BEFORE THE
OIL CONSERVATION COMMISSION
FARMINGTON, NEW MEXICO

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IN THE MATTER OF:

CASE NO. 1508 and
CASE NO. 1523

TRANSCRIPT OF HEARING

October 15, 1958

DEARNLEY - MEIER & ASSOCIATES
GENERAL LAW REPORTERS
ALBUQUERQUE, NEW MEXICO
Phone CHapel 3-6691

BEFORE THE
OIL CONSERVATION COMMISSION
FARMINGTON, NEW MEXICO
OCTOBER 15, 1958

IN THE MATTER OF:

CASE 1508 Application of El Paso Natural Gas Company for the establishment of 320-acre spacing units for the Dakota formation in San Juan and Rio Arriba Counties, New Mexico. Applicant, in the above-styled cause, seeks an order establishing 320-acre spacing units for all gas wells drilled to or completed in the Dakota formation in San Juan and Rio Arriba Counties, New Mexico, including the fifteen presently designated Dakota gas pools in said counties; and for the promulgation of special rules and regulations for said pools.

CASE 1523 Application of El Paso Natural Gas Company for an order establishing 320-acre drilling and spacing units and promulgating special rules and regulations for certain formations in San Juan and Rio Arriba Counties, New Mexico. Applicant, in the above-styled cause, seeks an order establishing 320-acre drilling and spacing units in San Juan and Rio Arriba Counties, New Mexico, and promulgating special rules and regulations for the gas producing interval lying between the base of the Greenhorn limestone of Cretaceous age and the base of the productive upper portion of the Morrison sandstone of Jurassic age, which includes undifferentiated Graneros, Dakota, and Morrison sands. The application includes all currently designated Dakota Gas Pools, Graneros Gas Pools and Graneros-Dakota Gas Pools with exception of the Barker Creek-Dakota Gas Pool and the Ute Dome Gas Pool.

BEFORE: Mr. A. L. Porter
Mr. Murray Morgan

TRANSCRIPT OF PROCEEDINGS

MR. PORTER: The meeting will come to order, please. At this time the Commission will consider Cases 1508 and 1523.

MR. PAYNE: Case 1508. Application of El Paso Natural Gas Company for the establishment of 320-acre spacing units for the Dakota formation in San Juan and Rio Arriba Counties, New Mexico.

CASE 1523. Application of El Paso Natural Gas Company for an order establishing 320-acre drilling and spacing units and promulgating special rules and regulations for certain formations in San Juan and Rio Arriba Counties, New Mexico.

MR. HOWELL: I am Ben Howell of El Paso Natural Gas Company. If it please the Commission, Case 1508 was continued from the last hearing when it developed that within the area of the Dakota formation were certain other formations that had been included with the Dakota in the designation of certain pools and that probably should be produced with the Dakota. As a result of that development, the case was continued and Case 1523 filed which defines with more accuracy the lateral limits of the area under consideration. Therefore, at this time, I would like to move to consolidate the two cases and to have the evidence which was introduced in Case 1508 applicable and to be considered in Case 1523. That will prevent us spending a couple of hours of going back over that testimony.

MR. PORTER: Is there objection to the counsel's motion?

MR. COOLEY: Mr. Howell, I take it that you expect only one order to be written as a result of the two cases?

MR. HOWELL: I would.

MR. PORTER: Without objection, the motion will be granted.

MR. HOWELL: Now, there have been other developments since we have been at this hearing. At the last hearing it appeared that an operator represented -- I think Mr. Brown is representing himself and Mr. Weaver, who have some wells in the Angels Peak-Dakota Pool, which have been developed on a 160-acre spacing, wished to have some additional time for testing, and after consultation with them, we feel that in the interest of expediting action for the rest of the basin and narrowing any controversy that we may have with each other to that one area, that we move now and ask for permission to withdraw and exclude the Angels Peak-Dakota Pool from the consolidated cases.

MR. PORTER: You are making a motion to amend your application to that effect?

MR. HOWELL: I so move.

MR. PORTER: Is there objection to the counsel's motion for amendment of the application?

MR. WHITING: Kenneth R. Whiting, attorney for Sunset International Petroleum Corporation. I would just like to make it clear if the withdrawal of the Angels Peak Pool from the effect of the order would only affect the Angels Peak Pool as it now exists, is that correct, Mr. Howell?

MR. HOWELL: That is my intention, and I might ask that when the nomenclature case which involves an extension to the present Angels Peak Pool is offered, I am going to ask for that portion of the nomenclature case to be extended and continued. That would give an opportunity for further study. And I may state that we probably, as a result of the study, will file an application for 320-acre spacing for the Angels Peak-Dakota Pool, and have a hearing in which the issues are limited to that relatively small area, and we think probably a better decision can be made and better evidence obtained where there is controversy about the matter.

MR. WHITING: That area would be limited to the Pool as it now exists and we would defer the petition today by tne Commission to expand the Angels Peak Pool.

MR. HOWELL: I would ask the Commission to do that. Of course, I can't speak for what the Commission would do.

MR. PORTER: Any further discussion on counsel's motion for amendment to the application? The motion will be granted.

At this time I would like for all who would like to have appearances in this case or intend to make appearances, will you please identify yourselves?

MR. HOWELL: El Paso Natural Gas Company is represented in this case by Oliver Seth, Garrett Whitworth and Ren R. Howell.

MR. KELLAHIN: Jason Kellahin of Kellahin & Fox, Santa Fe, representing Phillips Petroleum Company.

MR. BUELL: Guy Buell for Pan American Petroleum Cor-

poration.

MR. WHITING: Kenneth R. Whiting for Sunset International Petroleum Corporation.

MR. CHRISTIE: R. S. Christie, Amerada Petroleum.

MR. BRATTON: Howard Bratton, Hervey, Dowe & Hinkle, Roswell, appearing for Humble Oil and Refining Company.

MR. PORTER: Anyone else that desires to make an appearance in the case?

Mr. Howell, will you proceed with your testimony at this time, please, sir?

MR. HOWELL: Our witness, who was on the stand the last time, I believe, was sworn, but possibly it should be well to have the witnesses re-sworn since there is a new case.

MR. PORTER: One of the witnesses was not sworn the last time, so suppose we have all of them sworn at this time.

MR. HOWELL: Fine, fine, Mr. Porter.

(Witnesses sworn)

MR. HOWELL: Will Mr. Loleit take the stand.

ALLAN LOLEIT,

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

DIRECT EXAMINATION

BY MR. HOWELL:

Q Will you state your name for the record?

A Allan Loleit.

Q Mr. Loleit, you are the same Allan Loleit who testified in Case 1508 a month ago at the last hearing?

A Yes, sir.

Q And the exhibits which have been placed on the board here are the exhibits which were introduced by El Paso Natural Gas Company at the last hearing?

A Yes, sir.

Q Perhaps it might expedite matters if you would state very briefly what each exhibit consists of and if there have been any changes in the conditions or any additional information which you have obtained since the last hearing, and ask that you then state to the Commission what those changes have been.

A Exhibit No. 1 is this map here of the portion of San Juan basin. It shows all Dakota wells as of September 29th of this year. Blue indicates a well that has penetrated the Dakota, but is not producing from the Dakota. Red indicates a well that is producing gas from the Dakota. Black indicates a well that is producing oil from the Dakota. And half red and half black indicates oil and gas from the Dakota. Those lines across the map there with the numbers on it indicate cross sections which are Exhibits 3, 4, 5, 6 and 7; on this board there, and they more or less prove the existence of the Dakota throughout the basin. On the cross sections, the test tract, when it is filled in solid with red, indicates that gas is being produced from that zone. And the black indicates that there is oil producing from that zone.

Q Now, have there been any changes that you have discovered that should be made as to any of these exhibits since the last hearing?

A Yes. On one cross section Magnolia Ingwerson, which I previously listed as a dry hole, is still producing oil and water and gas. That's on cross section No. 2. And also on cross section No. 3, on the extreme left of the section Southern Union Culpepper Martin No. 2 is now **Aztec's Culpepper Martin No. 2, and that has produced gas from the Dakota at one time, but it is plugged back and producing from the Mesaverde at present.**

Q I think in your testimony a moment ago, you stated that the Exhibit No. 1 showed all wells completed to September 29, which is after the last hearing.

A Pardon me.

Q Are you in error as to that date?

A The date is wrong, yes.

Q What should the date -- to what date does the Exhibit show the wells?

A Those show to September 29th of this year; the last hearing was the 17th, I believe.

Q And there were no wells completed between the 17th and the 29th?

A Yes, there were some completed, and I added a few wells to that Exhibit.

Q I see.

MR. PORTER: In other words, the map has been brought up to date, to September 29th, showing all completions?

A Yes, sir.

Q (By Mr. Howell) But has there been any significant change that would change the conclusions which you reached in your testimony at the last hearing?

A No, sir.

Q Now, before cross examination, I would like to recall your testimony under cross examination, I believe, by Mr. Nutter. In discussing the comparison between the characteristics of the Dakota formation with the Mesa Verde formation or the Pictured Cliffs formation, and in reading the testimony, it is not clear to me just what your opinion is. Will you please state to the Commission what your opinion is with reference to the comparison of characteristics of the Dakota formation, first with the Mesa Verde and then with the Pictured Cliffs?

A Well, the Mesa Verde formation itself, I believe the production aerially will be as widespread or more so than with the Mesa Verde.

Q That is the Dakota --

A The Dakota will be, yes. And the Pictured Cliffs formation has areas of spotty permeability which I don't -- with evidence up to this time, I can't see that carries through with the Dakota.

Q Have you found in your study of the Dakota formation any evidence of corridors of low permeability which separate trends

as there appear to be corridors of low permeability separating trends in the Pictured Cliffs formation and resulting in the designation of different Pictured Cliffs Pools?

A In the Dakota I found no such trends.

Q Now, have you collected, since the date of the last hearing, any data relating to the wells which you have shown on your cross sections and compiled it in the form of a schedule?

A Yes, sir.

MR. HOWELL: Would you mark that as El Paso's Exhibit No. 8.

What have you shown as to each well that is covered by the cross sections on El Paso's Exhibit No. 8?

A On these cross sections I have the name of the well, the location, the date of the completion, the top of the Graneros, the total depth, the potential, the producing interval, how the well was stipulated and what drill stem tests were run in the Dakota.

Q Would you like to summarize your conclusions and reasons for your recommendations as to the vertical limits which should be established in this hearing? I might state that possibly, for convenience, we may refer to the producing gas sands lying below the base of the Greenhorn and above the upper producing portion of the Morrison as the Dakota reservoir. Now, what would you include within the Dakota reservoir to be subject to the spacing order which the Commission has been asked to issue?

A That includes the Dakota sand, the Dakota formation and

the upper part of the Morrison.

Q Have you found the gas produced from each of these sources to be comparable in quality and pressure?

A I believe they are.

Q And what is the extent, generally, of the separation that you found to exist between these separate sources?

A In the Graneros sand, between that and perhaps the top of the Dakota, there is sometimes an interval of maybe ten, twenty, thirty feet of shale, and then between the lower Dakota and the upper Morrison, it is indefinite where you can definitely pick a top.

Q Have you found any evidence of communication in places between the Graneros and the Dakota, or do you think there is communication in places?

A I think there very well could be communication between the Dakota sand and Graneros sand.

Q Now, is the Graneros sand a blanket-in sand condition, underlying the same area as the Dakota?

A It is a blanket sand except for several areas where the Graneros sand is not present.

Q So that it does exist with the Dakota in some areas and not in others?

A Yes, sir.

Q And is it a gas producing sand in all the places where it exists?

A Toward the deepest part of the basin, I believe it is all gas producing except in the Graneros Otero Field it is oil, producing oil and gas.

Q Produces both oil and gas. Any portions of what you would call the Graneros formation that are non-productive, is any part of it shale rather than sand formation?

A Yes, it's shale.

Q And is that situation one that is spotty over the Field?

A No. The Graneros sands, where it is present, covers considerable areas.

Q And then about what is the interval of separation between the Graneros sands and the Dakota in those places?

A Anywhere from perhaps a few feet to maybe twenty, thirty feet.

Q Now, approximately what vertical limits in feet would be covered by your recommended definition of the vertical limits for this Dakota reservoir?

A I'd include at least four hundred feet from the base of the Greenhorn down.

Q Briefly, about what is the interval between the top and the base of the Mesa Verde formation in the basin?

A About eight hundred feet.

Q And does the Mesa Verde formation have several producing -- gas producing members in it?

A Yes, sir.

Q Is one of the topmost members, the Cliff House, gas producing?

A Yes, sir.

Q And the lowest member, the Point Lookout, gas producing --

A Yes, sir.

Q -- or one of the lowest, let's say?

A Yes.

Q So, is the situation which exists in the Mesaverde formation comparable to that which exists in this Dakota reservoir?

A Yes, sir.

MR. HOWELL: That's all.

MR. PORTER: Anyone have a question of the witness at this time? Any questions of Mr. Loleit?

Mr. Howell, are there any exhibits that you wanted to enter at this time?

MR. HOWELL: If they have finished with his testimony, I would like to offer our Exhibit No. 8.

MR. PORTER: Without objection, El Paso's Exhibit No. 8 will be admitted into the record.

MR. KELLAHIN: I have a question here in just a moment.

MR. PORTER: Mr. Kellahin.

CROSS EXAMINATION

BY MR. KELLAHIN:

Q Your definition of the vertical limits, am I correct in my understanding your recommendation, is the base of the Green-

horn through the undifferentiated Morrison formation, productive upper portion of the Morrison and no further than that?

A Well, it depends on how far -- well, let me say it is awfully hard to pick the top of the Morrison, and you might have some sand, maybe twenty, thirty, forty feet thick in the top of the Morrison, if our peaks are correct, but below that you will find perhaps the brushy basin shale, maybe some minor sand strands, and there is no production as far as I know, or no shows of gas from the brushy basin, so it would be the sand units above the brushy basin which are hard to differentiate between the Dakota.

Q In other words, you would not then necessarily include the first producing interval encountered in a Morrison well?

A No.

Q In your examination, did you find any evidence of vertical impermeability between the formations which you have discussed, that is, as between the Graneros and the Dakota, or between the Dakota and the Morrison?

A Vertical impermeability?

Q No, horizontal impermeability. I stated that wrong.

A There is probably some. I don't recall of any offhand.

MR. KELLAHIN: Thank you.

QUESTIONS BY MR. COOLEY:

Q Mr. Loleit, I am still somewhat confused as to how you would identify the vertical limits of the producing interval about which you are testifying here. If you were to have to identify it

from an area, I take it from your testimony that the top would be picked as the base of the Greenhorn, is that correct?

A Yes, sir.

Q Now, tell me how you pick the bottom of this producing interval.

A Well, the Graneros interval, the shale, including the sand, sometimes vary between fifty and a hundred feet, sometimes it might be less than that, than the average thickness of the Dakota, from the outcrop studies, I think the maximum we found was about 225 feet, so that brings us to almost up to 375 feet total thickness, then I allowed a little more for sand that might be below the Dakota that might be lower Cretaceous or Morrison.

Q You still haven't told me exactly how you would pinpoint this in defining the vertical limits of this area which is to be spaced. That's the problem that I am confronted with. Do you pick it from a formation, or do you pick it from a footage measurement from the base of the Greenhorn?

A On the average, the way I stated previously, it would probably be on a footage basis, but picking the top of your Morrison sometimes is a problem. What we usually do, we first drill through about 200 some odd feet of Dakota, the first conglomeration or first shale you meet, we would consider that the upper Morrison and then stop.

Q Mr. Loleit, you still haven't pinpointed the base of the horizon or producing interval which you intend to space that you

are applying for spacing in this hearing, and before we can proceed I think it is necessary that you define the limits, the vertical limits of the interval which you propose to space. Now, there's got to be some way of determining what we are dealing with here.

A Yes.

Q You define the top of it as being the marker, or the base of the Greenhorn. Now, do you propose to define the base of this producing interval as possibly four hundred feet below the base of the Greenhorn, or do you intend to pick a formation as the bottom of this thing?

A Well, in areas it would vary. It probably would be less than four hundred feet.

MR. HOWELL: May I interrupt --

MR. COOLEY: Please do.

MR. HOWELL: -- with a question that might clarify it? Mr. Loleit, would it be possible to define the bottom as being a hundred feet into the Morrison formation, would that cover all producing gas sands that should be covered in this reservoir?

A I believe it would.

Q (By Mr. Cooley) Mr. Loleit, can you pick the top of the Morrison?

A Well, that's pretty hard.

Q You can't get a hundred feet below it?

A Let me say something. Your top of the Morrison would either be, possibly be a conglomerated or virgated shale, usually

a green shale in this area, and I don't recall offhand of any virgated shale in the Dakota. They have some black shales in there.

Q Let's put it this way. If this interval which you propose to space were defined as that interval lying between the base of the Greenhorn and four hundred feet below the base of the Greenhorn, would you include anything in this interval which you desire here to exclude?

A No.

Q Would you include everything that you desire here to include?

A Yes.

MR. COOLEY: No further questions.

MR. PORTER: Anyone else have a question of the witness? No further questions, the witness may be excused.

(Witness excused)

MR. PORTER: At this time the hearing will recess until one-thirty.

(Recess)

MR. PORTER: The hearing will come to order, please. Mr. Howell.

MR. HOWELL: If the Commission please, at the last hearing some of the staff suggested that we produce testimony showing the areas in which the ownership above the base of the Mesaverde was different than the ownership below the base of the Mesaverde. The next witness will testify as to that matter. With that intro-

duction, I will call Darryl Canfield.

DARRYL CANFIELD,

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

DIRECT EXAMINATION

BY MR. HOWELL:

Q Mr. Canfield, please state your name for the record.

A Darryl Canfield.

Q And what position do you occupy with El Paso Natural Gas Company?

A Division landman in Farmington, New Mexico.

Q As such, do you have records showing the ownership of lands in the San Juan Basin in San Juan and Rio Arriba Counties, New Mexico?

A Yes.

Q Have you prepared a map reflecting certain features of ownership?

A Yes.

Q Will you mark that as El Paso's Exhibit No. 9, and state to the Commission what that map shows?

A Yes. The acreage shown in blue on the map is acreage in which the Dakota and Mesaverde ownership and the working interest is owned by different parties. The acreage shown in yellow is acreage where the ownership in the Dakota and Mesaverde are basically the same, there being a difference in some acreage. There

is a second party that has a right to drill and explore in the Dakota, but should a gas well be completed, it can be turned over to the owner of the Mesaverde for operation.

Q Now, what does the area in white reflect?

A The area in white is where we did not have information available or did not obtain that information.

Q Well, does that map correctly reflect the information which has been accumulated in El Paso's Farmington office in the Land Department regarding the ownership?

A Yes.

MR. HOWELL: We offer Exhibit No. 9 in evidence.

MR. PORTER: Without objection, El Paso's Exhibit No. 9 will be admitted.

MR. HOWELL: That's all the questions I have.

MR. PORTER: Any questions of the witness? The witness may be excused.

(Witness excused)

F. NORMAN WOODRUFF,

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

DIRECT EXAMINATION

BY MR. HOWELL:

Q Will you state your name for the record?

A F. Norman Woodruff.

Q What position do you hold with El Paso Natural Gas Company?

A I am the company's manager of gas proration operations.

Q What experience have you had with reference to reservoir engineering?

A I am a graduate petroleum engineer. Prior to assuming my present position with the company, I worked in the company's geological and reservoir engineering section doing reservoir engineering work, and I have testified before this Commission as a reservoir engineer on the San Juan basin on numerous previous occasions.

Q In connection with your testimony today, have you had available and used the information which the company has in its reservoir engineering department?

A Yes, sir, I have.

Q Well, now, will you please state briefly the type of data which you have studied and the records which you have studied in preparing to testify in this hearing?

A I have reviewed the core analysis, certain electric logs, the drilling completion, testing and production history of the wells.

Q Now, of how many wells?

A Of forty-one wells.

Q Have you had core analysis of all of those?

A No, on twelve wells.

Q Now, is there any other information that you have used?

A I believe not.

Q Will you please state your conclusions and opinions to the area that each refers to, as the Dakota gas reservoir which we've suggested would have vertical limits, the top of which would be the base of the Greenhorn limestone, and the bottom of which would be the producing portion of the Morrison formation, which the record shows, I think would include the Graneros and the Dakota sands, and possibly some portion of the Morrison?

A I agreed that that is an appropriate definition of a Dakota reservoir.

Q Now, will you state what characteristics the Dakota reservoir in San Juan County and Rio Arriba County, New Mexico has?

A From the twelve core analyses available, we had determined that the average porosity of the Dakota formation is 7.2 percent, the average interstructural water 30.6 percent. Utilizing the cores and electric logs on forty-one wells, we've been able to determine that the average thickness is forty feet, and from the --

Q Now, average thickness, you mean -- what do you mean by average thickness?

A It is the average thickness that we pick for net effective pay.

Q Forty feet of net effective pay will be found in the Dakota reservoir?

A That is what has been found to exist within the forty-one wells presently drilled.

Q That is the average?

A That is correct. I might mention that some of these wells don't go through the Dakota; the majority don't, as we pointed out here today. Some of them just go into the upper portion, and we have taken the position that was open in the particular well bores and taken the effective net pay for that portion.

Q Now, have you also had occasion to make studies and have data available concerning the Mesa Verde formation and the wells completed in the Mesa Verde formation?

A Yes, sir, I have.

Q Just state briefly what that is.

A In comparison to the 7.2 porosity for the Dakota, the Mesa Verde averages 9.1 percent. The Mesa Verde has 28.6 percent interstructural water content as compared to the Dakota's 30.6. The average thickness and net effective pay in the Mesa Verde is fifty-one feet as compared to the Dakota's forty feet.

Q Now, upon what data is that average figure obtained?

A From the same type of data utilized in our determination of the averages for the Dakota.

Q And averages how many wells?

A The major portion of the wells in the basin.

Q That have been drilled into the Mesa Verde formation?

A That's correct. We had available forty-three core analyses.

Q For Mesa Verde wells?

A For Mesa Verde wells.

Q Now, what is the pressure, relative pressure as between the Dakota and Mesa Verde formation?

A The average original shut-in pressure for the forty-one wells on which I had data was 2,877 PSIA. The average pressure of Mesa Verde wells has been determined to be 1,364 PSIA.

Q Now, what other characteristics of either reservoir would you care to comment on?

A We've also attempted to analyze both the reservoirs to determine what average permeability characteristics were exhibited and reported on the core analysis. I found a great variety in both reservoirs. The Dakota weighted average permeability was 4.12 millidarceys. The Mesa Verde weighted average permeability was 4.38 milladarceys.

Q Now, in your study, did you give any attention to determine the extent, if any, of fracturing in the Dakota sands?

A Yes, sir. We analyzed the core analysis to determine whether fractures were reported or whether fractures might be apparent because of the abnormal permeability characteristics. And we found that in five of the wells, vertical fractures were definitely reported, and that in all except two of the wells, there was an indication of probable fracturing. I also took this data in an effort to determine whether this condition existed fairly well from the base of the Greenhorn to the maximum depth cord which is approximately 260 feet below the base of the Greenhorn, and we find

that fractures do exist or probably exist over the entire interval.

Q Now, what effect does the existence of fractures and similar conditions in the aforementioned have with reference to the area which one well will economically and efficiently drain?

A It enables the well to more easily drain its reserve and probably drain a greater area than had the fractures not been present. And I might add that vertical fractures also tend to interconnect stringers which may not otherwise be interconnected through drilling, except through drilling.

Q Did you make any estimate as to the reserves per acre in the Dakota formation in the areas which have been found to be productive of gas?

A Yes, sir, I did so.

Q Will you state to the Commission what you found and the comparison of these estimates with those of the Mesa Verde?

A Yes, sir, I will. Utilizing the reservoir characteristics that I have previously described, the average reserve recoverable, reserve for a 320-acre Dakota well, would be four billion, one hundred twenty-eight million cubic feet. Utilizing the data that I have previously expressed for the Mesa Verde, the recoverable reserves on a 320-acre tract are three billion, eight hundred seventy-two million cubic feet. So that the recoverable reserves are very similar on a 320-acre with the Dakota being somewhat in excess of the Mesa Verde.

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12,093/Ac

Q Incidentally, those last reserve figures, are those the ones

that have been used before the Federal Power Commission in hearings?

A Yes, sir, the resultant per acre foot are those same ones used in Federal Power Commission hearings.

Q The studies which you have conducted have led you to conclusions, I am sure, as to the comparison of the Mesa Verde with the Dakota reservoir in its producing characteristics, particularly with reference to the ability of a well to produce the reserves in the same length of time. Will you please comment to the Commission what you found and what your opinion is on that subject?

A Yes, sir, I will, and I believe it might be well to give the Commission some data that we had determined on delivery characteristics of wells. We have analyzed and averaged the initial potential flows of twenty-six Dakota wells for which data was available, and found that the initial potential flow is four million, two hundred seventy-three thousand cubic feet per well. We find that the average State deliverability is available for seventeen of those wells and that they -- and that the deliverability was 19.3 percent of the initial potential flow or an average of eight hundred twenty-five MCF State "D." I also determined that information for the Mesa Verde;found that the average Mesa Verde initial potential flow was three million, nine hundred fifty thousand cubic feet, that the average State deliverability was 18 percent, or approximately seven hundred and twelve MCF. The Mesa Verde's seven hundred twelve compares with the eight hundred twenty-five for the Dakota. The State deliverabilities reflect the formation's ability to deliver

gas into the well bore, and it would appear that under the same conditions of drawdown, that the Dakota formation is as able or more able to deliver its reserve into the well bore than the Mesa Verde. I further analyzed the deliverable capacity of the Dakota and Mesaverde against five hundred pound line pressure, and found that the Dakota could deliver an average of 25.7 percent of its initial potential flow against five hundred pounds, and that that average deliverable capacity would be one million, one hundred thousand cubic feet per day. The Dakota formation is able to produce approximately 19 percent of its initial potential flow against five hundred pounds. That would equal seven hundred and fifty MCF per day. That seven fifty compares with the eleven hundred MCF deliverable capacity for Dakota wells, so that under initial conditions the Dakota formation is capable of producing approximately 46 percent more than the -- against five hundred pounds than the Mesa Verde reservoir. Here again I have utilized all wells on which data is available. That includes poor ones and good ones on the Dakota. Some of them were comparatively poor wells. It is conceivable that with better completion methods in the future there will be better relationships than is exhibited here today.

Q From your studies, have you reached a conclusion as to the comparative ability of a Dakota well to drain an area surrounding the well bore, compared to a Mesaverde well?

A Yes, sir, I have.

Q And what is that conclusion?

A I have reached the conclusion that the Dakota well can more easily drain the area surrounding the well bore than could a Mesa Verde well.

Q And you have based that upon the studies and data that you have recounted here to the Commission?

A That is correct.

Q Now, at the time that 320-acre spacing was established in the Mesa Verde, I believe that we had probably even less information than we have today about the Dakota, is that correct?

A Yes, sir. I believe that to be correct.

Q Now, what, in your opinion, is the effect of the 320-acre rule as applicable to the Mesa Verde? That is, have you found any evidence that shows that Mesa Verde wells are actually capable of efficiently and economically draining an area of 320 acres?

A I consider that the Mesa Verde has exhibited the ability to efficiently and economically drain 320 acres. We have definitely been able to determine that there has been communication over areas in excess of that, that is exhibited by the pressures shown by wells in-field in areas where the majority of the acreage has been developed and has been produced for a period of time, we find that the pressures are lower in those areas and apparently have been drained.

Q That is in situations in which some drilling has taken place and wells are produced and then the later wells that are drilled upon completion find a lower reservoir pressure than existed

at the time of the first wells?

A Yes, sir, that's correct.

Q And from that you conclude that there has been drainage of those areas?

A That is correct.

Q So that the Mesa Verde wells have demonstrated generally their ability to drain at least 320 acres?

A I consider that they have.

Q Now, what is your opinion as to the ability of a well completed in the Dakota formation to efficiently and economically drain an area of 320 acres?

A Based on my studies, I believe that the well on 320 acres in the Dakota formation can more easily drain 320 acres than could a Mesa Verde well. Consequently, I feel confident that one well on 320 will efficiently and economically drain that size tract.

Q What, in rather general terms, is the difference in cost between the drilling and completion of a well in the Mesa Verde formation and one in the Dakota reservoir?

A Assuming that no unusual difficulties are encountered, a well in the Dakota reservoir will normally cost about $135,000, and a well in the Mesa Verde reservoir will normally cost about $85,000, or a difference of about $50,000.

Q I believe you have already testified that per acre reserves, according to your estimate, are substantially the same as between the Dakota reservoir and the Mesa Verde?

A That is correct.

Q Now, what is your opinion as to the relative rate of development of the area and of reserves as a result of the order that we're asking for and continuation of the present statewide rule of 160 acres. In other words, which rule, the 320-acre spacing or 160-acre spacing will be most likely to result in reasonable development and proving of additional reserves in the Dakota formation?

A We may anticipate a more or less set number of wells to be drilled each year.

Q Why is that?

A Because normally a company budgets itself to just some wells. Now, if you are going to drill that many wells and space them on 160 acres rather than 320, you would prove about half as much acreage as you would otherwise prove, or as you would prove by drilling the 320. Actually, facilities are built and markets are fulfilled based on a determination of recoverable reserves. The sooner you can prove what you have, the sooner you can build the facilities and the sooner you can start taking the gas out, and it is important from that standpoint to prove your area as quickly as possible.

Q Insofar as an interstate pipeline subject to Federal Power jurisdiction is concerned, it is necessary to first establish reserves before you can get the certificate to move the gas, is that correct?

A That is correct.

Q What, in your opinion, would the adoption of a 320-acre spacing rule result in as compared with 160?

A Well, first, to prove up the Dakota reservoir reserves much more quickly, and secondly, I think that the drilling on 320 acres rather than 160 acres will prevent the drilling of unnecessary and probably uneconomic wells.

Q Will it be an inducement to the operator to go ahead with Dakota development?

A On 320 acres?

Q Yes.

A I certainly consider that it would.

Q How would you classify the present stage of the development in the Dakota reservoir and the depletion of that reservoir?

A I consider they are in initial stage of development and depletion.

Q Has there been any opportunity to conduct any actual interference tests as between wells completed in the Dakota reservoir that you know of?

A No, sir.

Q Does the Dakota reservoir, in your opinion, extend across the state line into Colorado?

A Yes, sir, I consider that it does.

Q Do you know what the spacing is for the, what we have termed the Dakota reservoir which I believe is called in Colorado the Dakota-Morrison?

A May I say first that my answer to the last question is that I consider that the reservoir does, I think that the reservoir does extend, and is shown to extend by the geologic data that we have shown here today, and at the previous hearing last month, and in the Colorado portion of the Dakota reservoir, spacing has been established for 640 acres per well.

Q Have you any other points, comparisons that you would like to make, comments with reference to this Dakota reservoir?

A I believe not.

Q Have you prepared any suggestive rules for spacing in the Dakota reservoir?

A Yes, sir, I have.

MR. HOWELL: I guess we will mark this as El Paso's Exhibit No. 10.

Will you state very briefly the rules that you have suggested and why you have suggested these rules for spacing in the Dakota reservoir?

A The spacing rules shown are essentially the same rules as have been adopted for the Mesaverde. Rule 1 varies from the identical Mesaverde rule in that it permits the well to be drilled within any quarter section within the section. Now, we have recommended that this flexibility be granted the operators drilling Dakota wells in order that they may take full advantage of the possibilities of dually completing Dakota wells with other wells that are to be drilled or are to be worked over on the same acreage. We

think that we'll have more Dakota wells drilled if we can be assured of dual completions. And I think the nature of the Dakota reservoir is such as to, unrecoverable reserves are such as to necessitate or to at least make desirable the additional incentive.

Q You have -- by this rule, you have suggested that the operator be permitted to take to the Dakota a well in any quarter section of this section?

A That is correct.

Q Allocating to it a half of the section?

A That is correct.

Q And that would then permit either the reworking of an existing Mesa Verde well or if there was another shallower formation, Pictured Cliffs, or some other formation, it might permit the dualing of the Dakota, is that correct?

A That is correct. It may be that on a quarter section you have a Mesa Verda dualed with a Pictured Cliffs, and you could also dual the Dakota, the well bore very well.

Q You can then go into the other quarter section and drill a dual, a Pictured Cliffs, and Dakota?

A That's correct.

Q And by giving this flexibility, operators would be encouraged to test the Dakota because the test can be made more economically?

A That is correct.

MR. HOWELL: We would like to offer Exhibit No. 10.

MR. PORTER: Without objection, El Paso's Exhibit No. 10 will be received.

MR.HOWELL: I think that's all of our questions.

MR. PORTER: Anyone have a question of Mr. Woodruff?

CROSS EXAMINATION

BY MR. COOLEY:

Q Mr. Woodruff, regarding this proposed latitude, as you call it, in permitting the operator to drill in any quarter section rather than fixing them to a pattern as they have been in the Mesa Verde would tend to some degree to reduce the efficiency of drainage in the reservoir, wouldn't it, any time you vary from the pattern?

A I don't believe that it would have a significant variation in the efficiency of drainage in the Dakota reservoir.

Q If you have an ideal situation, though, disregarding the economics of the matter for the moment, where you could develop a reservoir on a set pattern as opposed to an erratic pattern, wouldn't you expect some degree of efficiency, greater degree?

A I believe that would be a reasonable conclusion. I don't consider that it would be significant in this instant.

Q Now, as I understand it, the primary reason for your requested latitude in this regard is to permit the dual completion of wells in the area?

A That is correct.

Q In the event that 320-acre spacing were adopted, do you

think it would be extremely offensive or burdensome if a spacing pattern or well pattern similar to that of the Mesaverde were adopted with provision to administratively permit dual completion such as, or as you have suggested, dual completion on an off quarter so that the Pictured Cliffs and the Dakota might be dually completed?

A I think it would be overburdensome and an unnecessary requirement to set up the spacing, say identical to the Mesaverde and require exceptions where you go elsewhere. You often don't know, when you are drilling a new well, whether you are going to be able to dually complete it or not. I don't know what prerequisite of standards the Commission would set, but I do know that you can always obtain prior to drilling, I believe the latitude is reasonable as requested.

Q In the event the Commission determines that the set spacing pattern, such as that in the Mesaverde, be adopted; that 320-acre spacing would not be feasible in the Dakota, assuming that set of facts, then would it be El Paso's preference to have 320 with fixed location, or 160?

A It would be our preference to have fixed spacing on 320 acres.

MR. COOLEY: That is all.

MR. PORTER: Anyone else have a question of Mr.Woodruff?

QUESTIONS BY MR. FISCHER:

Q Mr. Woodruff, when you are speaking of vertical fractures, horizontal fractures, do you think there is a greater degree of horizontal fracturing than there is vertical fracturing?

A The only fractures that have been defined other than fractures are vertical fractures on the core analysis that have been reported, so I cannot positively say whether there also may have been horizontal fractures.

Q Did you notice any actual evidence of vertical fractures in any of the impermeable stringers in the vertical limits that we are talking about?

A Yes.

MR. FISCHER: Thank you.

MR. PORTER: Any further questions?

QUESTIONS BY MR. UTZ:

Q Mr. Woodruff, referring to Rule 3, of your Exhibit No. 4, again back to the vertical limits, in view of the testimony of the previous witness in this case, would it still be your recommendation to leave Rule 3 as printed on this exhibit or put it between the base of the Greenhorn?

A I believe, in view of his testimony, it would be better to tag it as four hundred feet below the base of the Greenhorn. There is just some question as to what all that will include, but I think as we gain experience we can judge at that time whether that four hundred feet needed to be changed and make any changes as necessary when that is determined.

MR. UTZ: That's all I have.

MR. PORTER: Anyone else have a question of the witness? Mr. Kendricks.

QUESTIONS BY MR. KENDRICKS:

Q Mr. Woodruff, do you have any objections to a change in your Rule 2 which asks for notification of all offset operators in case of non-standard locations due to topographical conditions since it might reflect more the revised Rule 104, which requires notification of any operator closer than 790 feet to the well bore?

A I believe Rule 2 should be consistent with the provisions of Rule 104.

MR. KENDRICKS: Thank you.

MR. PORTER: Anyone else have a question?

QUESTIONS BY MR. CHRISTIE:

Q Mr. Woodruff, in your proposed Rule 2, do I understand this minimum 990 feet is from the outer boundaries of the quarter section or the inner boundary?

A It would be from any boundary of the quarter section.

MR. CHRISTIE: Thank you.

MR. PORTER: Any further questions of Mr. Woodruff? If no one else has a question, the witness may be excused.

(Witness excused)

MR. HOWELL: That completes our evidence.

MR. PORTER: Anyone else have testimony to present in the case? Any comments or statements to be made? Mr. Buell.

MR. BUELL: May it please the Commission, Guy Buell for Pan American Petroleum Corporation. Pan American urges the Commission grant the 320-acre units for the Dakota formation as requested by El Paso.

We are strongly supporting the adoption of 320-acre units, although our engineers believe, in fact, are confident that subsequent data will show that probably the more optimum unit is 640 acres. However, in our opinion, the most important thing at this time is to adopt 320-acre units so that we can at least minimize the drilling of unnecessary wells until we acquire subsequent data which will show 640-acre drainage. The Commission docket is always open, but we strongly support the 320-acre Dakota unit.

MR. PORTER: Anyone else have a statement in this case concerning the matter?

MR. BRATTON: I am Howard Bratton, Humble Oil and Refining Company. We strongly urge the adoption of El Paso's proposal of 320-acre spacing in the Dakota formation. We believe the evidence justifies the issuance of the order as requested.

MR. KELLAHIN: I am Jason Kellahin. Phillips Petroleum Company strongly urges the adoption of the 320-acre spacing for the Dakota formation under the proposed definition of the Dakota. In that connection I would like to make a brief observation on this testimony. While the witness frankly admits they have no interference tests, certainly the testimony offered is quite impressive in showing that this reservoir is at least as good and probably better as to drainage characteristics than the Mesa Verde. Until additional testimony or information is available, I think it would be a serious mistake to continue the development of this pool on 160-acres, and we strongly urge the adoption of this 320-acre rule.

MR. PORTER: Anyone else have anything to offer? Any comments, statements? Mr. Christie.

MR. CHRISTIE: I have a statement I would like to read in the record. I have some figures here that maybe you want me sworn to testify to, I don't know.

(Witness sworn)

R. S. CHRISTIE,

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

DIRECT EXAMINATION

BY MR. COOLEY:

Q Will the witness state his name and position, please?

A My name is R. S. Christie. Engineer for Amerada Petroleum Corporation, Tulsa, Oklahoma.

Q Mr. Christie, have you previously qualified before the New Mexico Oil Conservation Commission --

A Yes, sir, I have.

Q -- as an expert in the field of engineering?

A Yes, sir.

Q Proceed.

A Off the record.

(Discussion off the record)

A Amerada is not particularly in favor of El Paso's application in that we think the initial development, or at least the

initial stage of development of Dakota should be on 640-acres. We give that for these reasons: If a well will drain 640 acres and El Paso has not proved otherwise, then to develop on 320-acre spacing will result in unnecessary wells. We feel that if a well will drain only 320 acres, it is our opinion development on 320 acres would not on the average be a very profitable venture. We have estimated in one particular area where we have interest in the Dakota that the recovery will be 6.8 million cubic feet per acre. At the present rate of production, we estimate that these reserves will be produced in approximately eleven years. Our cost of the Dakota well is a little bit higher than El Paso's. We estimate an actual cost of the Dakota well is approximately $150,000, and Dakota Mesa Verde dual completion $184,000. If the reserves will be depleted in eleven years, then the present worth based on current price on a 640-acre unit is only $174,000. Therefore, it is obvious if a second well is required on 640 acres, then the profit is only $24,000. Of course, in addition to that, you have to pay out from dry holes. If it is necessary to drill on the Mesa Verde on 320 acres, savings of at least $74,000 can be realized, if one single Mesa Verde well is drilled and one dual Dakota Mesa Verde well is drilled on the other 320 acres. This, then, would be a very substantial savings if large areas are involved, which this area is. Mr. **Loleit** testified in a previous hearing in this case that there have been fifty wells drilled in the Dakota basin, **thirty** of which have been dry. This means, of course, that one producer will pay out the cost of

one and a half dry holes as well as his own costs. While it is unlikely that under a development program there would be an additional thirty dry holes out of fifty wells drilled, the success ratio will be low. This further points out the questionable economics of 320-acre spacing. I would like to recall here, too, that Mr. F. H. Lechish's analysis on dry holes drilled in gas areas, the percentage or the ratio is now one to about 10.78 wells, which is a little bit higher than the rate for oil. If we understand Paragraph 5, under El Paso's application, in effect, they have indicated one well will drain 640 acres. This is apparent from Amerada's Exhibit No. 1 which I offer in evidence at this time. This brings out the question that Mr. Cooley asked Mr. Woodruff a while ago. Under their proposed rule, it would be possible to drill up your 320 acres under such a plan as this. It is evident from this exhibit that if wells were permitted under this spacing, that there would be a large area in between the locations that would not be drained, and I don't think El Paso would propose a plan such as this if they didn't think they were going to drain the whole entire area, so that to me, in effect, I think they are probably admitting that one well will drain greater than 320 acres. If you would locate the wells 660 feet from the center of the quarter sections and have a 640-acre unit, you would drain the 640 acres just as adequately as you would to space them as the proposed rules suggest. Actually, the difference between the drainage, radius of drainage of a 320-acre unit and 640-acre unit, assuming a radial drainage, is only an additional 840 feet

approximately, so we submit that if a well with the permeability of the Dakota will drain 320, then it will drain 640.

We object to the language in Paragraph 6, Mr. Howell, I'm not sure whether you now ask for what was in the original application. If the language means that any other gas pool in the same sands within San Juan and Rio Arriba Counties should be developed on 320-acre spacing, we have some areas that you have no development at all, and we think that those areas ought to stand on their own feet and not be tied to 320, that will not be necessary.

MR. PORTER: You are referring to Paragraph 5 of the application?

MR. CHRISTIE: Of the application, yes, sir.

MR. HOWELL: Paragraph 6?

MR. CHRISTIE: Yes, I am sorry.

MR. HOWELL: The language, I think, is the same in the amended application.

MR. COOLEY: Mr. Christie, would you read the language to which you refer and state more particularly what your objection is?

MR. CHRISTIE: I am referring to this statement or this part in the first application, I'm not sure, "the establishment of drilling and spacing units as herein requested is necessary for the orderly development of the common source of supply in the designated Dakota gas pools and areas adjacent hereto and any other gas pool to the Dakota formation within the San Juan and Rio Arriba

Counties."

MR. COOLEY: Well, it is very clear, Mr. Christie, from the application that El Paso Natural Gas Company is, by this application, seeking 320-acre spacing in this horizon which has been designated as the Dakota producing interval wherever it may occur in San Juan or Rio Arriba Counties, with the exceptions of the four pools --

MR. HOWELL: Three.

MR. COOLEY: Three existing pools which have been expressly excluded from the application.

MR. CHRISTIE: Well, that's the way we interpret it, and it's our opinion that probably shouldn't include areas that are not now under development or haven't been developed. We may find entirely different conditions somewhere else in the county. For all these reasons, therefore, Amerada recommends 640-acre spacing with the well located 660 feet from the inner boundaries of the quarter sections. I think this would be a good time to remind the Commission that this is Oil Progress Week, and the majority of the companies are trying to make progress on this wider spacing, and I believe Amerada believes that the regulatory bodies of the various states would be of great assistance to the industry as a whole if they would at least start out with wider spacing and then, if necessary, to come down to the denser spacing.

MR. PAYNE: Mr. Christie, you are aware, are you not, that the application is for 320-acre spacing?

MR. CHRISTIE: Yes, sir.

MR. PAYNE: And that we could not grant 640 under this application even if we so desired, and that at any time your company could come in and file an application for 640-acre spacing.

MR. CHRISTIE: Yes, I realize that.

MR. PORTER: Does anyone have a question of Mr.Christie?

QUESTIONS BY MR. NUTTER:

Q Mr. Christie, you don't anticipate the same development or progress in the Dakota as on these forty wells?

A No, I believe I made that statement that we don't.

MR. PORTER: Anyone else have a question of Mr.Christie? You may be --

MR. COOLEY: I still am not sure that I understand his position. In view of what Mr. Payne just told you that the Commission in this application has but two choices, to establish 320-acre spacings in these areas, or remain on the statewide 160-acre spacing, in view of this fact, you are still objecting to approval of the application? I understand your company feels that 640 is more proper, but are you actually objecting to the granting of this application?

A If the Commission feels that there is sufficient evidence to substantiate the 320, we certainly would be in favor of that over the 160.

MR. COOLEY: That's the only choice we have in this hearing.

MR. PORTER: Any further questions? The witness may be excused.

(Witness excused)

MR. PORTER: Anyone else have testimony to present in the case? Any statements to be made that we haven't already heard?

MR. PAYNE: The Commission has received notification to the effect that the following named companies adopt and join in El Paso's application. These companies are as follows: King-Loc Petroleum Company, Superior Oil Company, Brookhaven Oil Company, Dacresa Corporation, Northeast Blanco Development Corporation, Delhi-Taylor Oil Corporation, Pubco Petroleum Corporation and Texas National Petroleum Company.

The following companies have concurred and recommend approval of El Paso's application: Kingwood Oil Company, Aztec Oil and Gas Company, Western Natural Gas Company, Empire States Drilling Corporation and Southern Union Gas Company as the application was amended by deleting the Barker Creek and Ute Dome Pools.

MR. PORTER: If there are no further statements in this case, we will take the case under advisement.

W C GILMORE--359 CORBER BLDG ALBUQUERQUE N MEX. YOU ARE HEREBY AUTHORIZED TO APPEAR ON BEHALF OF KUTZ CANON OIL & GAS COMPANY WHICH HOLDS EXTENSIVE LEASEHOLD INTERESTS AND OPERATING RIGHTS IN THE ANGEL PEAK KUTZ CANON FULCHER AREA SAN JUAN COUNTY NEW MEXICO AT THE HEARING OF THE NEW MEXICO OIL AND GAS CONSERVATION COMMISSION

TO BE HELD OCTOBER 15, 1958 ON THE QUESTION OF SPACING OF DAKOTA WELLS IN THAT AREA STOP THE POSITION OF KUTZ CANON OIL & GAS COMPANY AS TO THE SPACING OF DAKOTA WELLS IN THAT AREA IS THAT THE SPACING SHOULD BE ONE WELL FOR EACH ONE HUNDRED SIXTY ACRES-

KUTZ CANON OIL & GAS CO J F SEATON PRESIDENT:

C E R T I F I C A T E

STATE OF NEW MEXICO)
: ss
COUNTY OF BERNALILLO)

I, J. A. TRUJILLO, Notary Public in and for the County of Bernalillo, State of New Mexico, do hereby certify that the foregoing and attached Transcript of Proceedings before the New Mexico Oil Conservation Commission was reported by me in stenotype and reduced to typewritten transcript by me and/or under my personal supervision, and that the same is a true and correct record to the best of my knowledge, skill and ability.

WITNESS my Hand and Seal, this, the 28th day of October 1958, in the City of Albuquerque, County of Bernalillo, State of New Mexico.

Joseph A. Trujillo
Notary Public

My Commission Expires:
October 5, 1960