, 1977. Applications for hearing must be filed at least 22 days in advance of hearing date.

DOCKET: EXAMINER HEARING - WEDNESDAY - JULY 6, 1977

9 A.M. - OIL CONSERVATION COMMISSION CONFERENCE ROOM, STATE LAND OFFICE BUILDING, SANTA FE, NEW MEXICO

The following cases will be heard before Daniel S. Nutter, Examiner, or Richard L. Stamets, Alternate Examiner:

CASE 4962: (Reopened) (Continued from June 22, 1977, Examiner Hearing)

In the matter of Case 4962 being reopened pursuant to the provisions of Order No. R-4538 which order established temporary special pool rules for the Peterson-Pennsylvanian Associated Pool, Roosevelt County, New Mexico. All interested parties may appear and show cause why said temporary special pool rules should not be rescinded.

CASE 5967: (Continued from June 22, 1977, Examiner Hearing)

Application of Belco Petroleum Corporation for compulsory pooling, Lea County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests in the Morrow formation underlying all of Section 8 and in the other Pennsylvanian formations underlying the E/2 of said Section 8, Township 24 South, Range 35 East, Cinta Roja-Morrow Gas Pool, Lea County, New Mexico, to be dedicated to a well to be drilled at a standard location thereon. Also to be considered will be the cost of drilling and completing said well and the allocation of the cost thereof, as well as actual operating costs and charges for supervision. Also to be considered will be the designation of applicant as operator of the well and a charge for risk involved in drilling said well.

CASE 5971: In the matter of the hearing called by the Oil Conservation Commission on its own motion to permit John J. Moya, Fidelity & Casualty Company of New York, and all other interested parties to appear and show cause why the following wells in Township 30 North, Range 11 West, San Juan County, New Mexico, should not be plugged and abandoned in accordance with a Commission-approved plugging program:

Hubbard Well No. 1 located in Unit M of Section 4; Goode Well No. 1 located in Unit P of Section 18.

CASE 5972: In the matter of the hearing called by the Oil Conservation Commission on its own motion to permit Lynn & McCoy and all other interested parties to appear and show cause why the Bishop Well No. 1 located 115 feet from the South line and 200 feet from the West line of Section 15, Township 29 North, Range 11 West, San Juan County, New Mexico, should not be plugged and abandoned in accordance with a Commission-approved plugging program.

CASE 5973: In the matter of the hearing called by the Oil Conservation Commission on its own motion to permit G & B Oil Company, American Employers Insurance Company, and all other interested parties to appear and show cause why the Donella Well No. 1 located in Unit P of Section 3, Township 29 North, Range 15 West, San Juan County, New Mexico, should not be plugged and abandoned in accordance with a Commission-approved plugging program.

CASE 5974: Application of Maddox Energy Corporation for compulsory pooling, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests in the Pennsylvanian formation underlying the E/2 of Section 9, Township 18 South, Range 26 East, Atoka-Pennsylvanian Pool, Eddy County, New Mexico, to be dedicated to a well to be drilled at a standard location thereon. Also to be considered will be the cost of drilling and completing said well and the allocation of the cost thereof, as well as actual operating costs and charges for supervision. Also to be considered will be the designation of applicant as operator of the well and a charge for risk involved in drilling said well.

CASE 5975: Application of Bettis, Boyle, & Stovall for salt water disposal, Lea County, New Mexico. Applicant, in the above-styled cause, seeks authority to dispose of produced salt water into the Seven Rivers-Queen formation through the perforated and open-hole interval from 2,975 feet to 3,285 feet in its Annie L. Christmas Well No. 1 located in Unit E of Section 20, Township 25 South, Range 37 East, Jalmat Pool, Lea County, New Mexico.

CASE 5976: Application of Coquina Oil Corporation for special pool rules, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks the promulgation of special pool rules for the North Burton-Pennsylvanian Gas Pool, Eddy County, New Mexico, including a provision for 320-acre proration units. In the absence of objection, this pool will be placed on the standard 320-acre spacing for Pennsylvanian gas pools, rather than the present 160-acre spacing.

CASE 5977: Application of BTA Oil Producers for a dual completion and salt water disposal, Lea County, New Mexico. Applicant, in the above-styled cause, seeks authority to dually complete its JV-P Hagood Well No. 1 located in Unit B of Section 25, Township 26 South, Range 35 East, Lea County, New Mexico, in such a manner as to produce gas from the Pennsylvanian formation thru tubing in the production casing and to dispose of produced salt water down the production/intermediate casing annulus into the Delaware formation thru the open-hole interval from 5050 feet to approximately 6555 feet.

CASE 5978: Application of BTA Oil Producers for pool creation and special pool rules, Lea County, New Mexico. Applicant, in the above-styled cause, seeks the creation of a Pennsylvanian Gas Pool for its Hagood Well No. 1 located in Section 25, Township 26 South, Range 35 East, Lea County, New Mexico, and the promulgation of special rules therefor, including a provision for 640-acre spacing and proration units.

CASE 5979: Application of Texas Pacific Oil Company, Inc., for non-standard gas proration units, simultaneous dedication and unorthodox locations, Lea County, New Mexico. Applicant, in the above-styled cause, seeks approval for the following non-standard gas proration units on its State "A" A/C-2 Lease in Township 22 South, Range 36 East, Jalmat Gas Pool, Lea County, New Mexico:

a 480-acre unit comprising the N/2, W/2 SW/4, and E/2 SE/4 of Section 11 to be simultaneously dedicated to Wells Nos. 14, 36 and 42 located at unorthodox locations in Units B, M, and E, respectively, of said Section 11; a 160-acre unit comprising the E/2 SW/4 and the W/2 SE/4 of Section 11 to be dedicated to Well No. 62 to be drilled at an unorthodox location in Unit K of said Section 11; a 160-acre unit comprising the NW/4 of Section 9 to be dedicated to Well No. 63 to be drilled at an unorthodox location in Unit C of said Section 9; a 160-acre unit comprising the NE/4 of Section 9 to be dedicated to Well No. 40 located at a standard location in Unit A of said Section 9.

CASE 5980: Application of Ken Blackford, et al., for a non-standard gas proration unit and an unorthodox gas well location, San Juan County, New Mexico. Applicant, in the above-styled cause, seeks approval for a 160-acre non-standard gas proration unit comprising the N/2 NW/4, SW/4 NW/4 and NW/4 SW/4 of Section 24, Township 29 North, Range 12 West, Fulcher Kutz-Pictured Cliffs Pool, San Juan County, New Mexico, to be dedicated to a well to be drilled at an unorthodox location 660 feet from the North line and 1980 feet from the West line of said Section 24.

CASE 5981: Application of W. A. Moncrief, Jr., for pool creation and special pool rules, Lea County, New Mexico. Applicant, in the above-styled cause, seeks the creation of an oil pool for Upper-Pennsylvanian production for his State Well No. 1 located in Unit E of Section 26, Township 16 South, Range 33 East, Lea County, New Mexico, and the promulgation of special rules therefor, including a provision for 80-acre spacing.

BEFORE THE
NEW MEXICO OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
June 22, 1977

EXAMINER HEARING

IN THE MATTER OF:	)	
Case 4962 being reopened pursuant to the provisions of Order No. R-4538 which order established temporary special pool rules for the Peterson-Pennsylvanian Associated Pool, Roosevelt County, New Mexico.	)	CASE 4962 (Reopened)

BEFORE: Richard L. Stamets, Examiner

TRANSCRIPT OF HEARING

A P P E A R A N C E S

For the New Mexico Oil Conservation Commission:	Lynn Teschendorf, Esq. Legal Counsel for the Commission State Land Office Building Santa Fe, New Mexico
For the Applicant:	Antone L. Peterson, III, Esq. Attorney at Law Amoco Production Company Post Office Box 3092 Houston, Texas
	ATWOOD, MALONE, MANN & COOTER Attorneys at Law Post Office Drawer 700 Roswell, New Mexico

E X H I B I T

EXHIBIT INDEX

MR. STAMETS: We will call next Case 4962 and I would point out before we get into this case that the Associated Pool Rules for the Peterson-Pennsylvanian were established by Order No. R-4538 but that Commission Order No. R-5353 which was effective February 1st, 1977 superseded this Order and brought the Peterson-Pennsylvanian Associated Pool under the general rules for associated pools in Northwest and Southeast New Mexico. The only difference was that it dropped the API gravity, definition of a gas well, and changed the allocation formula.

I would like to call for appearances in this case.

MR. PETERSON: Antone Peterson, an attorney representing Amoco Production Company. There also should be an appearance letter from Atwood, Malone, Mann and Cotter, New Mexico counsel.

MR. STAMETS: Yes, there is.

MR. BENISCHEK: H. W. Benischek, mineral owner, Peterson Field.

MR. STAMETS: Will you be presenting any testimony, Mr. Benischek?

MR. BENISCHEK: Yes, sir, I would like to have about seven mimutes to present it and I'll present it quickly.

MR. STAMETS: Will you be representing yourself?

MR. BENISCHEK: That is corect. I am a major

owner in the field.

MR. STAMETS: I would like all those who will present testimony to stand and be sworn at this time.

(THEREUPON, the witnesses were duly sworn.)

MR. PETERSON: If it please the Examiner, Amoco Production Company would like to recommend that the temporary field rules as now constituted be made permanent.

Would you like for me to proceed first?

MR. STAMETS: Yes.

HOWARD H. RICE, JR.

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

DIRECT EXAMINATION

BY MR. PETERSON:

Q. Would you state your name for the record, please?

A. Howard H. Rice, Jr.

Q. Have you testified before the Commission or one of its Examiners previously?

A. No, sir, I have not.

Q. Could you then give us a general overview of your educational background, please, Mr. Rice?

A. I graduated in May of 1968 from the University of Arizona with a degree in Civil Engineering.

Q. And what has your experience been in the oil and gas industry since that time?

A. I accepted employment upon graduation with Pan American Petroleum Corporation, a predecessor of Amoco Production Company. I accepted a position as an engineer in Oklahoma City. After approximately six months I took a military leave of absence for two years. Upon return to Pan American Petroleum Corporation it was in the Odessa area in West Texas. I spent approximately two years there handling various projects at a project engineer level. I was then transferred to the Division Office in Houston, Texas and in a period of approximately sixteen months I had three different assignments in operations in our reservoir group. My last assignment in the reservoir group was as a section leader in one of our reservoir sections. I was then transferred back to Odessa, Texas where I served in the capacity of area engineer. In that office I had overall responsibility for Amoco's production and on-going development in exploration activity from an engineering standpoint. We had, during my tenure there, a staff that ranged from twenty to twenty-five engineers. Late last year I was transferred back to the Division Office in Houston and my initial assignment was as an operations coordinator responsible for on-going development activities in West Texas and the eastern half of New Mexico and approximately two months ago I was given my current

assignment which is head of our proration group.

Q. And your position as proration group supervisor includes supervision over New Mexico, is that correct?

A. Yes, sir, it does.

MR. PETERSON: Are the witness' qualifications acceptable, Mr. Examiner?

MR. STAMETS: Let me make some clarifications here. So many of these titles don't really say too much. I presume that your experience since graduation, except for the military, has been in the field of petroleum engineering dealing with reservoir drilling, general operations, is that correct?

A. Yes, sir, that is absolutely correct.

MR. STAMETS: The witness is considered qualified.

Q. (Mr. Peterson continuing.) I would like for you then to turn your attention to what has been labeled Amoco's Exhibit One, Mr. Rice, and explain generally what that exhibit shows, please?

A. Amoco's Exhibit Number One is a structure map of the Peterson-Pennsylvanian Associated Pool. The map is contoured on top of the main Cisco pay. The circles indicate those wells which penetrated the Pennsylvanian section since late 1971. Those circles which are not colored denote dry holes, of which there have been seven. The dry holes pretty well surround the developed portion of the field and pretty well define the productive limits. Those four wells which are colored green

indicate the four oil wells, the two pink circles denote two gas wells and the red circles on the Swearingen "C" No. 1 is a well which Amoco plans to dually complete the existing Fusselman completion with the Pennsylvanian. This was the subject of a hearing two weeks ago, that is Amoco's application for a dual completion was the subject of a hearing two weeks ago.

Q. To your knowledge has any action been taken on that application?

A. Not to my knowledge.

Q. I would like for you to, looking at Exhibit One, try and explain briefly the chronological development of the field from its discovery onward, please, Mr. Rice?

A. The field was discovered in September of 1971 with the drilling of the Amoco Peterson "A" Gas Com No. 1 located in the northwest quarter of the northeast quarter of Section 19. As you noted on the map this was a gas completion. The next well was drilled five months later. It was the Amoco Swearingen "A" Gas Com No. 1 which was the second gas well in the field. It is located also in Section 19 in the south half.

Subsequent to that three dry holes were drilled, all by Amoco, on the southern extremities of the field. Those were the Amoco Peterson "B" No. 1 in Section 29, the Amoco Radcliff Gas Com No. 1 in Section 24 of Township 5 South, Range 32 East.

All of the other wells that have been drilled in

this field to date are in Township 5 South, Range 33 East.

The third dry hole is the Amoco Lambert Gas Com No. 1 in Section 30.

In December of 1972 the first well to penetrate the oil rim in this reservoir was drilled. That was the Amoco Peterson "C" No. 1 located in the northeast quarter of the southeast quarter of Section 18. That well potentialed for two hundred and ninety-four barrels of oil per day, zero barrels of water per day and a gas-oil ratio of fifteen hundred.

Two other dry holes were drilled prior to the adoption of temporary field rules. Those were the Phillips Peterson No. 1 in the northeast quarter of the northeast quarter of Section 18, which was off the structure and the Amoco Swearingen "B" No. 1 in the southeast quarter of the northwest quarter of Section 20 which was likewise off the structure and tested water.

Temporary field rules were adopted on June 1st, 1973 for a period of one year, the one year to commence when gas sales from the field commenced.

Q. Were these wells on production at the time the temporary field rules were established?

A. No, sir, they were not.

Q. Due to the lack of gas market?

A. The gas market was not established until June of 1976.

Q. The hearing today is actually a reopening of the hearing which you just mentioned establishing temporary field rules. Could you please trace the development of the Peterson-Penn Field since the time of the hearing on temporary field rules?

A. Since the discovery of the oil rim in the Peterson "C" No. 1 the development activity has been pointed toward finding other wells or locating other wells in this limited oil rim. In February of 1976 following about a three year lull in activity an effort was made to establish a gas market. Amoco drilled the Radcliff No. 1 in the southwest quarter of the southwest quarter of Section 17. It was a successful oil completion in that it potentialed for two hundred and sixty-four barrels of oil per day, zero water and a gas-oil ratio of fifteen forty-nine.

The following month, in March of '76, Amoco drilled the Swearingen "C" No. 1 in the northwest side of the structure in an attempt to locate the oil rim there. That well is located in the southeast quarter of the southwest quarter of Section 18. The Pennsylvanian section came in higher than anticipated and we believe that it will be gas productive but a Fusselman oil well completion was made in that wellbore at the time it was drilled.

As I previously mentioned, Amoco's request for authority to dual this well with the Pennsylvanian was the

subject of a hearing two weeks ago.

The next well drilled was in April of 1976, it was the Swearingen "D" No. 1 in the northwest quarter of the southwest quarter of Section 20 and it potentialed for two hundred and seventy-nine barrels of oil per day with a gas-oil ratio of eleven thirty-three and zero barrels of water recorded on the potential test.

We came back then to the northwest flank of the reservoir and offset the Swearingen "C" No. 1 by a little over a thousand feet, again in an attempt to locate an oil rim in this area. This well is located in the southwest quarter of the southwest quarter of Section 18. The well came in structurally low and was dry after swab testing, essentially a hundred percent water.

The final successful completion in the field was the Amoco Swearingen "B" No. 4 located in the southwest quarter of the northwest quarter of Section 20. That well potentialed for four hundred and ninety-two barrels of oil per day but with a hundred and ninety-three barrels of water per day. The gas-oil ratio upon completion was two hundred and forty-four.

The final attempt to drill a well in this field was in November of '76 when Wainoco, Incorporated, drilled a dry hole in the southwest quarter of the northwest quarter of Section 17 and found themselves off structure.

Q. All right, in light of the development history which you have just set out and in light of what you know about the reservoir, could you give us your opinion or what are your impressions of the structure and reservoir delineated on Exhibit Number One?

A. Well, the data that has been generated by the drilling and testing programs, the logging programs and the subsequent performance indicate that this is principally a gas reservoir with a limited oil rim.

We feel we can define pretty well the gas-oil contact and the water-oil contact. The gas-oil contact is estimated to be at a subsea datum of thirty-three ten and the water-oil contact is estimated to be at a subsea datum of thirty-three thirty-four, giving us a maximum oil column gross thickness of twenty-four feet.

Q. All right, do you have any further comments regarding Exhibit One?

A. No, sir.

Q. I would like to have you look at Amoco's Exhibit Two, a chart, and explain what you have tried to show with this exhibit?

A. This is a performance plot of production parameters since field-wide production commenced in June of 1976. The curve goes through April of 1977. The uppermost curve is a plot of gas-liquid-hydrocarbon ratio.

June of '76, the first month of production in the field, is not felt to be representative since some of the wells were put on late in the month and it appears that the high GOR or high gas-liquid ratio wells were probably put on earlier.

July is thought to be more representative of the gas-liquid-hydrocarbon ratio in the initiation of production. As you can see that ratio was approximately six thousand to one. The ratio has steadily increased over the eleven months of production applied here to April of 1977 when it was approximately twelve thousand to one.

The next curve is a plot of gas production in thousands of cubic feet per day. With the exception of the last two months, you can see that the production is relatively constant at about sixty-five hundred MCF per day.

The last two months in both the gas production curve and the liquid-hydrocarbon production should not be taken as representative. The plant which processes the gas from this field was down for a few days in each of those months.

I should point out that the field has had excess capacity to produce over what the market could take so the gas production curve is not representative of the capacity of the well.

MR. STAMETS: Let me ask you a question at this point. Are your gas wells producing less than they are

allowed?

A. Yes, sir, they are.

The next curve is barrels of liquid hydrocarbon per day, which even disregarding the last two months is declining rather sharply, indicative of the depletion process of the limited oil rim which is taking place.

The number of wells curved indicates that we have had five wells on production in the field until October of 1976 when we completed this Swearingen "B" No. 4 and we have had six wells on production since that time.

The last curve is barrels of water produced per day. As you can see it has increased slightly since production commenced. All of that water production is coming from the four oil wells. Sixty to seventy percent of it is coming from one well, the Swearingen "B" No. 4.

Q. (Mr. Peterson continuing.) All right, there is a similar chart labeled Amoco's Exhibit Three, could you tell us what the difference is or what the similarity is between what has been labeled as Amoco's Two and Three?

A. Amoco's Exhibit Three is the same data except that we have eliminated the production from the two gas wells so we are left now with a set of performance curves to depict the four oil wells.

The curves are very similar and again you must disregard the last two months of datum in terms of gas

production per day and oil production per day but we see the same increase in gas to oil ratio and we see the same sharply declining curve in the barrels of oil produced per day, again indicative of the depletion of the limited oil rim on this gas reservoir.

As I previously mentioned, all of our water production does come from the four oil wells so the barrels of water per day curve is identical on Exhibit Three to what it was on Exhibit Two.

Q. Do you have any further comments regarding Exhibits Two or Three?

A. No, I do not.

Q. What other reservoir data or other data do you have to support Amoco's recommendation that the temporary field rules be made permanent?

A. We have collected some bottom-hole pressure data earlier this year. When the reservoir was discovered in the Peterson "A" Gas Com No. 1 in Section 19 we found the reservoir pressure to be twenty-seven hundred and twenty psi at a subsea datum of thirty-two eighty. In March of this year we took bottom-hole pressure build ups in the Peterson "A" Gas Com No. 1. Again that the discovery well, and also in two oil wells, the Swearingen "D" No. 1 in Section 20 and the Radcliff No. 1 in Section 17. As you can see from Exhibit Number One, this gives us very good coverage of the productive part of

this field.

Each of these pressures that I'm going to discuss was corrected to the same common subsea datum as the pressure was measured at in the discovery well. The Peterson "A" Gas Com No. 1 after seventy hours recorded a bottom-hole pressure of fifteen hundred and ninety-seven psi. The Swearingen "D" No. 1 recorded sixteen hundred and forty-three psi and the Radcliff No. 1 recorded sixteen hundred and sixty-three psi. In each case the bottom-hole pressures were still increasing gradually but in each case we estimate that they would stabilize in the range of seventeen hundred psi. This is approximately one thousand psi less than the reservoir pressure at the time of discovery. Another point that we can make in this data is that although reservoir withdrawals varied greatly over the nine months that these wells were on production, the similarities in the bottom-hole pressures measured are indicative of a reservoir in good communications and also indicative, of course, that the reservoir is being adequately drained by the existing wells.

Q. Have you made any studies of the economics of drilling an oil well to the Pennsylvanian formation in the Peterson-Penn Field?

A. Yes, sir, I have. The average feet of pay that we can calculate off of our porosity logs in the oil wells that have been drilled to date is about ten feet. The average

porosity is about four percent. Using these parameters and recognizing that today it would cost us approximately three hundred thousand dollars to drill a well in this field and recognizing further that although we might get a flowing oil well initially, the performance history that we've seen to date would indicate that in a short period of time we would have to install pumping equiment at the cost of approximately twenty-five thousand dollars.

Using the parameters that I have mentioned and assuming that we could recover the reserves of a well drilled today in approximately twenty-four months we would have to encounter fifty acres of undrained oil column, ten feet thick as I mentioned, in order to get our money back. That would be zero return on our investment. In order to make an economical venture we would have to be able to drain one hundred to a hundred and fifty acres.

Q. In your opinion will Amoco's recommendations to make the temporary field rules permanent prevent waste, protect correlative rights and serve the interests of conservation?

A. Yes, I believe they will. The temporary field rules as adopted were designed to favor slightly the oil wells and all of the performance data that we have to date indicates that is what is occurring.

Q. Were Exhibits One through Three prepared by you or

under your supervision, Mr. Rice?

A. Yes, they were.

MR. PETERSON: I would like to move that Amoco's Exhibits One through Three inclusive be admitted into evidence.

MR. STAMETS: These exhibits will be admitted.

(THEREUPON, Amoco's Exhibits One through Three were admitted into evidence.)

CROSS EXAMINATION

BY MR. STAMETS:

Q. Mr. Rice, it would appear that you don't have any active water drive in this area, is that correct?

A. That's correct. We have seen a very slight increase in our water production from the oil wells but as I mentioned, that is mainly due to water production from the Swearingen No. 4. The only porosity we encountered in that well was right at the water-oil contact and it has been a high water cut producer since and we attribute the water production in the other three oil wells, the very slight amounts that they make, due to the fact that they are likewise completed very close to the water-oil contact.

Q. So the water you are producing is simply water that is being depleted from the reservoir in the same fashion as the oil that is being depleted?

A. Yes, sir.

Q. I would like to get the locations on these three wells again that you pressure tested. Now the discovery well was the first well drilled and that was from twenty-seven twenty psi originally down to fifteen ninety-seven?

A. Yes, sir, we measured fifteen ninety-seven at the end of seventy hours.

Q. And the "D" No. 1 is the one in the southwest quarter of Section 20, is that correct?

A. That's correct.

Q. All right, now, did you take an original test on that well when it was completed?

A. Yes, sir, we did. The Swearingen "D" No. 1 original reservoir pressure was measured at twenty-six hundred and forty-nine at a subsea datum of thirty-three twenty-one.

Q. Was that before any production?

A. There was very little production prior to that time. The only production of any significance was from the Peterson "C" No. 1, the discovery oil well. It produced in November of '72, or it was December of '72 and January of '73 between eleven and twelve thousand barrels of oil.

Q. Now in the Radcliff Well, that is located in Section 17 in the southwest quarter, is that correct?

A. Yes, sir, that is correct.

Q. And what was the original bottom-hole pressure on that well?

A. The original bottom-hole pressure there was twenty-six hundred and eighty-three at a subsea datum of thirty-three twenty-six.

Q. Was that before or after production had started?

A. That was before the field-wide production started, yes, sir.

Q. In these two cases you have slightly lower bottom-hole pressures at slightly deeper depths?

A. Yes, sir, that is correct.

Q. How do you explain that?

A. I don't have a good explanation for that unless the reservoir withdrawals from the Peterson "C" 1, limited though they were, did cause some reservoir pressure draw down.

Q. And, of course, the Radcliff well had been on production when that was taken?

A. That is correct.

Q. Do you have original bottom-hole pressures on the other wells?

A. I don't believe I have the information with me. I do not have the information with me, I do believe that we got bottom-hole pressures on the other wells and that information could be provided if it would be helpful.

Q. What's the nature of the reservoir and the communication, is it all of porosity or is the reservoir full of vugs and fractures?

A. I don't know that we know for sure. With the porosity that we are looking at and the producing rates that the wells are capable of, we suspect fracturing communications.

Q. Did you core any of these wells?

A. Yes, sir, there were two or three cores taken.

Q. And did the cores show any fracturing?

A. I do not know, sir, I did not look at that information.

Q. Basically your indications of communications are limited then to the pressures on these wells?

A. Yes, sir, that's basically it.

MR. STAMETS: Are there any other questions of the witness?

MR. BENISCHEK: May I ask one?

MR. STAMETS: Yes, Mr. Benischek.

MR. BENISCHEK: Do you have any barrels per acre foot in the reservoir?

MR. RICE: No, sir, we do not.

MR. BENISCHEK: Do you have any pressure draw-down information between wells over a significant period of time?

MR. RICE: We have the information which I put into the record.

MR. BENISCHEK: Well, I've heard this. I mean have you shut one well in and then produced another to check for communications?

MR. RICE: No, sir, we did not do any of that type of work.

MR. BENISCHEK: That's all I have.

MR. STAMETS: Do you have anything further, Mr. Peterson?

MR. PETERSON: No, I don't, Mr. Examiner.

MR. STAMETS: The witness may be excused.

(THEREUPON, the witness was excused.)

MR. STAMETS: Mr. Benischek.

H. W. BENISCHEK

having been first duly sworn, testified as follows:

MR. STAMETS: Mr. Benischek, would you identify for the record the location and extent of your interest in this pool?

MR. BENISCHEK: The major interest is in the northwest quarter of the west half of the northeast quarter of Section 18 and all of the east half of the east half of Section 18 and I represent a hundred and sixty acres out of two hundred.

MR. STAMETS: Your total interest is a hundred and sixty acres?

MR. BENISCHEK: I'm representing a hundred and sixty acres.

MR. STAMETS: You say you are representing it?

MR. BENISCHEK: Yes, sir.

MR. STAMETS: In what regard? Who else is an owner?

MR. BENISCHEK: I have deeded a few acres to some other individuals and I am representing them.

MR. STAMETS: I would point out that in order to represent other individuals or corporations before State agencies you must be an attorney or be represented by an attorney, a New Mexico attorney. However, you can represent your own interests here and speak for them without an attorney.

MR. BENISCHEK: Okay, I'll revise my statement and state that I own the major interest of this particular lease.

MR. STAMETS: Now, I got the second half of that, the east half of the east half of 18, what was the other acreage involved?

MR. BENISCHEK: It's the northwest quarter of the northeast quarter of Section 18.

MR. STAMETS: What section?

MR. BENISCHEK: Section 18, 5 South, 33 East.

MR. STAMETS: All right, thank you.

MR. BENISCHEK: Okay, may I start?

MR. STAMETS: Yes, sir.

MR. BENISCHEK: Okay, I'm H. W. Benischek. I have been an Assistant Division Engineer with one major oil company, I've been a Senior Engineer with another major oil company, I have been Chairman of the Petroleum Engineering School at the

University of Oklahoma and visiting professor at Texas Tech. I'm a registered Petroleum Engineer, I have been in the oil and gas business since 1947 and I continue to be in the business.

Now, I have a prepared statement which I would like to read and I have it timed, I'll condense it very fast so I won't take up too much time.

(Reading.) As a mineral owner representing the owners of the major mineral interest, we'll change that to, I am the major mineral owner with major interests in the east half of the east half of Section 18, Township 5 South, Range 33 East, Roosevelt County, New Mexico. I believe that the New Mexico Oil Conservation Commission Order No. R-4538 dated May 23, 1973, which specifies a spacing of one hundred and sixty acres per well for oil wells is discriminatory and contradictory to long established rules and regulations of the State of New Mexico Oil Conservation Commission. These rules state that wildcat and development oil wells shall be located on a tract consisting of approximately forty acres, that is contiguous acres, contiguous surface, unless otherwise provided in special rules. (Reference Rule 104.)

Although not explicitly stated, special pool rules would not be provided except under extraordinary circumstances. Normally, mineral and/or royalty owners have no knowledge of hearings which are of economic interest to them. In my opinion, they should always be notified, particularly when radical

departures from the norm are formulated. Existing rules were formulated over a period of years for maximum economic recovery without waste.

The Amoco Production Company Amoco Peterson "C" Well No. 1 located nineteen hundred and eighty feet from the south line and six hundred and sixty feet from the east line of Section 18, Township 5 South, Range 33 East is defined as an oil well as documented in the State of New Mexico Oil Conservation Commission files. NMOCC forms completed and submitted by Amoco categorize the well as an oil well producing from the Cisco-Pennsylvanian formation at depths from seventy-seven fifty-nine to seventy-seven eighty-two feet. This producing zone is classified by Amoco as a carbonate reservoir. (See Daniel R. Currens testimony, Case 4962, dated May 9, 1973, page 4, line 25 and page 5, line 1.)

The dedicated acreage for this well is now a hundred and sixty acres. Amoco should show cause why the special rules promulgated in Order No. R-4538 were requested and why they should remain in effect and it is on page 8, paragraph 4, same reference.

The Swearingen "C" No. 1, a Fusselman formation producer located in the same Peterson Field is located five hundred and fifty-four feet from the south line and two thousand seventy-eight feet from the west line of Section 18, Township 5 South, Range 33 East. According to information which I

examined in the New Mexico Oil Conservation Commission files, the well has forty acres dedicated. Unless the dedicated acreage has been revised, this forty acres versus the hundred and sixty acres dedicated for the Peterson "C" Well No. 1 under the special rules is flagrantly inconsistent. Both are oil wells as shown by the records, both are producing from carbonate formations and should receive the same forty acre dedication.

A carbonate reservoir does not normally have good horizontal and vertical communication. The geological literature contains many references to the non-communication found in carbonate reservoirs over long distances. There is not sufficient drilling in the Peterson Field to establish data to verify the nature of communicating characteristics, porosity and permeability of the producing formation over a significant areal extent. Thus, closer spacing is warranted. Furthermore, experience has shown that porosity and permeability may vary greatly in short distances in a carbonate reservoir, resulting in the probability that pockets of undrained reservoir exist under the hundred and sixty acre spacing pattern.

Amoco previously presented testimony to the New Mexico Oil conservation Commission which implied that the Peterson "C" Well No. 1 might become a gas well under producing conditions. Royalty owners were not cognizant of this testimony. Based on Amoco's statements of oil and gas sales for the period from

June 1976 through April 1977, the computed gas-oil ratio is within the limits authorized. Oil continues to be sold and for the month of April 1977 in excess of a hundred barrels per day, which is hardly a gas well.

In the transcript of the hearing of Case No. 4962 wherein Amoco requested special rules for the Peterson-Pennsylvanian reservoir, Mr. Currens, an Amoco witness, testified with respect to spacing. On page number eleven, lines ten and eleven, he stated, quote, I think from what we've seen, one well should drain a hundred and sixty acres here, end of quote. On page number sixteen, lines seven through nine, he states, quote, we've got good communication, I think throughout the field, end of quote. These drainage and communication statements are arbitrary and not supported by facts presented in the transcript of the hearing nor by the exhibits.

Amoco had no opposition from the mineral owners and it appears that the statement "to prevent waste and protect correlative rights" seems primarily for the best interest of Amoco and not for the State of New Mexico nor for the royalty owners. Was the company's request for a hundred and sixty acre spacing made to avoid drilling another oil well on the established forty acre oil well spacing pattern?

The Swearingen and other royalty interest owners in the west half of the southeast quarter of Section 18, Township 5 South, Range 33 East are receiving one-half of my revenue

from the Peterson "C" Well No. 1. The low permeability previously reported in testimony by Amoco does not, in my opinion, permit good horizontal migration of oil over the dedicated one hundred and sixty acres.

A recent 1977 Society of Petroleum Engineers Paper No. 6462 entitled "Infill Drilling in the Mississippi Limestone, Garfield County, Oklahoma" by Gaiser D. Maddox proves with factual data that more wells per quarter section in a low communicating reservoir are profitable. The author states that oil and gas has been and will be produced which never could have been recovered from the original wells.

I have a copy of that paper I would like to introduce into the record.

Amoco and Associates have accrued a return of eight hundred and seventy-six thousand three hundred and ninety-nine dollars and twenty cents for oil from June 1976 through April 1977 and gas from June 1976 through March 1977, from the Peterson "C" Well No. 1. Additional income from this particular well was distributed by Phillips during initial well tests and prior to June 1976, which is not included in this figure which is nearly a million dollars. The amount is a significant return for the period of time produced and at the relatively shallow producing depth. The investment is profitable.

Based on the foregoing, I think that the hundred and sixty acre spacing is not in concert with the protection of

correlative rights and waste will result. Forty acre spacing for oil wells in the Peterson Field is recommended. This was the acreage dedicated on December 8, 1972 to the Peterson "C" Well No. 1. (End of reading.)

That is the end of my formal presentation. I have noted this morning since I received this structure map that the contour lines have been changed with no additional drilling which rather surprises me. The prior contour lines on the prior exhibit showed that a two hundred and fifty barrel well could be obtained in the southeast quarter of the northeast quarter of Section 18 and also an oil well south of the Peterson "C" 1 and I would hardly call this a gas field when you have one, two, three, four oil wells and two gas wells. It looks more like an oil field to me and also I heard this morning, since I arrived, a figure of less than twenty-five feet of pay thickness, which is contradictory to what I saw in the record also. I heard a figure of porosity which is lower than what was reported previously during the previous testimony.

I think that the spacing that is in effect is wrong and should be reissued effective with the date of the original order at the time this is reviewed.

And also on the communication characteristics I asked the question as to whether or not they had any reservoir reserve calculations. I didn't get a good answer on that and I didn't get

a good answer on communication and as far as communication is concerned in a carbonate reservoir it's very obvious from the literature that it's not and any geologist knows that.

Incidentally, I have also been, and I didn't mention this, but I have also been an evaluation engineer and have worked on recoveries and income, economic reports and evaluations of reservoirs and individual wells for a major oil company.

That's all I have to say.

MR. STAMETS: Are there questions of Mr. Benischek?

MR. PETERSON: Mr. Examiner, Amoco will have questions. We would appreciate a few minutes to consult, we were not given a copy of Mr. Benischek's statement before he presented it and had no idea that there was any opposition. To my knowledge no communication has flowed between Mr. Benischek or anyone else and Amoco and we were unaware of his dissatisfaction and we would certainly like to ask him a few questions but we would appreciate a few moments to consult.

MR. BENISCHEK: Correction, Mr. Examiner, there was communication with Amoco and I stated that I would be present for this hearing, with Mr. Charlie Miller of Amoco.

MR. STAMETS: This seems like an appropriate time to take a coffee break.

(THEREUPON, the hearing was in recess.)

MR. STAMETS: The hearing will please come to order.

Mr. Peterson, do you have some questions of Mr. Benischek?

MR. PETERSON: Yes, sir.

CROSS EXAMINATION

BY MR. PETERSON:

Q. Mr. Benischek, in your statement you seem to intimate that notice was not given to the mineral interest owners, royalty interest owners in the field, is that a mis-impression on my part or is that indeed what you intended to say?

A. I received no notification of any kind with respect to the spacing, the hearing or the results.

Q. New Mexico statutes provide for notice by publication, are you contending that that notice was not fulfilled?

A. No, sir, I didn't say that.

Q. All right.

A. I said that I think that royalty and mineral owners should be notified directly in my statement.

Q. Well, I don't think you said directly and I just wanted to clear it up.

A. No, I didn't use the word, directly.

Q. The New Mexico statutes provide that notice by publication is sufficient.

A. I understand that.

Q. Mr. Benischek, would you agree that waste can be caused by the drilling of unnecessary wells? Waste as defined --

A. That is a question that requires a tremendous amount of anlaysis. You could drill a well in a dry area or you might drill one in a set up field and not have waste. You have opened up a whole field of reservoir mechanics which I would be glad to discuss with you but I don't think the Examiner would want to take that time.

Q. You then believe that additional wells in this field are necessary, that additional wells would not be wasteful, I take it?

A. I will answer that, yes, based on what information I was able to get from the files and what little I was able to get from Amoco, which includes porosity which doesn't agree with what I heard this morning.

Q. You heard Mr. Rice testify that ten feet of net porosity or ten feet of porosity was all that Amoco could under really the most liberal interpretation give to the oil column in this field and you disagreed rather vehemently with that. You mentioned that you disagreed because of your search through the files and I would like to get the basis for that opinion if I could.

A. Well, it's recorded in the files. I have it somewhere

here, the form that was recorded by Amoco with the Commission. I'm sure that you've got it there, sir, I can dig it out.

Q. If you could I would appreciate it.

A. This particular one here shows seventy-seven fifty-nine to seventy-seven eighty-one. There is another report. This one shows --

Q. Pardon me, that's in what well?

A. We are talking about the Peterson "C" No. 1, Section 18, 5 South, 33 East?

Q. All right.

A. The one I'm interested in, the acreage I'm interested in.

Q. That's the gross porosity?

A. I didn't say porosity, I said pay section.

Q. The gross pay section?

A. Yes, but I just found another figure here.

Q. All right.

A. Yes, Form C-104 that was submitted December 4th, 1972 gives seventy-seven fifty-nine to eighty-two.

Q. That's also gross pay section?

A. I interpret Amoco's report as that being the case.

Q. Do you have any idea what the net pay is, what is your opinion of the net pay, have you seen any logs?

A. Yeah, I have the logs, unfortunately I didn't bring them with me but I have the electrical logs and I don't have

the net pay figures with me but you normally perforate sections that are porous and very often you don't perforate all of the porous section in order to make a well.

This is considerably more than ten feet. When you speak of net pay you can get in a long discussion. I don't know how familiar you are with reservoir mechanics but I have been in it a good many years.

Q. You stated earlier that you are a major interest owner in the northwest quarter of the northeast quarter of Section 18 and the east half of the east half of Section 18. You also stated that, I assume that if the temporary field rules as constituted are perpetuated as Amoco recommends that you being a major interest owner in that acreage will be caused harm and I'm just wondering, you are aware of the dry hole just immediately east of the east half of Section 18 in Section 17 and you are aware of the dry hole in the northeast quarter of the northeast quarter of Section 18, are you not?

A. Yes, sir.

Q. In your opinion, is this a field which has been well defined by development?

A. It is probably not completely defined and I disagee with the fact that you call it a gas field, I think it's an oil field with a gas cap because you have more oil wells than you do gas wells and there is room for more oil wells.

MR. STAMETS: I would like to clarify the designation of the field for the record. This is not a gas pool nor is it an oil pool, it is an associated reservoir at the present time, according to the present definitions.

Q. (Mr. Peterson continuing.) I'm sorry, you do or you do not think this is a reservoir which has been well defined by development?

A. Well, let's put it this way, as you pointed out, my interest is in Section 18 and it's very obvious that additional wells can be drilled in Section 18 that would probably be oil wells and furthermore down in Section 20 I'm at a loss to understand why there are two wells there which are very close together, it looks like it started out to be forty acre spacing and now they are a hundred and sixty and they are oil wells, I don't understand it.

Q. You heard Mr. Rice's testimony that his interpretation is that there is a very narrow oil column and that is his interpretation as you understand it and you disagree?

A. Just a minute, run that by again.

Q. His interpretation is that it is a very narrow oil rim and you disagree with that interpretation?

A. I did not necessarily say that I disagreed. I said that I think additional wells can be drilled which will be oil wells.

Q. Economical wells?

A. Economical, yes, sir, probably as much as five hundred barrels an acre foot, I'm not sure because I couldn't get the information from Amoco, I can't tell you until I try it.

Q. What do you base the five hundred barrels per acre foot on then?

A. I had to take some estimates of porosity and water saturation, just ball park estimates, that's all I could do because I don't have the facts.

Q. I appreciate that. You have indicated that additional oil wells can be drilled in Section 18. I count four holes in Section 18, three of which are in the south half. You are saying that you think an additional oil well could be drilled on what is now the Peterson "C" 1 Unit, is that correct?

A. Probably two oil wells. You have revised these contours from your previous exhibits. I just found that out this morning after you handed me this exhibit which I appreciate very much and the previous contours would indicate that you could get a two hundred and fifty barrel well north of the Peterson "C" 1, also probably the same south of the Peterson "C" 1.

Q. I think you will find and I don't want to testify, but I think you will find that there were additional wells drilled after that time and I think if you will look at the dates you will see that. I may be wrong and please correct me

if I am wrong.

A. Your witness would have to --

MR. STAMETS: For the record, Mr. Benischek, you are looking at a Xerox copy of what was Exhibit Number One in Case 4962, is that correct?

A. Yes, this was taken directly from Amoco's previous testimony.

MR. STAMETS: And my observation is that there are definitely additional wells drilled, the Fusselman well in the southwest, both of the wells in the southwest quarter of Section 18 are not on Exhibit Number One in this case, nor is the well in the northwest quarter of Section 17, nor either of the two oil wells in the west half of Section 20 and there may be others but there apparently have been a number of wells drilled since Exhibit Number One in Case 4962 on 5-5-73 was introduced.

MR. BENISCHEK: I'll accept that.

Q. (Mr. Peterson continuing.) For additional control like that would you accept the contours as revised, there was a reason for the revision, correct?

A. Well, yes, I'll have to accept them on the basis of that information, yes, sir. I'm not saying I agree, I accept them.

Q. Yes, sir, I understand.

A. But my statement still holds that additional oil wells

can be drilled on the Peterson where I own acreage, two oil wells.

Q. Let me discuss that with you now.

A. Possibly three.

Q. You have stated --

A. On forty acre spacing, at least two.

Q. All right you have stated in your prepared statement that Amoco and Associates have accrued a return of eight hundred and sixty-seven thousand three hundred and ninety-nine dollars and twenty cents for oil from June 1976 through April 1977 and gas from June of '76 to March '77 from the Peterson "C" 1?

A. Yes.

Q. You have also been receiving revenue from that production have you not?

A. yes, I have.

Q. If you take Amoco's interpretation of this reservoir and assume that this hundred and sixty acre unit is being drained, which Amoco sincerely believes that it is, then in fact, if you went back to smaller spacing this unit would have been being drained to the tune of a lot of this money and you would probably or perhaps get a non-economical well if you drill on smaller spacing, is that correct?

A. You cannot prove that statement with the facts that we have that have been presented by Amoco, no way in a carbonate

reservoir.

Q. We have proved that statement, I think, to my satisfaction and --

A. Your witness himself said a few minutes ago that there might be fractures and he wasn't sure about the communications. The previous witness said that there was communication but the literature is full of information on carbonate reservoirs stating that communication is normally very poor in carbonate reservoirs and I have plenty of references to show that usually more wells, more oil. This goes way back to the thirties, Cutler's Rules, Thomas' work and then I introduced this paper for the record incidentally, if Mr. Stamets will accept it, which gives the same thing, more wells, more oil and this field has about the same porosity and about the same formations.

Q. Do you have any additional documentary evidence which would support your interpretation of the reservoir performance?

A. Only what I have heard from Amoco. Now, this somewhat relates to your prior question. There are many areas where you can go back into field and drill wells and get a lot of oil, say from a hundred and sixty to forty acre spacing as has been done in this paper here and it has been done in many. The literature is full of that too, he works for high price, he works for low price. Now you may get the same pressure in another well, that's why I asked the question of your witness

as to whether or not he had any draw-down tests between a shut-in well and an open well and to see if he had any information on communications. I'm not sure that it would definitely be reliable if he had answered, yes, but I asked the question. But very often you can get the same pressure in the middle of the field almost like the pressure you had in a well originally if you have fairly poor communication.

Q. All right, then your basic disagreement is, I think, and correct me if I'm wrong again, your figures from Amoco's form on the Peterson "C" 1, which form was filed with the Commission, the form indicating that the gross porosity interval productive of oil in your opinion is seven seven five nine to seven seven eight two and you consider a great deal more of that porosity to yield hydrocarbons than Amoco does, is that correct?

A. I don't believe Amoco stated what they expected it to yield. I didn't hear that, I don't believe.

Q. Well, you deem all or a vast majority of that gross porosity to be productive of hydrocarbons, is that correct?

A. All I can do was to assume as is normally done in the field, is to perforate your porous formation, that's all I can do is assume that Amoco did, so that's what I used. You are not going to get me in a trap.

Q. I'm not trying to trap you.

A. I'm not just saying that there is only ten feet

because I can't buy it, I don't know.

Q. Well, you don't recall what the electric log that you examined showed insofar as the porosity is concerned?

A. No, sir, I had a little difficulty with the copy that I had trying to interpret the net. I had several logs on that well and the well to the north up there too and I had some difficulty. However, I did not come up with a ten foot -- I didn't come up with any figure, let me put it that way, I was lost.

MR. PETERSON: I thank you, Mr. Benischek. That's all the questions I have. I would, however, like to call Mr. Rice for redirect if there are no further questions of Mr. Benischek.

MR. STAMETS: I've got one or two of Mr. Benischek.

MR. BENISCHEK: Yes, sir.

CROSS EXAMINATION

BY MR. STAMETS:

Q. You have discussed carbonate reservoirs and you did submit a paper concerning the Mississippian reservoir in Oklahoma, have you studied the New Mexico carbonate reservoirs such as the Lusk-Strawn, Indian Basin, Upper Pennsylvanian, the Dagger Draw, the Empire-Abo, not Empire-Abo, it's obviously not a Pennsylvanian reservoir but it's a major carbonate reservoir in the state, have you studied those?

A. I'm a petroleum engineer, I have performed geology, I have worked on Fusselman wells which are similar, I'm familiar with the formation and I know about what it does. This particular field, this particular formation, I haven't been in the field since this has been developed but I know about -- I have examined Fusselman under the microscope, which is also a carbonate.

Q. So the ones that I've named which are not exactly recent but modern Pennsylvanian reservoir developments in the State, you have not examined to determine whether or not they fit your statement that there is no good communication in carbonate reservoirs?

A. Well, I haven't examined those specifically but the geological literature, as I said I'm not a geologist, but the literature contains many references to non-communicating characteristics of carbonates.

Q. I would state that I believe the records of the Commission contain a considerable amount of evidence on communication in these pools which is available and might be of interest to anybody wanting to study the same.

A. I would have to have a lot of information on pressures and draw downs to verify to my satisfaction.

MR. STAMETS: Let's go off the record a minute.

(THEREUPON, a discussion was held off the record.)

MR. STAMETS: Back on the record.

MR. PETERSON: Mr. Examiner, Amoco would like to request a continuance so that additional information may be developed and presented at a later date to better define Amoco's recommendation to adopt, to make the temporary field rules permanent.

MR. STAMETS: Okay, this case will be continued to the Examiner Hearing in July, the 20th of July.

We will continue this case. I presume Mr. Peterson you could have this in a couple of weeks if we got to it that quick?

MR. PETERSON: I feel confident that we could.

MR. STAMETS: We do need to continue this to an examiner hearing where I am the examiner and because of some scheduling problems I have I could not say just now whether I will be the next examiner or the following examiner but we will determine that before the week is out and advise both of you, Mr. Benischek and Amoco, when the case will be rescheduled.

If there is nothing further we will continue this case.

REPORTER'S CERTIFICATE

I, SIDNEY F. MORRISH, a Certified Shorthand Reporter, do hereby certify that the foregoing and attached Transcript of Hearing before the New Mexico Oil Conservation Commission was reported by me, and the same is a true and correct record of the said proceedings to the best of my knowledge, skill and ability.

Sidney F. Morrish, C.S.R.

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BEFORE THE
NEW MEXICO OIL CONSERVATION COMMISSION
OIL CONSERVATION COMMISSION CONFERENCE ROOM
STATE LAND OFFICE BUILDING
SANTA FE, NEW MEXICO
Wednesday, May 9, 1973

EXAMINER HEARING

IN THE MATTER OF:

Application of Amoco Production Company for special pool rules, Roosevelt County, New Mexico.

Case No. 4962

BEFORE: Daniel S. Nutter,
Examiner

TRANSCRIPT OF HEARING

MR. NUTTER: We will call next Case 4962.

MR. CARR: Case 4962, application of Amoco Production Company for special pool rules, Roosevelt County, New Mexico.

MR. COOTER: Mr. Examiner, I am Paul Cooter with Atwood and Malone, again entering our appearance on behalf of the applicant Amoco Production Company. The case will again be presented by Mr. Jerry Gross.

MR. NUTTER: Thank you, Mr. Cooter.

MR. GROSS: Again, for the record, Mr. Examiner, my name is Jerry Gross, I am an attorney with Amoco Production Company. I have one witness who has previously been sworn.

DANIEL R. CURRENS,

a witness, having been previously duly sworn according to law, upon his oath, testified further as follows:

DIRECT EXAMINATION

BY MR. GROSS:

Q Would you state your name for the record, by whom you are employed, and in what capacity?

A Dan R. Currens, employed by Amoco Production Company, Staff Engineer.

Q Have you prepared or had prepared under your supervision certain exhibits to be submitted to this hearing, concerning the Peterson-Penn Pool?

A Yes, sir.

MR. GROSS: Are there any questions about Mr. Currens' qualifications?

MR. NUTTER: No.

Q (By Mr. Gross) Mr. Currens, briefly, would you review precisely what you are requesting in the Peterson-Penn Pool and be quite specific about it?

A Yes, sir. We apparently have discovered an associated oil and gas pool here, and we are requesting rules that are appropriate to that kind of production.

Specifically, we are requesting that oil wells be on 160-acre spacing with a 160-acre depth bracket allowable for the depth, which is between 7,000 and 7,999. Further, that the gas-oil ratio limit for the oil wells be 4,000 to 1. We are recommending that the classification of the well as an oil well be that it produce with a liquid gravity less than 60 degrees api. or with a gas-oil ratio less than 25,000 to 1.

We are recommending with respect to the gas wells, that gas be on 320 acres, as is conventional for a Pennsylvanian gas production, and that the allowable for a gas well be proportionate on an acreage basis to the oil well gas limit; that is, a gas well allowable, for example, for a 320-acre gas unit would be the gas limit for the 160-acre oil allowable times 2.

Q Have you prepared a structure map on top of the Cisco

carbonate in the Peterson-Penn Pool, Mr. Currens?

A Yes, sir, I have.

MR. GROSS: We've identified, Mr. Examiner, as Exhibit 1, Mr. Currens' structure map.

Q (By Mr. Gross) Now, what does your structure map depict, Mr. Currens?

A Well, this is the top of the Cisco in the area of the Peterson-Penn Pool, and it shows the structure based on the control from the eight wells that have been drilled here to date. You will note that to the west, the structure map is not completed, even though the westernmost well, the one in Section 24, did go to the Cisco. It appeared that there might be some faulting in that well; and, so, knowing what the location of that faulting might be, I didn't run the contours on out to that side. Certainly, the pool is limited on the west by that dry hole.

Q Have you identified the two gas wells that have been completed in this field, Mr. Currens?

A Well, as you say, we have two gas wells in the field, and they are the wells with the red circles around them.

Q Those are the what?

A Those are the Amoco Peterson Gas Com "A" Number 1, which is in the north half of Section 19, and the Swearingen Gas Com "A" Number 1, which is in the south half of

Section 19; both of those being in Township 5 South, Range 33 East, Roosevelt County, New Mexico.

Q Have you identified the unit that each one of those wells are attributed to by hashed lines?

A Yes, the northern well has the north half of the section for the unit and the southern well has the south half of the section for the unit.

Q How have you identified your oil well in this field, Mr. Currens?

A That's the green dot in Section 18.

Q What are the brown dots?

A The brown dots are wells that activated the Cisco, or were drilled to the Cisco or below, in this immediate area, that did not result in completions in the Peterson-Penn Pool.

Q Mr. Currens, what is the tract that you have on here in red on your Exhibit 1?

A That's the trace of a cross section that includes each well that's been drilled in here.

MR. NUTTER: That's not indicated on this exhibit.

MR. GROSS: As Exhibit 2, Mr. Examiner, we have identified Mr. Currens' cross section.

Q (By Mr. Gross) And, this is an eight-well cross section, is it not, Mr. Currens?

A That's correct.

Q And this includes all the wells that have been drilled in this field?
A Yes, and drilled to that horizon, even though they were not completed in this pool.
Q If you would, explain what is the straight -- well, I can't call it straight -- the rather crooked line that runs across your cross section.
A The one that runs up and down?
Q Yes, sir.
A The solid dark line is a structural depiction of the top of the Cisco in these wells.
Q Have you also identified by little circles where these wells have been perforated?
A Yes, as well as the intervals of Drill Stem Tests, squeeze of perforations, and so on.
Q Referring specifically to the three producing wells, is there good continuity, and are you producing from the same common sand in those three wells?
A Yes, sir, I believe we are. The three producing wells that we have here are the second from the left, Peterson C-1, the one immediately to its right, the Peterson "A" Gas Com 1, and then skipping to the third from the right, the Swearingen "A" Gas Com 1; and, in looking at those three wells, just starting with the Peterson C, you can see the same correlative interval there between, say,

about 7,725 to 7,810, where that well's perforations are exhibited within that interval. You can see it in the next well, the Peterson A, in an interval 7,680 down to about 7,780, and in the Swearingen you see that same interval appear at about 7,670 down to around 7,750.

Q In addition to this continuity that you see on this cross section, Mr. Currens, do you have some pressure information which also lends support to the fact that these three wells are in the same common reservoir?

A Yes, sir.

Q What is that pressure information?

A The discovery well in this pool was the Peterson "A" Gas Com 1, and the bottomhole pressure on that well at the end of its potential test was 2719 psi. The second producer or completion that was drilled -- actually, neither of these gas wells are producing because there is no market out there right now; the Swearingen "A" Gas Com had a bottomhole pressure on completion of 2738 psi, at the same datum, and those wells were completed about a year and a half apart. And, the Peterson C, the oil well in Section 18, initially on completion we measured a bottomhole pressure of 2660 at that datum. In February of this year, after the well had been out of its test period and had been shut-in for a rather extended period of time, we measured a pressure of 2720

psi. So, apparently, that first pressure wasn't quite built-up when we measured it; so, I've got three pressures of 2719, 2720, and 2738, which all indicate that this is a pool.

Q Mr. Currens, do you have any porosity or permeability figures? We are looking at this cross section on these wells.

A Yes, we did some coring in here, and in the producing wells we have seen permeability up to 13 millidarcies, and porosity up to 12 percent.

Q Mr. Currens, have you prepared an exhibit which sets out the summary of the completion information of each well in this field?

A Yes, sir, the completion attempts.

MR. GROSS: Mr. Examiner, we have identified as Exhibit 3-A through 3-H the various wells that have been completed and attempted completions in this field.

Q (By Mr. Gross) Again, with Exhibit 3-A, Mr. Currens, the Phillips Peterson "D" Number 1, as I understand it, this exhibit also runs from north to south, is that correct, as far as your line of sections is concerned?

A As far as the cross section goes, it's from north to south or from left to right on the cross section. The first well on Exhibit 3-A is the left-hand well on the cross section.

Q On the Phillips Peterson "D" Number 1, what happened to it?

A Well, that well was drilled to a total depth and after evaluation of log and core, it was completed as a dry hole, March 14, 1973, with no completion attempt being made, no log stem or pipe was run.

Q Now, on your Peterson "C" Number 1, Mr. Currens, when was this well completed?

A This well is the oil producer. It was completed November 29, 1972. It potentialed 294 barrels of oil in 24 hours, with 1,500 to 1 GOR. The gravity of the liquid was 45.5 degrees api.

Q Did this have a 60-day test, Mr. Currens?

A Yes, sir, it did produce for a test period.

Q What happened during your 60-day test, as far as producing characteristics are concerned?

A During the 60-day test, it produced a little over 11,000 barrels of oil at an average gas-oil ratio of 4570, and the gas-oil ratio at the last of the test was 8,750.

Q What were your rates, Mr. Currens?

A During the test period, rates were up to 320 barrels a day.

Q Mr. Currens, what is the status of this field at this time?

A Well, it's all shut-in. There are two gas wells, one

oil well which produced for a test period. We are negotiating for a market right now; we don't have one firmly set yet.

Q Mr. Currens, looking at your oil well, now, you've requested 160-acre proration units, have you not?

A Yes, sir.

Q Based on the data you have available, do you feel that one well will adequately drain 160 acres in this oil reservoir?

A I think from what we've seen, one well should drain 160 acres here.

Q Continuing on down your line of sections, Mr. Currens, we come to the Amoco Peterson Com Number 1. Now, this is one of your gas wells, is it not?

A Yes, sir. That's a northern gas well and the discovery well in the field.

Q What was its test data?

A It was completed August 28, 1971, calculated open flow of 7210 Mcf a day. It had a Gas Condensate ratio of 27,700, and it's liquid gravity was 70.5 degrees api.

Q Continuing on, Mr. Currens, you next come to the C. W. Radcliffe, a dry hole. When was that well completed as a dry hole?

A It was plugged and abandoned August 26, 1972, after Drill Stem Test indicated no peak.

Q Your next well on the line of sections is the Swearingen "B" Number 1. Now, what is the status of that well?

A That's over on the east side of the field and this has been completed as a dry hole April 17, 1973. We tested this Cisco interval in here and we had some float gas after some swab runs. But, we were never able to get the well to flow and we had water production from it. We swabbed water.

Q Mr. Currens, if you would, review the test data on your third well that's completed in this field, the Swearingen "A" Gas Com Number 1, your southernmost producer.

A Okay. That well was completed February 25, 1972. It had an absolute open flow of 25,820 Mcf a day, had a Gas Condensate ratio of 25,900 to 1, and its liquid gravity was 70.5 degrees api.

Q Mr. Currens, if you would, briefly review the status of the other two wells at the southernmost portion of the field, which are presently shut-in.

A Okay. The Lambert Gas Com Number 1, as it was drilled, tested in the Canyon unsuccessfully, just water, and then up in the Cisco we had little traces of gas in this well, which is the upper set of perforations 6,650 to 58, but we didn't have commercial gas in the well, and it's now

shut-in. We may need it for a water-disposal well or something else at a later date.

Q That was shut-in in November of '72, is that correct?

A Yes, that's when we finished our testing on it.

Q All right. What about your Peterson "B" Gas Com Number 1?

A Again, we were unsuccessful in establishing production from the Cisco. We really only got back a little water after all our stimulation water, which is outlined on the data sheet, and it was shut-in in August of '72. Again, prospectively, we may use it for a water-disposal well or some other zone of test.

Q Mr. Currens, based on your study, have you recommended rules which you feel will both protect the Gas Cap and the oil column and prevent the migration of oil into the Cap which could cause waste?

A Yes, sir.

Q How is that?

A Well, I think we probably have a pretty thin oil column here as compared to the Gas Cap. Certainly, the reservoir seems to have limited areal extent, and two of the wells are gas wells. We wouldn't want oil column oil to be sucked up and resaturate gas saturated rock. So, with the recognition that the gas wells produce a proportionate oil well gas limit, we favor the oil well very slightly by the production of oil from that well not

being in the formula which should give it just slightly greater withdrawals than the gas wells would have and therefore keep away from the prospect of oil migrating up structure and resaturating the Gas Cap.

MR. GROSS: Mr. Examiner, that concludes our Direct Testimony. We offer into evidence our Exhibits 1, 2, and 3-A through 3-H.

MR. NUTTER: Applicant's Exhibits 1, 2, and 3-A through 3-H will be admitted in evidence.

CROSS-EXAMINATION

BY MR. NUTTER:

Q Mr. Currens, you've got the ratios on here for these two gas wells. What was the fluid production on those tests?

A I'll have to calculate it because I didn't write it down.

Q If you don't have it, that's all right, as long as the GR's are correct.

A The Gas Condensate ratio was taken from that fluid production.

Q Well, we can obtain that, then. Now, you mentioned that while you were testing the oil well, that the GOR at the end of the test was 8,750. Was that GOR showing a steady increase during the 60-day production test?

A Broadly, yes, sir. Production was not constant nor completely uniform during that test period. That was a pretty bad spell of water there, for one thing, but

steadily, yes, if you plotted a trend you would see an up stroke.

Q What was the original ratio when you first tested the well?

A The potential test, 1,500.

Q Then, it ended the 60 days at 8,750, but it averaged 4,570?

A Yes, sir. Actually, during the course of the testing there, we changed our meter and we found somewhat different test results. I have a little basic doubt about that original 1,500, Mr. Examiner. I would think it would have been higher than that.

Q Now, is this a flowing well or pumping?

A It's a flowing well.

Q What were the rates of production during that 60 days?

A All the way from 60 or 80 barrels a day to about 300, 320.

Q Was this 60 to 80 because the well was pinched?

A It was pinched in because of tank room. As I say, that was a rather bad weather period.

Q It didn't indicate any lack of capacity on the well's part?

A No, sir. In fact, the last production was something over 200 barrels a day. I'm talking from memory, but it had 1,400 or 1,500 flowing pounds, flowing tubing pressure.

Q This is a crude oil that's produced from this well?
A Yes, sir, that gravity difference is rather marked and it does look like crude.
Q Is there an oil-gas contact in here?
A There has to be one, but we haven't been able to pin it down with our work; but, obviously, there must be one. We've got good communication, I think, throughout the field. We have a Gas Cap and oil rim, is what it looks like.
Q Do you anticipate any further drilling at this time?
A I don't anticipate any at this time. We are always looking for prospects.
Q How many of these wells that are shown on the cross section here did Amoco actually drill?
A Amoco drilled all but one, the Phillips Peterson "D" 1, the northernmost well, and we are a partner in that well.
Q So you feel it is a reservoir of quite limited areal extent?
A Unfortunately, yes.

MR. NUTTER: Are there any further questions of Mr. Currens?

(No response.)

MR. NUTTER: He may be excused. Do you have anything further, Mr. Gross?

MR. GROSS: No, sir, Mr. Examiner.

MR. NUTTER: Does anyone have anything they wish to offer in Case Number 4962?

(No response.)

MR. NUTTER: We will take the case under advisement and call a 15-minute recess.

(Whereupon, the hearing was recessed for 15 minutes.)

REPORTER'S CERTIFICATE

I, JOHN DE LA ROSA, a Court Reporter, do hereby certify that the foregoing and attached Transcript of Hearing before the New Mexico Oil Conservation Commission was reported by me; and that the same is a true and correct record of the said proceedings to the best of my knowledge, skill and ability.

COURT REPORTER

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