STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION
STATE LAND OFFICE BLDG.
SANTA FE, NEW MEXICO

16 May 1984

COMMISSION HEARING

IN THE MATTER OF:

Application of Cities Service Oil & Gas Corporation for 640-acre spacing in the West Bravo Dome Area, Harding County, New Mexico. CASE 8191

BEFORE: Commissioner Joe Ramey, Chairman
Commissioner Ed Kelley

TRANSCRIPT OF HEARING

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MR. RAMEY: Mr. Kellahin, what is your pleasure in Case 8191?

MR. KELLAHIN: Mr. Chairman, I have reviewed again the application we have filed on behalf of Cities Service Oil & Gas Corporation. We believe that that application is slightly inconsistent with the statements I've made to you insofar as the application has some boundaries that are determined simply because of ownership.

We think that spacing cases ought to be decided based upon geologic and engineering reasons and that we do not part out windows or delete acreage simply because of surface ownership.

And therefore, at this point, I see that there will be substantial need for revision of that application and we would request that that application be dismissed at this point without prejudice.

MR. RAMEY: Upon your request the application will be dismissed without prejudice, Mr. Kellahin.

The hearing is adjourned.

(Hearing concluded.)

C E R T I F I C A T E

I, SALLY W. BOYD, C.S.R., DO HEREBY CERTIFY that the foregoing Transcript of Hearing before the Oil Conservation Division was reported by me; that the said transcript is a full, true, and correct record of the hearing, prepared by me to the best of my ability.

Sally W. Boyd CSR

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION
STATE LAND OFFICE BLDG.
SANTA FE, NEW MEXICO

26 September 1984

COMMISSION HEARING

IN THE MATTER OF:

Application of Cities Service Oil & Gas Corporation for special pool rules, Harding and San Miguel Counties, New Mexico. CASE 8352

BEFORE: Richard L. Stamets, Chairman
Commissioner Kelley

TRANSCRIPT OF HEARING

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MR. STAMETS: The hearing will please come to order.

I have received a request this morning that the two cases be heard in reverse order, taking special pool rules first and the unit agreement second.

Is there any objection from any party to that change?

Hearing none, let's go ahead then and call Case 8352.

MR. TAYLOR: The application of Cities Service Oil & Gas Corporation for special pool rules, Harding and San Miguel Counties, New Mexico.

MR. STAMETS: Call for appearances in this case.

MR. KELLAHIN: Mr. Chairman, I'm Tom Kellahin of Kellahin and Kellahin, Santa Fe, New Mexico, appearing on behalf of the applicant, Cities Service Oil & Gas Corporation, and I have two witnesses to be sworn.

MR. STAMETS: Other appearances?

MR. LOPEZ: Mr. Chairman, my name is Owen Lopez with the Hinkle Law Firm in Santa Fe, New Mexico, appearing on behalf of Amerigas and we may have two witnesses to be sworn today.

MR. STAMETS: Other appearances?

MR. CARR: May it please the Commission, my name is William F. Carr, with the law firm Campbell and Black, P. A., of Santa Fe. I represent Amoco Production Company.

We do not intend to call a witness.

MR. STAMETS: Any other appearances?

I'd like to have all those who are going to be witnesses to stand and be sworn at this time, please.

(Witnesses sworn.)

MR. LOPEZ: If the Commission please, before we begin, I have a motion to present to the Commission with a brief.

There has been some confusion and so I'm going ot have to orally amend my motion to include under Township 19 North, Range 30 East, I think it has to do with the advertisement. The way we read the application the way the case included, Township 19 North, Range 30 East does not include Sections 19 through 36. I would like, now that I've seen the map on the wall, to add those to the inquiry -- to the motion.

The essential purpose of my motion is to delete from the hearing here today all those

lands that lie within the Bravo Dome Unit. The reason for this is explained in our brief we submit with the motion.

Have I already distributed all the briefs?

MR. KELLAHIN: No, sir, I didn't get one.

MR. LOPEZ: Okay, here's one.

Essentially, as you will note from the brief, this Commission heard Case Number 8190 in May and entered its order, I believe it was in June. The subject of that Case Number 8190 was to consider Amoco's application for 640-acre spacing throughout the Bravo Dome Unit Area of Amoco's. That includes lands that are subject to the application today.

The Commission, in Order No. R-7556, established a 640-acre spacing area for a portion of the Bravo Dome Unit Area and 160-acre spacing area for the remaining balance of the Bravo Dome Unit Area.

The 160-acre spacing lies pretty much to the south and west of the -- or in the south and west portions of the Bravo Dome Area.

At that hearing Cities Service attempted to bootstrap its case that was advertised for hearing at that date on Amoco's evidence and on behalf of Amerigas we moved not to allow that to happen and the Commission granted our request.

Cities Service is back here to-

day, presumably with their own well test information for the purpose of establishing the same 640-acre request, perhaps modified.

Nevertheless, Cities Service did enter an appearance and did participate in Case 8190. The Commission thereafter entered its order and, as you will note from our brief, there seems to be undisputable authority that the way for Cities Service to have attacked the order entered in that case was either to seek a rehearing or appeal the case. They should not prefer to readvertise a new case overlapping the area that's already been ruled on, and there are many reasons why the Commission should not entertain their motion at this time. If they did want to come in and have the Commission reassess its order that was entered in the previous case, the method would be by amending -- asking for an amendment to the order or if the Commission were to entertain a request for those lands that lie within the Bravo Dome Unit Area today, there would be a clear opportunity for conflicting orders overlying the same area and it certainly would not give much comfort to operators that the rules would be so subject to change and uncertainty in such a short period of time.

Thank you.

MR. STAMETS: Mr. Kellahin, would you like to respond?

MR. KELLAHIN: Mr. Chairman, for purposes of responding to Mr. Lopez, I want to hand you

a copy of the order Mr. Lopez is referring to. It's the granting of the Amoco application for temporary spacing in what is often referred to as the Amoco Bravo Dome Area.

Mr. Chairman, I'd like to make some points with regards to our proposed Exhibit Number One. It's on the wall, and to give you a little background about how we got to where we are today, you can see on Exhibit Number One that there is an outline in yellow. That is the area that the Commission spaced on 640 acres as a result of the order that Mr. Lopez has referred to. It's R-7556.

At the time that that case was scheduled there was also docketed on that same docket a case where Cities Service Oil and Gas Corporation to create a spaced area in the Bravo Dome, which has generally been described as the West Bravo. That area generally lies over in this portion of that area outlined with the pink tape.

The application of Cities Service at that time stopped approximately at the line that separates the red wells and those wells that aren't circled in red. The red wells are Cities Service wells. These wells here that are not marked with any color are the Amerigas wells.

The line of our original application is generally here to the west.

The application of Cities -- of Amoco for the spaced area originally included all of the Bravo Dome Unit. That unit outline generally conforms to

the yellow outline until you get to the southwest area of the map and you can see an area that is not outlined in yellow or pink. It's a broken area that runs through the southwest portion. This acreage is the Amoco Bravo Dome Unit.

It was our contention at the hearing back in May that we are dealing with one common source of supply in the Tubb formation for the entire Bravo Dome and that there was not any reason to separate out the main Amoco operated Bravo Dome from this southwest area.

We move to consolidate for hearing purposes the testimony that was going to be elicited at that hearing to present evidence from our witnesses concerning this area to the south and to the west.

The Commission denie us the opportunity to consolidate those cases for hearing and elected to hear testimony only on the Amoco operated area.

At the conclusion of that case we asked Mr. Ramey, without prejudice, to withdraw that application and allow us to amend the boundaries for our proposed West Bravo Dome Pool and to refile that.

I have for you a copy of the transcript of the May 16th, 1984 hearing for that case. It contains simply one page and you can read it and note that Mr. Ramey gave us the opportunity to refile without prejudice.

And that is why we are here to-

day. Our testimony, we believe, will demonstrate conclusively that there is a need to create another pool in the carbon dioxide area in the Tubb formation that conforms to the boundary that we propose to use.

Mr. Lopez would have you believe that once the Commission establishes a pool and adopts temporary special pool rules for the pool that it is somehow cast in concrete and that those rules cannot be expanded, amended, or the area expanded or amended at any other time. He says that it's a collateral attack now upon that prior order for the Commission to hear another case involving other testimony and evidence to whether or not part of the area that was subject to the first hearing can be included in the area that we're talking about today.

I think the first thing you have to decide is whether or not that is correct. It is our contention that it is not.

I've looked briefly at Mr. Lopez' factual summary in his brief. I note that the cases he cited are general administrative law cases about the finality of orders. I do not see anything in his brief, nor am I aware of any cases that preclude the Commission with its continuing jurisdiction to go ahead and modify and create new pools at any time it would be appropriate.

That retained jurisdiction is in fact in the Amoco order and it says on the very last page, it says that jurisdiction of this cause is retained

for the entry of such further orders as the Commission may deem necessary.

Historically the Commission has changed pools, created new pools, deleted acreage from old pools and added its new pools. It's an evolving process and it's not cast in stone.

We contend that we ought to be allowed to go forward with the area as applied for and as outlined on Exhibit Number One.

Now if the Commission does not want to follow its historical practice with regards to spacing cases and contends that there must be some merit in Mr. Lopez' motion, then you need to decide, and I think this is the issue and the way to frame the issue, you need to decide whether or not that you can include acreage that was subject to a prior hearing at the Oil Commission into an application for a new pool area, whether or not that will constitute a collateral attack on the prior order. Our contention is it does not, and that that's all we need to say, is that the Commission, with its jurisdiction over pools, can simply do that.

If you're uncomfortable with that, the next issue you must decide is whether or not you can include the acreage, or at least that acreage in this application, that was subject to the prior hearing, and include that without new evidence.

I am not aware that the Commis-

sion establishes the jurisdictional procedure in the District Courts on new trials, but there is some similarity in that process. A party before the District Court can ask for a new trial if there is new evidence available. I think you can decide this issue without getting to this point but if you decide that in order to have another hearing that involves some of the same acreage, if you make the judgment and the decision that that hearing must be based upon new and additional evidence, it is our tender of proof to you that there is new and additional evidence that was not available at the hearing in May, and if it's in that context that you decide on Mr. Lopez' motion, we believe that in that context you also ought to deny his motion.

Our tender of proof is that with regards to the well that's identified by the red arrow, that there has been a long term flow test that's been conducted subsequent to the May hearing and that additional evidence and the calculations and extrapolations made by the engineers based upon that new data causes them to conclude, and our proof will be, that this area is capable of draining 640 acres.

In addition there is evidence available and testimony that was not available at the prior hearing to indicate that there was isochronal tests and calculations made on all those wells indicated in the green arrows that is new additional information that was not available at the prior hearing.

In addition, the engineer has again studied the geological data available for this pool and there is no dispute or doubt in that engineer's mind that we are dealing with a reservoir in the West Brawo Dome that has essentially the same reservoir properties as you find in the main Bravo Dome and that there will be no reason to treat those separately unless you want to do so for some artificial reason.

Our point is that there is no basis in Mr. Lopez' for several reasons. One, historically the Commission does continue to act and modify orders when it deals with pools. There is no finality to those orders. This does not constitute a collateral attack and you could deny it simply at that point.

If you're more comfortable with the proposition that this case will involve additional acreage and additional testimony that was not subject to hearing back in May, then you also should deny the motion.

In addition, I think you do a substantial injustice if you say that in May Cities Service, who was prepared and willing and able to present a case, is not allowed to consolidate it for hearing purposes, at the conclusion of that hearing allows us to withdraw our application without prejudice, and we come here today and you do prejudice by not hearing our case. I think you've done a substantial injustice, and for all those reasons we request that Mr. Lopez' motion ought to be denied.

MR. CARR: May it please the Commission, I'd like to respond briefly to the motion on behalf of Amoco Production Company.

As you are aware, Amoco is the operator of the Bravo Dome Carbon Dioxide Gas Unit and certain of the acreage which is involved in Mr. Lopez' motion which is before you now is located within the boundaries of the Bravo Bome.

As you're aware, we came before you in May of this year and sought 640-acre spacing for the entire Bravo Dome Unit Area. We believed then that that was appropriate and we believe so now.

We received an order from the Commission which carved out a portion of the unit and let that acreage remain on 160-acre spacing. Amoco elected not seek a rehearing in that case but instead determined that they would proceed under that order, accumulate additional data and when the matter was reopened in three years come back before you.

That does not, however, change our position that the proper spacing within this entire area is 640 acres, and we support Cities in their application to that extent.

I do think that it's important to note that this is not the first time this question has come before the Commission.

On November 4, 1980, in Case

7075 there was a dispute before the Commission involving spacing rules for the Puerto Chiquito Area in northwest New Mexico. This case had come on before for hearing before Examiner Daniel Nutter and an order was entered establishing temporary pool rules for the area in question, and that order, the Examiner order, contained a number of provisions that resulted from an agreement of the parties at the time of that Examiner Hearing.

The day after, the 31st day after the time ran for filing an application for hearing de novo, a new application was filed, a new case was brought before the Commission, and it was -- the Applicant, Benson-Montin-Greer, requested that that case not go to an examiner but come to the Commission, and the questions raised by that new application were questions which were the result of agreement by the parties before Examiner Nutter, which were contained in the Examiner order.

Koch Industries appeared and raised the very same question as today, collateral attack. What is the proper way to appeal an order of the Oil Conservation Commission, either if it's an Examiner, or in this case it would be a Commission order?

We argued that matter and as a result the Chairman of the Commission, Mr. Ramey, ruled, and I think correctly so, that whenever a question comes before you involving pool rules, where waste is a question, where correlative rights may be impaired, you have not only a

right but an obligation to hear that matter. He denied the motion to dismiss the case as a collateral attack and the matter went forward and went to hearing.

We submit that that is good and sound precedent for the matter before you today and that the motion should be denied.

MR. LOPEZ: Mr. Chairman, I think if I might have just a moment to respond, so there's no confusion, we are not objecting to going forward with the hearing today as long as we can finally determine exactly what was advertised, and I might suggest for that we might need to readvertise.

We were under the impression with respect to the acreage outside the Bravo Dome Unit Area, that there is less than has been shown on the exhibit, but that's certainly a detail that can be resolved.

It appears clear to us that in the Order R-7556 the Commission at that time clearly established a Bravo Dome 160-acre area, which is that area within the Bravo Dome Unit that wasn't made 640-acre spacing, subject to 640-acre spacing.

I recall that in the Puerto Chiquito case Mr. Carr unsuccessfully argued the position that I am taking today. I think that his arguments at that time and today still urged are completely valid. If Amoco did not want to abide by the order entered in that case their procedure was to seek a rehearing or to appeal the or-

der in that case, not to come back in and support Cities in a new application overlapping the same area.

It would seem that Mr. Ramey had no intention when he allowed Cities Service to withdraw their application in the previous case and refile, that they would overlap the area that was under consider. The Commission must appreciate the fact that Cities Service at the time of the last hearing came with witnesses and it would seem that much of the information that they allege was unavailable must have been available at that time or they would not -- I would not suspect that they would frivolously have filed an application and had it advertised for hearing back in May.

MR. STAMETS: Within the area that is questioned by your motion here today, are there any owners besides Amoco and Amerigas?

MR. KELLAHIN: Yes, sir.

MR. STAMETS: There are. So --

MR. KELLAHIN: There's Cities Service.

MR. STAMETS: Oh, I'm sorry. Let me rephrase that question.

Does any of the assembled throng here today know if there are owners other than those threee?

MR. LOPEZ: I think we're talking about the area between the exterior boundaries of the

Bravo Dome Area will essentially be pointed out. We're looking at the area between the outline of the Bravo Dome Unit and the yellow line that excludes the area carved out --

MR. STAMETS: What I'm trying to find out is if there's anybody between the north pink line and the south pink line who is not represented here today by counsel.

(Thereupon a discussion was had off the record.)

MR. LOPEZ: Mr. Commissioner, we believe there's a lot of Federal acreage in the area and as far as we suspect, we think that Amerada Hess, CO2-In-Action, and other interested parties must have acreage within that area.

MR. STAMETS: Let's -- let's go off the record.

(Thereupon a discussion was had off the record.)

MR. STAMETS: Mr. Lopez, we are going to delay any action on your motion until the close of the hearing today, and going to allow Mr. Kellahin to proceed at this time, and to consider the entire area that has been applied for.

MR. LOPEZ: Maybe we ought to

go off the record again.

MR. KELLAHIN: I'd like to leave this on the record, Mr. Chairman.

MR. LOPEZ: Okay. Mr. Chairman, I would need an opportunity to check the application versus the area that's been defined on the exhibits as the area advertised.

MR. STAMETS: Well, we'll give you an opportunity to do that during the break.

MR. LOPEZ: All right.

MR. STAMETS: Mr. Kellahin, you may proceed.

MR. KELLAHIN: Thank you, Mr. Chairman.

Mr. Chairman, we'll call at this time our first witness, Rebecca Egg. That's E-G-G.

REBECCA EGG,

being called as a witness and being duly sworn upon her oath, testified as follows, to-wit:

DIRECT EXAMINATION

BY MR. KELLAHIN:

Q Miss Egg, would you please state your name and occupation?

A My name is Rebecca Ann Egg. I'm a reservoir engineer for Cities Service Oil and Gas Corporation.

Q Miss Egg, would you describe for the Commission what has been your educational background?

A I have earned a BS in petroleum engineering at Texas A & M. University in 1981; a BS in geology at University of Texas, Permian Basin, in 1983.

Q Apart from those two degrees, do you hold any other degrees within your professiona that you practice now?

A No, I don't.

Q Are you the -- are you a member of any society of engineers?

A Society of Petroleum Engineers.

Q Would you describe for the Commission what has been your employment background and work experience as a petroleum engineer?

A Prior -- after graduation I was employed by Cities Service Oil and Gas in May of 1981 and I've worked as a reservoir engineer there since.

Q When you first commenced your employment with Cities Service in what office were you located?

A In the Midwest Office.

Q And that is where you still practice your profession?

A Yes, it is.

Q What is your area of responsibility as a petroleum engineer for Cities Service?

A I have done the reservoir engineering

work in all of New Mexico for approximately a year and a half and now my area extends to north and east Texas.

Q Would you describe for the Commission what has been your experience with studying the production and information arrived out of the Bravo Dome Area? Now when I talk about Bravo Dome Area, I'm talking about all the carbon dioxide area of Harding, Quay, and Union County, and not simply Amoco's acreage. All right, when I refer to the Bravo Dome Area, would you describe for us what has been your experience?

A I first looked at the Bravo Dome Area approximately three years ago and it has been my responsibility to handle any reservoir engineering work that has been done in the region since that time.

Q Let me ask you to identify for us by going to your proposed Exhibit Number One, and let me ask you some additional general questions about your background and experience within this area. If you don't mind, you might go to the plat for us.

MR. KELLAHIN: Mr. Chairman, we have smaller sized copies of Exhibit Number One which I will pass out at this time, which may be helpful.

Q Let me first direct your attention, Miss Egg, to what is outlined in the yellow outline on Exhibit Number One, and have you identify for us what that represents.

A The yellow outline is the boundary of the

area that is approved for 640 acres in the earlier hearing.

Q All right, you're going to have to help us, the reported won't be able to hear you unless you speak up or at least turn your head so that she can hear you.

Within that spaced area, the Amoco spaced area, what information have you studied from that area?

A I've studied the logs of wells within that area. I have looked at their pressure testing.

Q Did you also attend the Commission hearing held in May, 1984, at which testimony was presented for that case?

A Yes, I did.

Q All right, let's look now to the area identified in the pink outline and have you identify that for us.

A The pink outline signifies the area which Cities Service is applying now for 640-acre spacing.

Q Within that area would you describe for us generally what well data and geology and other information that you've examined?

A I've examined cores of wells that are cored there. I've examined all the well logs on the Cities Service and Amerada Hess wells and several of the Amoco well logs.

I've looked at pressure testing that Cities Service has done there.

MR. KELLAHIN: Mr. Chairman, at

this time we tender Miss Egg as an expert petroleum engineer.

MR. STAMETS: Miss Egg, you mentioned a degree in 1983. What was that? I missed it.

A Geology, Bachelor of Science.

MR. STAMETS: Are there questions about the witness' qualifications?

She is considered qualified.

MR. KELLAHIN: Mr. Kellahin, let me expand that tender as an expert to include a geologic expertise in addition to the geology she might have otherwise acquired as a petroleum engineer.

MR. STAMETS: She is considered so qualified.

MR. KELLAHIN: Thank you.

Q Let me ask you some preliminary questions about the Exhibit Number One.

You've identified for us the yellow outlined area.

Would you identify for us now what is represented by the green lines on Exhibit Number One?

A The green lines are the traces of the cross sections which Amoco prepared for their spacing hearing.

Q Have you reviewed the cross sections that Amoco tendered into evidence at that hearing in May of '84?

A Yes.

Q What is indicated within the Amoco spaced area by the orange arrows?

A The orange arrows point to the wells in which long term flow tests were conducted.

Q Now, when we look at the area outlined in pink, from that area on across to the Amoco area there are red lines. Would you describe what those red lines represent?

A The red lines are the traces of cross sections that I prepared to investigate reservoir characterisitics across the Bravo Dome Area.

Q Would you identify for us what is indicated by the red dots on Exhibit Number One?

A The red dots are the -- signify the wells in which isochronal tests were run.

Q Well, --

A And -- I'm sorry.

Q -- what does -- the green arrows represent what?

A The green arrows are the wells in which isochronal tests were run. The red dots are wells that Cities Service or Amerada Hess has drilled in that area.

Q You've highlighted in orange a square around a well at B and another well to the south at C'.

Would you simply at this point identify those wells?

A The well at B is, that's drilled by CO2-

In-Action is the George Trujillo No. 1. It's a dry hole, and that well was used to designate the western boundary of our application area.

Q All right, sir, Miss Egg, what is C'? What's that well?

A C' is another dry hole.

Q Within the area we propose to space on 640 there is a blue line that's not otherwise highlighted that meanders in and out and around and through this area. What is that line?

A That's the Amoco Unit boundary.

Q There are other wells within the Cities Service proposed 640-spaced area that are not colored or highlighted in red. Would you tell us generally what type of wells those are?

A The wells that lie outside the Amoco Unit boundary are the wells that are operated by Amerigas on the Mitchell Ranch Lease.

The wells within the Amoco Unit boundary are Amoco Unit wells.

Q Subsequent to the hearing on May of 1984 have there been any additional wells that were drilled within the area outlined in pink?

A Yes. The Amerada Hess well has been drilled since that time.

Q Would you identify for us and highlight in yellow with the marker the Amerada Hess well that was

drilled subsequent to the last hearing?

A It's this well, (not understood.)

Q All right, let's go to Exhibit Number Two. Miss Egg, we have distributed Cities Service' Exhibit Number Two, and I have placed before you Exhibit Number Two. I ask you if you will please identify the exhibit for us.

A Exhibit Two is a structure map of the Tubb sandstone in southwest Bravo Dome Area.

Q Is this an exhibit that you prepared?

A Yes, it is.

Q You've indicated on your structure map that you have used the top of the Tubb sandstone?

A Yes.

Q In your opinion is that a readily identifiable geologic marker upon which you can accurately and reasonably map the Tubb sandstone?

A Yes.

Q Would you describe to the Commission the process that you went through in preparing your structure map?

A I examined the Cities Service logs and picked the top of the Tubb sandstone. The top of the Tubb sandstone was available to me from Amoco from logs. They had picked those numbers and I verified them by checking approximately ten of them in my picks and every case corresponded with theirs.

After identifying the top I contoured the

top of the Tubb sandstone.

Q Would you describe for us what, if any, conclusions you have reached based upon your mapping of the Tubb structure?

A Based on this map I can conclude that there are no -- no discontinuities that would result in inhibiting the wells to drain a wide area.

Q When we look at the structure map, if there were discontinuities that would be of such geologic significance to have an impact upon the ability of a well to produce and drain a certain quantity of acreage, how might that discontinuity be represented on the exhibit?

A Well, it's possible that the Tubb sandstone might be absent. It's possible that a discontinuity would appear along the line of a fault, but no such -- no such thing was apparent on this map.

Q In examining the logs, did you see any logs in which the log showed an indication that a fault had been cut or in examining the relationship of logs did you find any evidence of faulting?

A No, not in this area that is mapped.

Q When we look over to the western boundary of the proposed area there is a CO2-In-Action well?

A Yes.

Q Outlined in the red square?

A Yes.

Q Is that the same CO2-In-Action dry hole

that you've depicted as being the first well on the B-B' cross section on Exhibit Number One?

A Yes, it is.

Q All right, would you again describe for us what the significance is of that well at that location in terms of your geologic opinions?

A There is a facies change between the Cities Service Smith Well, which lies in Section 21 of 18 North, 29 East, and the George Trujillo Well in 18 North, 28 East. The facies change involved the change from sandstone to shale.

Q In determining where to establish for purposes of these temporary rules a proposed western boundary, do you have an opinion as to where to first locate that western boundary in this area?

A That boundary should be place between the two wells that I just described.

Q All right. Let's look at the southern boundary of the proposed space area and direct your attention specifically to the well that's located in Section 16 that's also highlighted with the red square.

Would you again identify that well for us?

A That's a dry hole drilled by Cities Service, the State "DP" No. 1.

Q Do you have an opinion as to the information obtained from that well and its relationship, if any, to

the starting point for the southern boundary for this spaced area?

A Yes. That well was wet and although good sands were apparent, the water saturation was too high for wells to be productive. Consequently, the southern boundary should approximately follow the contour lines on the map.

Q And until additional wells are drilled and tested in this area to the south, in your opinion is the propose southern boundary a reasonable place to first locate this spaced area?

A Yes, it is.

Q I notice on this Exhibit Number Two that you have not highlighted the Cities Service operated wells on the exhibit. If you'll take a moment for us and help us locate generally where those wells are in relation to the wells that are operated by Amerigas.

A The Cities Service wells can be identified. They're the ones with the top of the Tubb sandstone marked on the map. There is no information concerning the top of the Tubb sandstone available on the Mitchell Ranch wells, which are the remainder of the wells which lie outside the Amoco Unit boundary.

MR. STAMETS: As a point of clarification, could we look for just a moment in the Township 18 North, Range 30 East, in Section 7? I see two wells there and only one number.

A Yes.

MR. STAMETS: Is one of those wells -- are both of those wells Cities Service wells?

A No, only the one with the number is.

MR. STAMETS: Okay. Thank you.

Q Let me give you the yellow marking pen, Miss Egg, and have you approximate for us that area that would separate out the Cities Service wells from those that are operated by Amerigas. Can you draw a line that will generally separate those wells?

A Well --

MR. KELLAHIN: Let me do this differently.

Mr. Chairman, I'd asked the witness a question that's not easily answerable. Let me try another question.

Q Miss Egg, let me ask you to draw a line north to south on Exhibit Number Two that would be a line that generally includes all the Cities Service wells. Let's start with that first.

MR. KELLAHIN: Mr. Chairman, I'd like to borrow your copy of Exhibit Number Two so that I may ask Miss Egg to do the same thing on your exhibit or copy of exhibit that I've asked her to do on her copy.

Q Let me ask you some questions with relationship to the wells.

First of all, with relationship to the CO2 wells that would be to the west of the yellow line and

contained within the pink outline, I see a number of wells indicated that are within a section or two sections of that line to the west of it. Are there wells in that area that are operated by Amerigas?

A Yes, there are.

Q And are there wells in that area that are operated by Cities Service?

A Yes.

Q When we look east of the line there are also carbon dioxide well symbols. Who generally operates those wells immediately adjacent to, within a mile or two miles of that yellow boundary on the east side of that boundary?

A Amerigas operates those wells.

Q All right. In making your examination of the geology and the reservoir characteristics that you've examined, do you see any significant differences either geologically or engineering between the wells west of the yellow line?

A No, I don't.

Q As we move to examine the wells east of that line, do you see any geologic difference between those wells and the wells west of the line?

A No.

Q As we move farther to the east, do you have an opinion as an expert as to where you would place the eastern boundary of the area that Cities Service proposes to

space on 640 acres?

A Yes.

Q And where have you placed that boundary?

A That boundary should coincide with the boundary of the area that was already approved for 640-acre spacing.

Q And why do you express that opinion?

A Because there is no -- nothing geologic to indicate that the reservoir stops to the east in this area.

Q Let's have you go to Exhibit Number Three, which is the A-A' cross section.

All right, Miss Egg, would you go to Exhibit Number Three and identify that exhibit for us?

A This exhibit is a cross section from the West Bravo Dome Area and extends into the Amoco operated Bravo Dome Area.

Q Would you identify for us what you were attempting to investigate by the construction of Exhibit Number Three?

A I was investigating the continuity of individual sands within the Tubb sandstone.

Q How did you go about selecting the wells that you would locate on Exhibit Number Three?

A The wells were selected only to approximate equal spaces between the wells.

Q Did you attempt to pick out only the best

wells that you found within a given area?

A No, these wells are all typical.

Q Would you identify for us on Exhibit Number Three the Amoco well that ties in, the one or more than one, that tie into any of the cross sections that Amoco used at the other hearing?

A This well and this well would both tie in to Amoco's --

Q You'll have to identify what you mean by "this well".

A Sorry. The Amoco operated 19-33-281J and the Amoco operated 19-34-331G.

Q Are there any other wells on your A-A' cross section also appear on the Amoco cross sections?

A Yes, there is one more.

Q All right, and which one's that?

A It's the Amoco operated 19-31-351S.

Q Would you describe for the Commission the process that you went through in order to pick the thickness of the Tubb sand as depicted on your Exhibit Number Three?

A Yes. That process varied depending what logs were available. Cities Service wells and all of the -- and some of the Amoco wells, we had neutron density logs available and when those were available, I would choose those sands where we had good crossover effect between the neutron and density logs, and where the gamma ray showed that the well was not -- the sand was not shaley.

Where density logs were available I simply chose the porous zones, using the density track and the clean zones, using the gamma ray track.

Q Was the method of selecting the logs and analyzing those logs one that is standard to your industry?

A Yes, it is.

Q Would you describe for us generally what you have concluded from examining the wells as depicted on Exhibit Number Three?

A I can conclude from this cross section that the sands are continuous across wide areas in the West Bravo Dome Area.

Q As you move from A on the western side of the area under consideration to A', the eastern side, do you see any discontinuity in the sands in the Tubb that would cause you to believe that you're dealing with a separate reservoir?

A No.

Q When we talked about the Tubb sand interval, we're talking about what type of production, Miss Egg?

A CO2 production.

Q Are there any other formations or reservoirs within this area that have CO2 in them?

A Yes, two others have been reported. They are the Glorieta and the Santa Rosa.

Q Vertically where would the Glorieta and the Santa Rosa lie in relation to the Tubb formation?

A They both lie above it.

Q In your opinion is the Tubb formation an appropriate formation to space and develop as a separate source of supply for carbon dioxide, separate from those other two formations?

A Yes.

Q And why do you so conclude?

A The Tubb sandstone has above it the Cimarron anhydrite, which is a good sealing layer, and there is no -- it is not possible that the three reservoirs would constitute one source of supply.

Q In preparing your cross section I believe you've told us that you've examined the cross sections that Amoco has used?

A Yes, I did.

Q What, if any, difference is there between the method that you used in picking the thickness of the Tubb, any difference between your method and the method used by Amoco as represented on any of their cross sections?

A Amoco used correlations between porosity and permeability that were derived from their core analyses.

Based on the determination of permeability from the cores using that correlation, they chose that net sand would be all those sands in which permeability exceeded one millidarcy.

Q What method did you use?

A I used an examination of the individual

logs, checking for porosity and cleanness of sand.

Q If you had used the Amoco method on cross section A-A', would there be any difference in the way you have shaded the Tubb formation?

A Yes, there would. The Amoco method generally yields far more pay in a well than my method does.

Q Miss Egg, I show you what is marked for identification as Cities Service Exhibit Number Four and ask you to identify that exhibit.

A This exhibit was prepared to show the correlation between a cored well and a well that was -- in which -- that appears on the cross sections in which I've picked pay by my method.

Q Would you identify for us which is the well on which you had the core information?

A The cored well was the State "DS" No. 1.

Q Does that appear on cross section A-A'?

A State "DS" No. 1 appears on no cross section.

Q Where will we find that well on Exhibit Number One?

A It's located in Township 18 North, 30 East, Section 29.

Q All right, and for comparison you have picked the State "DS" No. 1 Well?

A Yes.

Q And where will we find that well?

A The State "DO" No. 1?

Q I'm sorry, the State "DO" No. 1.

A That's located in 18 North, 30 East, Section 20. The State "DO" appears on cross sections B-B' and C-C'.

Q All right, so the cored well is in Section 29 just to the south of the well "DO" No. 1 in Section 20.

A Yes.

Q Okay. Would you describe what you've concluded by making a correlation between the core and the log analysis?

A I concluded that my choice of sands from the log correlated well with the permeable zones that we found in the core. This substantiates my method of picking the sands.

Q All right. Let's go to cross section B-B'.

All right, Miss Egg, would you return to what we've placed on the board as Cities Service Exhibit Number Five, and have you identify this cross section.

A This is cross section B-B' that extends from the West Bravo Dome Area again into the Amoco Unit.

Q Would you identify for us the process you went through in selecting the wells to place on this cross section?

A Again these wells were selected for equal

spacing between the wells.

Q What were you attempting to investigate and determine by the construction of a cross section as located in B-B'?

A This cross section was generated in order to determine whether geologic continuity existed across the West Bravo Dome Area and in the area that was approved for 640-acre spacing.

Q And what do you conclude from preparing that cross section and analyzing the logs?

A I conclude that such continuity does exist and that there are no geologic impediments to a well draining a large area.

Q Was this cross section prepared in the same way, using the same method for analyzing those logs and the thickness of the Tubb as you used for the A-A'?

A Yes, it was.

Q And in fact are those methods the same for all of your cross sections?

A Yes.

Q When we go to Exhibit Number Six, which is cross section C-C', is this also an exhibit that you prepared?

A Yes.

Q What were you attempting to examine by constructing this cross section?

A I was examining the sand continuity with-

in the West Bravo Dome Area, a cross section running from the northwest to the southeast.

Q And what wells have you selected for purposes of this cross section?

A I selected wells that were drilled by Cities Service back in 1981.

Q In your opinion are those wells typical of the area in which they penetrate and are characteristic of those areas?

A Yes, they are.

Q Have you selectively picked out the best and the worst wells?

A No.

Q All right. What do you conclude from that exhibit?

A I conclude that the sands are continuous within the West Bravo Dome Area.

Q All right, let's go to your D-D' cross section.

All right, Miss Egg, let's have you identify Exhibit D-D', which is marked as Exhibit Number Seven.

A This is a cross section which extends from the north to the south in the West Bravo Dome Area.

Q What were you attempting to examine by preparing a cross section from D to D'?

A I was examining sand continuity.

Q You were looking at those wells that are

available to you on the far western side of the 640-spaced area for Cities Service?

A Yes. Each well along that western boundary is included on this cross section.

Q And with regard to that western boundary, what have you concluded about the continuity of those wells running north to south along that boundary?

A The sands are very continuous along the western boundary.

Q Miss Egg, I show you at this time what I've marked as Cities Service Exhibit Number Eight.

Would you identify for us what Exhibit Number Eight is?

A Exhibit Eight is a core analysis for the State "DS" No. 1, the well that we've used in my correlation of log and core analysis.

Q All right, sir. Miss Egg, would you refer us to that portion of Exhibit Number Eight that identifies, I guess it's the first page of that exhibit, would you identify for us the method in which this core was taken?

A This core was cut with fresh water mud and analyzed by CORE Laboratories.

Q All right, and what does that analysis show to you as a geologist and an engineer?

A The analysis shows that there are good, permeable, porous sands within the Tubb formation.

Q What is the general range of permeability

that is determined from analysing the core of this well?

A Oh, on the sand the permeability -- well, the permeability averages around 10 to 20 -- 10 millidarcies from the core analysis.

Q All right, is there any other factors or conclusions about the core analysis that you would like to express at this time?

A No, there is not.

Q All right. Miss Egg, I show you what we've marked as Cities Service Exhibit Number Nine and ask you if you prepared this exhibit?

A Yes, I did.

Q Would you identify the exhibit for us and tell us what you have done in preparing this exhibit?

A The exhibit identifies average reservoir parameters for the West Bravo Dome Area, specifically for those wells which were drilled by Cities Service.

Q Of the wells drilled by Cities Service, how many wells are you talking about?

A Without considering the dry hole, this includes an analysis of eighteen wells.

Q And what have you concluded about the reservoir parameters by analyzing the eighteen Cities Service wells?

A I used these parameters to calculate an original gas in place volume and a reserves volume, and I can estimate, using these parameters and conclusions, that

we can recover approximately 3 Bcf per 640 acres, using volumetric analysis.

Q When you make an examination of the reservoir parameters, Miss Egg, and you find the average net pay to be 26 feet, what happens to the volumetric calculation if that net pay thickness is greater than 26 feet?

A You will have more gas in place.

Q And if the net pay figure is less, you have less gas in place?

A True.

Q What happens when the average porosity that you've calculated to be 18 percent, what happens if that number is higher than that?

A If the porosity is higher, you will also have more gas in place.

Q And if the water saturation number is higher than 50 percent, what happens to the gas in place calculation?

A You'll have less gas in place.

Q What is the effect of the reservoir pressure number on the calculation?

A The higher the pressure, the greater the gas in place.

Q Can you describe for us generally how these reservoir parameters compare to those testified to by Amoco in the Amoco Bravo Dome spaced area?

A Our porosity and water saturation are si-

milar to the values presented by Amoco.

Our net pay is quite a bit less but our reservoir pressure is also higher.

Q Does the net pay thickness of the well have any relationship to the ability of that well to drain a great area or a small area?

A No, there is no relation.

Q If the Amoco area is thicker than the Cities Service area in terms of net pay, what does that mean?

A That would indicate that they have more gas in place but it says nothing about the ability of the well to drain an area.

Q Based upon the reservoir parameters that you have determined to be typical of the eighteen wells you've analyzed, do you see any of those reservoir parameters that would cause you to believe that wells in the West Bravo Dome should not be spaced upon 640 acres?

A No, nothing indicates that.

Q And in fact if the net pay thickness is less than the Amoco Area, you would expect to have to dedicate a greater number of acres to a well than you would if you had a thicker pay section.

A Yes, that would be true.

Q All right, let's go on to Exhibit Number Ten and have you identify that for us.

A Exhibit Ten?

Q Yes, ma'am. Would you identify Exhibit Number Ten for us?

A Exhibit Ten is a comparison of the wells that were drilled in the West Bravo Dome Area and three wells drilled in the Amoco Unit.

Q All right, when you talk about the wells drilled in the West Bravo Dome Area, you're identifying what operator as having drilled those wells?

A Cities Service.

Q The Amoco wells listed on the comparison, can you go to Exhibit Number One and generally identify for us where each of those three wells is located?

A Yes. The first well is located in 19 North, 31 East in Section --

Q Let's have you circle each of those wells in red.

A Section 35. That well appears on one of my cross sections.

The second well is in Township 19 North, Range 33 East, Section 35.

The third well is in 18 North, 35 East, Section 7.

Q Why have you selected those three wells from which to draw the comparison?

A I selected three wells that were widely distributed across the Amoco Area and I selected one of the wells to be in the especially good part of the Amoco produc-

tive area.

Q And what conclusions do you reach by a comparison of the pay quality between the Cities Service wells in the West Bravo Dome Area and the three Amoco wells?

A I can conclude that the pay quality is very comparable. The only real difference is the net pay value.

Q And you've already concluded for us that the net pay value does not -- is not a factor that affects the ability of one well to drain a given amount of acreage.

A Yes.

Q Is it that -- it's the permeability factor that is the deciding element.

A That's correct.

Q And how does the permeability compare between the Amoco wells and the Cities Service wells? Can you give us a generalization?

A I can tell you, although I did not do the work myself, that the permeability is comparable. The next witness will address better.

Q All right, let's go on to Exhibit Number Eleven, then.

Does part of your employment with Cities Service include making economic evaluations of wells?

A Yes, it does.

Q Would you identify for us Exhibit Number Eleven and describe what you have represented on that exhi-

bit?

A Exhibit Eleven includes two production schedules.

The first is for one well spaced on 640 acres. The second is the combined production of four wells on 160-acre spacing.

Q In terms of the production schedule, have you made an assumption about the daily rate of production from the carbon dioxide well?

A Yes, based on the data that we had from our wells, I made the assumption that initial production from each well would be approximately 1-million cubic feet of gas per day.

Q In your opinion for purposes of your analysis, is the assumption of a million Mcf a day a fair assumption?

A Yes, it is.

Q All right. Tell us then what you have concluded by making that comparison.

A I've concluded that both -- well, one well on 640 acres and four wells on 160 acres would produce a comparable amount of gas and that drilling four wells simply accelerates the rate at which that gas is produced.

Q If we use one well on 640 and assume a production rate of a million a day, over what period of time would you recover the gas under the 640 acres?

A Twenty years would be required.

Q If you drill four wells to a section or have spacing on 160 acres and assume the same production rate, how fast will you deplete to recover those same reserves?

A In that case the reserves are recovered in seven years.

Q All right, let's go to Exhibit Number Twelve.

Miss Egg, does Exhibit Number Twelve also represent your work product?

A Yes.

Q This is part of your study of the West Bravo Dome Area?

A Yes, it is.

Q Is this one of the typical economic evaluations that you're accustomed to running --

A Yes.

Q -- on Cities Service wells?

A Yes.

Q All right, would you describe for us first of all what the exhibit is and explain for us how you went about making this evaluation?

A The production schedule is based on the exhibit that I just presented.

Using that production schedule I ran the economics for a typical well on 640 acres and a typical well on 160 acres.

Q All right, for the reserves -- is that the reserves in place or the recoverable reserves?

A That's recoverable reserves.

Q And you used a recovery factor of what percentage?

A 80 percent.

Q And the recoverable reserves of -- for the 640 are different than the 160?

A Well, yes, they are, in that four wells on 160 acres would drain the same amount of reserves as one well on 640 acres.

Q What I'm saying is the 740 number is simply one-fourth of the 2900 number?

A Approximately, yes.

Q All right, and how did you go about making the comparison of the cash from operations?

A The cash from operations is simply the income that you get after taxes are paid.

Q All right, and when you go through the rest of the calculation and evaluation, what conclusions do you reach about a well drilled upon 640-acre spacing versus a well drilled on 160-acre spacing?

A A well on 640-acre spacing is a viable investment where a well on 160 acres is not. The reserves that you recover on a well spaced on 160 acres do not justify the drilling of that well.

Q If you drilled a well on 160-acre spacing,

can you do so at a profit, based upon your economic evaluation?

A No, you can't, not with the assumptions I made concerning gas price and inflation factors.

Q Are the assumptions that you've made on gas price and inflation factors typical --

A Yes, they are.

Q -- for evaluation of this type of reservoir?

What's the significance of the minus in front of the 146 and the minus in front of the 112 on the seocnd column?

A Those represent losses.

MR. KELLAHIN: Mr. Chairman, I wonder if we might take a break at this point in Miss Egg's testimony? I do have some further questions but it might be convenient to take a short break.

MR. STAMETS: Fifteen minute recess.

(Thereupon a recess was taken.)

MR. STAMETS: The hearing will come to order.

Mr. Kellahin, you may proceed.

MR. KELLAHIN: Thank you, Mr. Chairman.

Q Miss Egg, I'd like to ask you to give us some conclusions based upon your opinions and study of this are and perhaps we might use Exhibit Number Two, which is the structure map as a reference exhibit for purposes of my questions.

When we talk about the thickness of the Tubb reservoir in the area outlined by the pink outline, would you generally describe for us what happens to the thickness of that reservoir as we move from, say, the eastern boundary on to the west?

A Well, as shown in cross section D-D', there -- the reservoir does thicken towards the west up to the point where there's a facies change to shale.

Before you get to that point, though, generally there's a thinning of the sand.

Q How would you characterize the reservoir as you move from the south boundary up towards the north boundary of the proposed spaced area?

A The reservoir thins.

Q When we talk about the thinning or thickness of the net sands in the Tubb, what are we simply talking about?

A We're talking about the volume of pay quality rock.

Q What effect does that thinning and thickening have in terms of the ability or the capacity of a given well to drain 1000 acres, 640 acres, or any quantity

of acreage?

A Pay thickness isn't relevant.

Q In doing your economic evaluation as represented in those exhibits, what did you conclude about the economics, using your reservoir parameters? What did you conclude about your economics in terms of one well to a section versus four wells to a section?

A Because the reserves for the four wells in a section will be recovered by the four wells, the volume of gas that is recovered do not justify the drilling of those four wells; whereas one well will be profitable.

Q Do you have an opinion based upon your study as to whether or not wells spaced upon 160 acres would result in the drilling of unnecessary wells?

A Yes, it would.

Q Will the drilling of wells on 160-acre spacing in your opinion result in the recovery of additional reserves from the Tubb formation that would not otherwise have been produced from the one well to a section?

A No.

Q Can you describe for us or give us a general example fo the type of reservoir you would see if -- you would see that would cause you to believe it would be spaced upon 160 acres?

A I would see discontinuous sands in the cross sections; perhaps areas where the Tubb sand, you know, Tubb formation included no net sand.

Q Why would you want to drill wells on 160 acres if you saw a reservoir like that?

A Because it's possible that a sand might not be encountered by any wells, penetrated by any wells on greater spacing.

Q Do you see that type of reservoir where you would want spacing on 160 acres when you examine this Tubb reservoir?

A No.

Q In making a comparison between the reservoir parameters in the West Bravo Dome and the reservoir parameters in the Amoco spaced area, can you make a comparison about the economics of drilling wells on 160 acres in the Amoco Area versus the economics of drilling them on 160 acres in the West Bravo Dome Area?

A Yes. Although we have higher pressure, it's not enough to compensate for our thinner pay. They have a greater volume of gas that they can recover in the Amoco operated Bravo Dome Area than we have in the West Bravo Dome Area; therefore, when we drill four wells on a section, each well will recover less gas than wells spaced on 160 acres in the Amoco Bravo Dome Area.

Consequently, our economics look worse on 160 acres than Amoco's would and Cities Service would be hurt more by such limited spacing.

Q In terms of deciding the boundaries for the West Bravo Dome spaced area, do you see any logical geo-

logic or engineering justification for separating a boundary between the Cities Services wells and the Amerigas wells within this area?

A No. The cross sections show and the structure map shows that there's geologic continuity throughout this area.

Q What happens if those wells operated by Amerigas on their acreage are allowed to be drilled and spaced and produced upon 160 acres where immediately adjacent to that we have a pool for Cities Service spaced upon 640 acres?

Do you see any engineering or geologic difficulties with that kind of situation?

A I see economic difficulties in that Cities Service would be obligated to protect correlative rights between those areas; consequently, even though Cities Service were spaced on 640 acres we would be obligated to drill wells along the boundary of our proposed unit.

Q Why would you be so obligated?

A If we didn't, then CO2 would be drained from beneath our leases.

Q In your opinion what is the most logical place to locate the boundary of the 640-acre spaced area that we've been discussing in this application this morning?

A Based on my geology the most logical boundary is against the boundary of the area that's already approved for 640-acre spacing.

MR. KELLAHIN: Mr. Chairman, that concludes my examination of this witness.

We move the introduction of Cities Service Exhibits One through Twelve.

MR. STAMETS: Without objection these exhibits will be admitted.

Are there questions of this witness?

MR. LOPEZ: If the Examiner please.

MR. STAMETS: Mr. Lopez.

CROSS EXAMINATION

BY MR. LOPEZ:

Q Miss Egg, let me make sure I understand your testimony here today.

I think you've indicated in your testimony that it is your opinion that one well can drain a 640-acre spaced area because there is continuity of pay throughout the area we're looking at. Is that correct?

A There is no geologic reason that one well cannot drain a large area.

Q What -- what is your testimony that indicates that one well will drain a 640-acre area?

A My testimony is based on the geology. I'm also aware of the results of the following witness and he will examine the permeability.

Q So your testimony is based on geology.

A Yes.

Q And is it your opinion that based on your cross section -- I think this was Exhibit Two, on your structure map, that the geology is essentially the same throughout the area indicated on Exhibit One?

A Yes, it is essentially the same.

Q Would you explain to me, then, why you have not included in your spacing request the area between the north end of the pink area indicated on Exhibit One and the southern end of the yellow area?

A Geologically there is really no reason why that are should not be included. We chose that as a reasonable starting point for the 640-acre spacing area.

Cities Service did not have an interest in much of that area to the north.

Q Is it your testimony that the reasons for the selection of the geographic area advertised for this hearing is based on Cities Service's acreage position primarily?

A No, I can't say that primarily it is.

Q Was it a significant consideration in selecting area?

A It was a consideration.

Q Now let's go to the southwest end of your proposed 640-acre spaced area. It lies between two wells that you've described as essentially dry holes. On what

basis have you included the acreage lying the most southwest township indicated in your 640-acre spacing area?

A That southern boundary was drawn on the -- at the approximate location of the gas/water contact which I've been able to establish on my structure map.

It seemed obvious to me that that area would in all likelihood be productive of CO2.

Q Okay. Now, let's turn our attention to your cross sections and consider them as a whole.

Would you not agree with me that the pay zone deteriorates significantly going from the east side of the Bravo Dome Area to your area which is in the western part of the Bravo Dome Area?

A No, the pay quality is the same. The net thickness is less.

Q Okay, so I stand corrected. The thickness in pay, would you agree with me, deteriorates significantly going from east to west?

A I would agree that the pay thins from southeast to northwest.

When you have an abrupt boundary to the west, you have the thick zones that are indicated on cross section D-D' and then no net sand -- well, very little net sand in the well that designates the western boundary of the spacing application area.

Q Now, cross section D-D' is a north/south cross section in the center of the -- Amoco's Bravo Dome

Unit Area, isn't it?

A It's a north/south cross section along the western boundary of our application area.

Q Okay. Well, let's not consider D-D' for the time being and consider A-A', B-B'.

MR. KELLAHIN: Excuse me, Mr. Chairman, there are two D-D' and A-A' on the exhibit. I think we're going to have to indicate them by color, also.

A Okay.

MR. KELLAHIN: Some of those are Amoco's cross sections; some of them are Cities Service cross sections.

MR. LOPEZ: I would like to refer only to Cities Service's cross section.

Q You stated that you were present at the Amoco hearing in the earlier case in May.

A Yes.

Q Do you recall Amoco's testimony that the thickness of pay in the western part of the Bravo Dome -- in the eastern, rather, in the eastern part of the Bravo Dome Area was in the range of 150 feet?

A I don't recall them stating that, but that number is correct.

Q And could you tell me again what you thought the average thickness of pay was in the western portion of the Bravo Dome Area?

A It was 26 feet.

Q Then would you agree with me that that indicates a significant deterioration of thicker pay going from east to west?

A Yes.

Q Now I've noticed, and maybe the best thing to do is for me to approach the exhibits, if I may, if I look at your cross section A-A', I assume this is Cities Service's cross section?

A Yes.

Q Would you agree with me that the -- that the eastern side of the -- I mean the western side of the Bravo Dome Area indicates more and thinner stringers that indicate pay?

A I wouldn't necessarily say more. The stringers are thinner.

Q And more discontinuous?

A No, I would disagree.

Q On what basis would you disagree? You've indicated some stringers that don't go past one wellbore and I don't see that happening much on the eastern side.

A You must understand that there are approximately eight miles, or so, between each well. Considering how the other stringers extend across the wellbore -- across the area, I would not expect those stringers where the sand was well developed only in one well to be penetrated only by that one well.

Q You just stated that there's as much as

eight miles or more between each well that is indicated on this exhibit.

On what basis can you testify that there is continuity of that stringer from well to well without any information between the wells? Isn't it possible that that stringer could terminate and pick up again?

A It's possible, but base on my geologic interpretation, I would say that it's highly unlikely that that stringer would not be encountered by a well drilled a mile away.

Q It's highly likely that that stringer would not be encountered by a well drilled a mile away, is that what you said?

A I may have gotten too many negatives in there.

The probability is that stringer would be encountered by a well drilled a mile away.

Q I'm sorry, I didn't follow you.

MR. KELLAHIN: Please tell him again. I like the answer.

A In my opinion that stringer would be encountered by a well drilled one mile away.

Q And what's the basis for your opinion?

A The continuity in the other sands. I would assume that there's a similar depositional environment that deposited all these sands.

Q When was accounts for all the various

stringers differing in thickness and in length and extent?

A The same geologic environment may include periods of sand deposition across a layer, across a period, and periods of shale deposition. It's normal to have stringers layered reservoirs.

Q Okay. It's normal throughout the geology of the oil and gas industry where they drill wells that this occurs?

A It's normal in virtually all the reservoirs that I've examined in the Permian Basin and in north Texas, which is more geologically similar to the Bravo Dome Area.

Q So it's your testimony that one well can drain a 640-acre spaced proration unit.

A On the basis of geology that's a true statement.

Q On the basis of the same geological testimony isn't it true that that same well could drain an area, let's say, of 760 acres --

A Yes.

Q -- over time, or 1280 acres?

A Geologically that's true, but as an engineer, I know that there are limitations there and I realize that.

Q And what are the limitations? On what do you base the limitations?

A On time. It's not viable that one com-

pany would wait long, wait a thousand years to drain an infinite reservoir.

Q Isn't it true as a general statement that the closer the spacing pattern, the more hydrocarbons will be recovered?

A That's not necessarily true.

Q Why isn't that necessarily true?

A I've seen evidence, if I may draw from a situation which is quite different than what we're having here, in waterfloods where we've infill drilled and no additional oil has been recovered.

Q Well, we're not dealing with a waterflood situation --

A Yes.

Q -- are we?

A No, we're not.

Q So putting aside a secondary or waterflood type of situation, in a normal primary recovery of an oil or any pool, isn't it generally correct that the more wells you drill, the more hydrocarbons you'll recover?

A That statement would also be a function of the pressures that you must have to economically produce a well.

Q Well, let's assume that the, as I think you testified, that the average reservoir pressure remains faily constant through the area in question, wouldn't it be true that the more wells would recover more hydrocarbons?

MR. KELLAHIN: Mr. Chairman, I'm going to object to this question. He's talking about hydrocarbons. I don't know that we've got hydrocarbons here.

Q Well, let's say CO2.

A Cities Service cannot conceivably wait however many years it would take for one well to drill -- to drain an unreasonably large area, but given enough time, one well would drain that area.

Q Okay. Would it drain disconnected stringers?

A No, it wouldn't, but we're not looking at 43,000 acre spacing, either.

Q Isn't there clear evidence that there is the existence of disconnected stringers lying within the area in question, and I refer you to what you've introduced as your Exhibit Ten?

MR. KELLAHIN: Mr. Chairman, I'll object to the form of the question. Clear evidence is not the standard of proof before the Commission. Substantial evidence, and I think the question ought to be phrased to the expert in that context.

MR. LOPEZ: I'll stand corrected and say substantial evidence.

A Would you please repeat the question?

Q Isn't there substantial evidence that there exist stringers within the area of your proposed ap-

plication?

A Yes, the reservoir by its nature is composed of stringers in a vertical sense.

Q Then wouldn't you agree that the closer the spacing pattern, the more opportunity there would be to encounter discontinuous stringers in a given area?

A I saw, as I was constructing my cross sections, very few horizontally discontinuous stringers. The vast majority of the reservoir rock can be penetrated by wells that are spaced six miles apart, let along one mile apart.

Q I'm sorry, I missed that last part. Could you repeat it?

A I'm saying that you see the same sand present in wells that are far apart.

Q I think we see the same sands but we see them appearing in different stringers. Isn't that correct?

A I'm confused by the way that you're phrasing your question.

Q Well, maybe we can help by referring to your Exhibit Ten. Would you do that for a minute?

Referring to your State "DH" No. 1 Well, shown on that exhibit, I think it shows that there's a net pay that -- net pay of four feet, is that correct?

A Yes.

Q And if we refer to what's been identified as State "DF" No. 1 Well, we have as much as 52 feet of net

pay. Wouldn't that indicate clearly a significant difference in the amount of net pay or putting it another way, in what stringers are encountered in a wellbore?

A What you can see by some of the cross sections across a larger area, for instance, A-A', B-B', and C-C', as well, you do encounter more stringers to the east; however, those stringers are continuous up to the point where they are no longer present in the west. They're not discontinuous per se in an immediate area.

Q In preparing your cross sections did you give any consideration to permeability?

A I can refer you to the Exhibit Four where a comparison was made between the log response that I used to pick my net pay and a well that was cored and the log -- I used the log response of the cored well to correlate to the well that appears on the cross sections, and then marked high permeability sections in that cored well, and in this way I did tie it to permeability.

Q Those two wells were essentially adjacent to each other, though, weren't they?

A Oh, I think there may be a couple of miles between them, one or two.

But I wasn't trying to show sand continuity between here, I was simply showing that the core permeability results correlate well with the method, the way that I picked my sands, and these sands that you see shown in yellow on the cross sections are in all probability also

permeable.

Q Well, would you agree that there is a difference in permeability occurring in the various stringers?

A There -- the log analysis in Section 8 shows a normal type of variation within each stringer, but it's nothing unusual.

Q Does the permeability vary going from west to east?

A I believe that Amoco presented in their testimony for their 640-acre spacing hearing in May a typical well with 98.6 millidarcies permeability.

The permeability shown in the core analysis for State "DS" No. 1 is comparable to that.

I believe the average of the pay zones, in fact, was even better, 13 millidarcies.

Q Did you agree -- do you agree with Amoco's testimony that the cutoff for pay -- for considering a pay zone is one millidarcy?

A I think that for transmitting CO2 through reservoir rock that would be a fair assumption.

Q So if I understand your testimony, it's based on your geologic testimony, the continuity of the pay thickness is present in the area under consideration here today, and one well can drill 640 acres based on that testimony of yours.

A I've shown that geologically there's no

reason why a well cannot.

Q So, do I understand you correctly that the basis for your request that the spacing be based on 640 acres is economics?

A I'd say more that it was common sense. Economics does play a part.

Q Okay. I think that I'd like to explore the economic basis with your for a minute, if you will, for justifying spacing on 640 acres, and in this respect I'll refer you to what's been marked Exhibit Twelve.

Now, what I would like to do is explore with you the foundation on which you arrived at your economic conclusions.

I don't think you've testified as to how much Cities Service expects to put out to pay for the cost of the average well drilled in this area. Could you tell me how much that figure is and on what basis you arrived at that conclusion?

A The individual well cost was estimated at $250,000. That's based on current costs for Amoco in drilling their wells and the problems that Cities Service encountered in drilling the wells that we have already drilled in the West Bravo Dome Area.

We have to add to that investment a proportion of the cost for a gatherins system, for dehydration and compression, and for a pipeline to which -- through which we can connect to a major pipelin to transport the gas

out of the area.

Q Is that usually done?

A It must be done on project econmics.

Q On project economics, but are you aware of any other spacing case where the cost of the pipeline and gathering system and dehydration facilities, et cetera, were included in weighing the economics of the project?

A I haven't studied the transcripts from other spacing cases.

Q What -- what costs did Cities Service incur with respect to the eighteen wells they drilled?

A Since we only drilled the wells and built the roads to the locations, I believe our average well cost back in 1981 was something in excess of $300,000.

Q And that was in 1981.

A Yes.

Q Then on what basis do you conclude that the average well cost would be $250,000 in 1984?

A Rig costs are down, for one.

Q Do you have any specific evidence of this reduction in the cost of well drilling?

A I don't have any specific evidence. As a reservoir engineer it was not my responsibility to come up with detailed cost estimates.

I used what was provided to me from production engineers.

Q I believe you testified and made it very

clear that Cities Service felt that the economics could only justify the drilling of only one well on 640-acre spacing. I'm trying to get at the basis of your conclusion in that respect.

Well, let's move on. What -- you said that in concluding that it would be profitable only to drill one well on 640-acre spacing that you took into consideration the price of the product. What is the price that Cities Service expects to receive for the CO2 produced in the area in question?

A We're estimating Ninety Cents per Mcf at the unit boundary, proposed unit boundary.

Q And how do you arrive at this price?

A This was based on prices that other operators are receiving.

Q What other operators?

A I believe that this is the price that Amoco is getting.

Q At what point in their system?

A At the unit boundary.

Q At the eastern boundary of their unit?

A I'm talking mainly after the gas is compressed and dehydrated and ready for transportation. I don't know at what point the pipeline leaves the unit.

Q I think you said that in determining the economic profitability of the venture you took in the cost of a gathering system. How did you arrive at the cost of

the gathering system?

A Our production engineer gave me a detailed estimate of the footage of pipes that would be recovered, the size of the pipe, the types of -- the grades of the pipe that would be necessary and estimated the cost on the basis of these forecasts.

Q And what were the basis of his forecast?

A The basis of his forecast was his design for the gathering system, the most efficient way to connect each well to a plant.

Q And on what spacing was this information developed?

A Okay. The investment for the 640-acre spacing case, the gathering system was designed for wells spaced on 640 acres.

A proportional -- excuse me. The estimate for the gathering system was increased for the 160-acre spacing by a particular amount that was not proportionate to the number of wells because the pipeline sizes would not necessarily have to be increased to transmit the extra gas.

Q I'm not sure I followed you. Let's refer to Exhibit Twelve and just kind of tackle it from there, maybe, if you could help me.

Cash from operations, now where does that figure come from?

A That is the income that the operators of a -- or the working interest owners of our proposed unit

will just be subtracting from that the royalty payments and the overrides that may exist, and that also takes taxes out.

Q But I assume this figure just didn't come out of the air. Is it based on one well per each section within the proposed area?

A Yes, this is for one well draining the reserves for 640 acres.

Q So how many wells would that be in the area, do you know?

A I don't know what the number would be throughout the entire application area.

In our proposed unit we're looking at approximately 67 wells.

Q Now in your proposed unit that's subject to another case that's before the Commission here today, right?

A Yes.

Q So does this figure have any relevance to the number of wells in the proposed area subject to this spacing hearing?

A Yes, it does. It's a typical well. It's a typical 640 acres.

Q So this is -- and I notice that the well based on 160-acre spacing only has $197,000.

A Unless gas is recovered.

Q Over time, or I mean -- I notice that the reserves are for one well on 640, are four times the amount

of reserves under 160-acre well.

A Yes.

Q And not getting into an argument on the basis of that, why is the cash from one well on 640 six times that on 160?

A The difference would result from the greater front end investment on the 160-acre spaced wells.

Q Yeah, but isn't that included in the capital investment?

A The -- the timing is somewhat different. These values are also -- also result -- take into consideration Cities Service tax basis, which is somewhat unusual, but I cannot go into that in detail.

Q Well, isn't it true that the economics are going to vary significantly depending on the operator and what each operator's intentions with respect to their projects entail?

Isn't that what you're saying?

A Can you clarify what you mean by their intentions?

Q Well, I suppose the economics would differ if the operator of the leased acreage, the CO2 acreage, were going to use that CO2 for its own purposes for enhanced oil recovery in one field, using its own pipeline, or whether that operator were going to in fact sell it to a third party for use in some other entirely different oil pool.

A Yes, the operating costs would be different; the investment costs would be different, but I must also add to that that I don't feel that has to do with spacing.

Q I thought the whole thrust of your testimony was that depending on the factor of time that it is clear that geologically that one well can drill -- drain ten acres, 640 acres, 6040 acres, so the reason for suggesting 640-acre spacing, besides just plain common sense, is an economic determination, and I guess my point is, aren't the economics going to vary depending on the operator and what its project entails, and I think you said yes.

A Yes, that's true, but --

MR. LOPEZ: Thank you.

MR. KELLAHIN: Let her finish the answer.

Mr. Chairman, may she finish her answer?

MR. STAMETS: You can certainly ask her to follow up on that, Mr. Kellahin.

MR. KELLAHIN: Is it my turn for redirect?

MR. STAMETS: Let's wait till Mr. Lopez finishes.

MR. KELLAHIN: Well, I object to the witness not being able to give a full and complete answer to the question. She said "but" and she's entitled

to that and I think the record at this point ought to reflect her answer rather than require me at some later point to come back and ask the same question.

It's only fair to this witness to allow her to explain her answer.

MR. STAMETS: She may feel free to go ahead and explain her answer.

A The operators, the leaseholders in the area that Cities Service hopes to unitize will all be selling their CO2 to a major pipeline in enhanced recovery operations in the Permian Basin.

The area that is included in the application area held within the Amoco Bravo Dome Unit will also be used for that same purpose.

A large majority of the operators will be using their CO2 for purposes and their investment will be reflected by these economics within this field.

Q What inflation factors did you use? I believe you testified that you used inflation factors in determining the economic profitability. What were those factors and upon what basis were they used?

A I can't give you specifically which factors -- what factors they were. They are the same factors used in the evaluation of all Cities Service projects and they are factors that are determined by our economic forecasters.

Q Now I also think you testified that you

used an 80 percent recovery factor for recovering the reserves in place. On what basis did you use that percentage?

A I'm aware of the results of a simulator that was run by the next witness. Those results were that if we take the CO2 production down to 100 psi and 50 Mcf per day economic limit for each well, we will recover 80 percent of the gas in place.

Q Did this take into consideration the viscosity of the carbon dioxide?

A The next witness will be better prepared to answer that.

Q I believe you testified that the thickness in pay does not affect the ability of a well to drain a specified area but is only a measure of the reserves in place. Did I understand your testimony correctly?

A Yes.

Q And these economics contained on your Exhibit Twelve, these are based on Cities Service wells located in the western part of the Bravo Dome, isn't that correct?

A Yes, although I can also add that the reservoir properties do not vary significantly within the application area.

Q But didn't you agree with me earlier and wasn't it your testimony that the thickness in pay improves as you go from west to east?

A The thickness of the pay is definitely

better in the developed area of the Amoco Unit. If you'll look back at Exhibit Ten, the well located in Township 19 North, 33 East, Section 35, has a net pay of 41 feet, which is less than some of the wells drilled to the west in the Cities Service area.

Q Well, that just essentially supports the proposition that the thickness in pay varies from well to well, isn't that right?

A There is some variation.

Q Well, if the reservoir thickness improves as you go from west to east, wouldn't commensurately the economics per well also improve as you go from west to east?

A When you're talking about a very wide area across the entire Bravo Dome Area, yes, that's true.

Q Then would you agree with me that since Amerigas' acreage and wells lie to the east of Cities Service's area of interest, that their economics could be better than Cities Service's?

A I don't believe that would be true. I have some production data on the Amerigas wells and their initial production rate on one good well, especially, was somewhat less than our best production rate.

It was all within the same range easily.

Q Are -- what kind of leases does Amoco -- I mean does Cities Service hold within the area in question? Are they the usual kind of oil and gas leases that encompass CO2 and are for a term of years?

A I'm not well qualified to answer this question; however, the leases that Cities Service holds were the leases that were originally taken by Amoco prior to our purchase of the Amoco property in the West Bravo Dome Area, so I would say, I would guess that, yes, they are the same as most of the leases taken in Bravo Dome.

Q Well, isn't the real purpose of Cities Service seeking 640-acre spacing, is to hold its leases with the minimum of drilling?

A No, the real purpose is to prevent the drilling of unnecessary wells and protect correlative rights.

MR. LOPEZ: No further questions.

CROSS EXAMINATION

BY MR. STAMETS:

Q Miss Egg, on your cross section D-D' you show relatively thick section in the Tubb formation just -- just barely to the east of where it pinches out. Why, do you have an explanation of why that is that it's so thick in the area?

A I don't have a very sound explanation. The gamma ray on those thick zones indicated that the sands were probably getting a little bit more shaley but they still fell within the range of what I call net sand.

Q If this is one monstrous reservoir, your

territory, the Amoco Unit, why is the pressure higher over here on the west side?

A That is a difficult engineering question because it is well known that we're up dip and yet the pressure is higher. I don't know of anyone who has come up with a good explanation of that.

We know, Amoco has postulated that some faulting does exist, but I don't know if a fault should be a good reason to designate a separate reservoir when the same reservoir quality exists on either side of the fault.

In addition, in my structure map, in constructing my structure map, I saw no evidence of faulting within the -- our application area today.

So I cannot -- I don't think that we have separate reservoirs, at least within our application area.

Q Is a pressure variation sometimes an indication of discontinuity in reservoirs?

A Yes.

Q You did not present an ownership map. Does Cities Service intend to submit one in this case?

MR. KELLAHIN: Mr. Chairman, be happy to do so.

MR. STAMETS: Okay, thank you.

Are there other questions of this witness?

MR. KELLAHIN: I have some redirect, Mr. Chairman, if there are no other questions.

MR. STAMETS: You may -- well --

MR. KELLAHIN: It won't take me three minutes.

MR. STAMETS: You may redirect.

REDIRECT EXAMINATION

BY MR. KELLAHIN:

Q Miss Egg, on Exhibit Number Ten, which is the comparison of the Amoco -- the Cities Service wells with the net pay, would you please take that exhibit and approach Exhibit Number One and identify for us the locations of certain wells I'm about to tell you about?

Mr. Lopez identified for us the State "DH" Well. It shows four feet of net pay. Would you show us where that well is?

I'm not going to ask you to identify all of these but I do want you to identify those that demonstrate a net pay thickness of 8 feet or less, and let's start on Exhibit Number Ten with the State "DH" Well that has 4 feet. Where is that well?

A It's this one in Section 9 of 19 North, 29 East.

Q All right, and the "DL" Well with 7 feet?

A The "DL" Well is in Section 32 of 20 North, 29 East.

Q And the "DO" Well with 8 feet?

A The "DO" Well is in Section 20 of 18 North, 30 East.

Q Miss Egg, do you have knowledge about Cities Service's plan of operation that would be conducted within the next three years if the Commission approves this application for 640-acre spacing for a temporary period?

A Yes, I do.

Q Would you describe for the Commission what those plan of operations are generally and what additional data and information may result from that operation that could be used to determine spacing at the date the temporary period expires?

A If our unit is approved, we plan to drill 32 wells in 1985; an additional 18 in 1986.

During 1985 plant construction, a gathering system construction would commence and hopefully we would have our first CO2 sales in the latter part of 1985 or the early part of 1986.

So, by 1987 when we come back to the Commission for permanent pool rules of 640-acre spacing for the area, we would have approximately a year's worth of production. In this time we're producing wells for a year, we think we can analyse our production and actually run long term flow tests so we can do similar simulations, history matches, to what Amoco presented that was sufficient for their spacing.

We'll have far more reservoir data with

the drilling of all these wells because it will show, without question, reservoir continuity in this area as my interpretation follows.

Q Thank you very much.

MR. KELLAHIN: I have no further questions.

MR. STAMETS: Any further questions of this witness?

MR. KELLAHIN: Mr. Chairman, I wonder if now might be a convenient time to break for lunch?

MR. LOPEZ: I think I might like to recross. Can we reserve that till after lunch if you want to break at this time?

MR. STAMETS: No, we'll stay till we finish with this poor witness.

That's no reflection on her. The hearing will be recessed until 1:15.

(Thereupon the noon recess was taken.)

MR. STAMETS: Mr. Kellahin, you may call your next witness.

MR. KELLAHIN: Thank you, Mr. Chairman. Mr. Hanley has not yet been sworn, Mr. Chairman. My witness for the unit case was sworn and this witness needs to be placed under oath.

(Mr. Hanley sworn.)

EDWARD JAMES HANLEY,

being called as a witness and being duly sworn upon his oath, testified as follows, to-wit:

DIRECT EXAMINATION

BY MR. KELLAHIN:

Q Mr. Hanley, would you please state your name and occupation, sir?

A Yes, my name is Edward James Hanley and I'm employed by Cities Service Company in Tulsa as Manager of Wellbore and Reservoir Mechanics Group in the Exploration and Production Research Department.

Q Would you spell your last name, please?

A Sure. H-A-N-L-E-Y.

Q Mr. Hanley, will you tell the Commission when and where you obtained your professional degrees?

A Yes. I have three engineering degrees, a BS, MS, and PhD in mechanical engineering, which I earned at Purdue University in the years of 1973, 1975, and 1978.

Q Would you describe for us what has been your employment experience in your profession subsequent to obtaining your doctorate degree in 1976?

A Yes. I've been employed by Cities Service Company in a variety of capacities.

I started with them as a Research Engineer where I was responsible for primarily reservoir evalua-

tion and well testing applications.

I also during that period taught the company well testing schools, both basic and advanced schools in well testing.

Subsequent to that I became a Region Reservoir Engineer for Cities Service operations in the Gulf of Mexico, which entailed supervision of all reservoir activities for the Gulf of Mexico Region.

Q Would you describe for us what study in general have you made of the West Bravo Dome Area of Harding County, New Mexico?

A Our group was requested to make an evaluation of the Bravo Dome Area by our Midland Operation Group, which is responsible for production in this area.

We were asked to investigate the available data in the field and design tests so that we could determine the reservoir characteristics, the flow potential, and appropriate drainage areas for production in the West Bravo Dome Area.

Q All right, sir, if you could speak up just a little bit more, Mr. Hanley, and give me the three areas that you were requested by the Midland Office of Cities Service to design and conduct studies for. What were those?

A We were specifically asked to determine the flow characteristics, the producing capacity, if you will, of the Bravo Dome wells in the West Bravo Dome Area.

That includes determination of the reservoir permeability.

We were asked to evaluate the success or failure of certain stimulation treatments which had been performed on the wells that had been drilled to date, and also to study the producing characteristics of the zone so that we could recommend an appropriate drainage area.

Q Have you conducted those studies and reached certain conclusions and opinions?

A Yes, I have.

MR. KELLAHIN: Mr. Chairman, at this point we tender Mr. Hanley as an expert petroleum engineer.

MR. STAMETS: Any questions as to the witness' qualifications? He is considered qualified.

Q Mr. Hanley, would you give us some background, first of all, on the testing program that your company conducted in terms of developing the necessary data from which you then made the three studies?

A Certainly. Basically we've conducted two sorts of tests in the West Bravo Dome Area, the first being isochronal flow tests and the second being an extended production test.

Q For the isochronal test, Mr. Hanley, would you identify for us what wells were subject to testing?

A Ten wells were selected for testing, for

conducting the isochronal test, and they were indicated on Exhibit Number One with the green arrows.

Q And for purposes of the flow test which well was selected?

A The State "DC" No. 1 Well, which is indicated by the red arrow on the exhibit, was selected for the extended flow test.

Q Can you explain for us why those wells were selected and particularly why that one well for the flow test was selected?

A Okay. We wanted to make -- for the isochronal test three of the wells were selected because there was core data available on the wells.

That would be the State "DS", the State "FN", and the State "DN", I believe, "HN", "HN", so those three were selected and we selected seven additional wells which would give us a cross section from northeast to southwest of the wells that we had drilled.

Just simply a representative number of wells from the -- from the Bravo Dome West Area.

Q Would you describe for us what the purpose is of an isochronal test?

A An isochronal test is run for a number of reasons. It's a very standardized test. It's one that's required on many natural gas wells by various State Commissions and it's run for the purpose of determining the flow potential of the well and for evaluating certain reservoir

and wellbore parameters.

Q What is the test period for the wells from which to run this isochronal test?

A Okay. I have an exhibit that might help us --

Q Yes, sir.

A -- talk about this.

Q Let's see if we can explain it by simply having the Commission hold the original. If it becomes too cumbersome we can put it up on the wall.

A Okay, what I have on this exhibit is -- are measurements made during one of the isochronal tests, and this exhibit shows data obtained on the "DC" Well, State "DC" Well, the well indicated with the red arrow on our map, during isochronal testing of that well.

And there are two curves shown on the exhibit. The lower curve shows the -- is a flow rate history. Now during the course of the isochronal test on this particular well we flowed the well four times at four different rates, beginning at time zero on the elapsed time scale.

Q Have you determined a length of flow rate and the number of flow rates and which, in your opinion, are reasonable for purposes of conducting this test?

A Generally a period of one hour is considered to be enough for a flow period; however, in making our analysis we wanted to obtain as much data as possible, so we extended the flow period to as much as, in this case,

six hours the first three flow periods and twelve hours on the final high rate flow period.

Q How do you determine how many times you flow the well for an adequate test?

A Well, the -- most state commissions require three to four flow rates.

We used four flow rates in this case. Actually three are more than adequate for analysis purposes.

Q What does Exhibit Number Thirteen then show you in terms of the measured flow rate and the measured pressure?

A This simply shows you, demonstrates the sequence of testing, a flow period followed by a shut-in period, followed by a flow period at a higher rate, shut-in period, et cetera, and the corresponding pressures, these are bottom hole pressures, which were measured during those flow periods.

Q And is Exhibit Number Thirteen prepared from the flow rates from which well, now?

A This is the State "DC" Well, which is indicated with the red arrow on our Exhibit Number One.

Q And did you conduct similar isochronal tests of the other nine wells, I believe, which --

A Yes.

Q -- you identified as part of this study?

A Yes.

Q All right, sir. All right, what is the

purpose, then, of Exhibit Number Thirteen, Mr. Hanley?

A This well, after conducting tests on all ten wells, this is a typical well and I wanted to show a typical responsible well to this Bravo Dome West Area to an isochronal test, and also to explain somewhat briefly how this data is used to evaluate reservoir properties.

Q All right, sir, what is the next thing you do?

A Basically, the pressure rates histories are taken and analyzed using conventional reservoir engineering methods to determine the formation permeability, the flow capacity of the well, and the wellbore condition, whether it is damaged, stimulated, or whatever.

Q All right, sir, and then what happens?

A What we did is conduct this test on the ten wells in the area and evaluated the permeabilities and skin conditions of the wells.

Q And what did that evaluation show you, Mr. Hanley?

A We found that all the wells we tested had very similar behaviors. The permeability was somewhat variable from something on the order of 3 or 4 millidarcies in the wells on the far west side to a high of 22 millidarcies in the area, well, I'm not sure which area it is, I'd have to look on the plat. I think it would be the "FN" Well had the highest.

The particular exhibit I've shown has a

permeability of 9.2 millidarcies, and this fell into what we consider to be average range, which is right in the middle of the range.

Q All right, sir, what is the next thing you did with regards to your study?

A Based upon our analysis of these data we conducted a simulation and the simulation -- the simulator we used was a two-dimensional radial gas simulator.

Q Is the two-dimensional radial gas simulator an appropriate model to use in this area for this type of reservoir?

A Yes. This would be the most appropriate type of simulator to use for modeling the behavior of this sort of well.

Q All right, sir, tell us what happens next.

A What was done was to use data calculated from analysis of this test, plug it into the simulator, and see if we could reproduce with that data this sort of behavior.

Q And were you able to do that?

A Yes, we were.

Q All right, sir.

A The next exhibit shows a simulation of the isochronal test.

Q All right, sir, at this point let me have you identify, then, Exhibit Number Fourteen.

A Exhibit Number Fourteen is titled Isochronal Test, Simulated Pressures and Flow Rates.

Q All right, what did you do with Exhibit Number Fourteen?

A What was done was to input the parameters from our analysis of the isochronal test of this well into the simulator, input the flow rates, and predict the pressure response of the well.

Q All right, and what did it show you when you did that?

A The pressure response of the well, as shown in the exhibit, matches very closely with the pressure response that was actually measured from this well.

Q All right, and how about the simulated flow rates?

A The simulated flow rates are not predicted by the simulator. They're input into the simulator.

Q All right, and with that information, then the computer model, using this program is able to simulate the pressures.

A That's correct, used in the mode that we (not understood.)

Q So if we take Exhibit Fourteen and overlay it on Thirteen, what does that show you, Mr. Hanley?

A When these exhibits are overlaid, and they were plotted on the same scale so they could be overlaid, we find a very close match between the predicted and

actual pressure measurements, and what this tells us is two things: One, that our analysis of the data was accurate and secondly, that our simulator is doing a good job of modeling this particular well.

Q All right, sir, what's the next thing you did?

A We did this sort of analysis on essentially all the ten wells.

Q Okay, and what did you find when you made that same analysis of not only the "DC" Well but the other nine wells?

A We found that we were able to get very good matches of our pressure history with the simulator and the input data from our testing.

Q All right, sir, then what did you do?

A Based -- we selected one of the wells for an extended flow test.

Q Okay. Which of the wells was selected for the extended flow test?

A The State "DC" No. 1 well was selected.

Q And this is the same well that is depicted on Exhibit Number Thirteen?

A That's correct.

Q All right, having selected that well for the flow test, what then did you do?

A We obtained permission from the State to vent carbon dioxide from this well for a period of 60 days.

Q All right, sir, then what happened?

A We again -- we began to produce the well and monitored the bottom hole pressures and the production of the well for a period of 60 or 61 days.

Q All right, sir, and what did you do with that information?

A Why don't I at this time bring out the next exhibit, which shows the measurements during this extended flow test?

Q Exhibit Fifteen has been distributed, Mr. Hanley, and Exhibit Fifteen then is the measured flow rates and the measured pressures from the State "DC" Well that you've been discussing?

A That's correct.

Q All right, and what does the measured flow rates and measured pressures tell you, or what did you do with this information?

A What we did during the flow test was attempt to simulate with this well realistic flow conditions. So we produced it at an economic rate, beginning in excess of 1-million cubic feet per day and allowed it to produce, after an initial transient, at essentially a bottom -- a constant bottom hole pressure.

Q All right, sir, then what did you do?

A Given this data we again went to our reservoir simulator using the properties which we had evaluated earlier and attempted to model with the simulator the

performance of this well and investigate how the well would perform for various drainage areas.

Q All right, sir, do you have an exhibit that shows the model simulation?

A Yes, I do.

Q All right, sir. Exhibit Sixteen, then, is the computer simulation of the measured pressures and measured rates that are depicted on Exhibit Fifteen?

A That's correct.

Q And if I overlay Sixteen on Fifteen we'll see how the computer is able to model against the actual rates.

A That's correct.

Q All right. Again, Sixteen is the computer simulation; Fifteen is the actual measured rates; Sixteen is the overlay on top of Fifteen.

All right, sir, what did that tell you?

A We found -- this told us two things. First, that again for the amount of data we have, our computer simulator is doing a good job of matching the actual measured pressure and production history.

Secondly, we found that 60 days was inadequate to determine the drainage area of this well. We had seen no evidence of any drainage limits of this well.

Q All right, what was the next thing you did?

A Shown on Exhibit Sixteen are projections

of what the performance of this well would be after the end of the flow period, which ended at approximately 70 days on our exhibit.

The projected performance of the well was based on two drainage areas, 640 acres and 160 acres. What was done in this case, since we're producing in a constant pressure mode, was to hold the bottom hole pressure constant and to predict what would happen to the flow rate for the following 50 days.

Q All right, sir.

A What we found was beginning at approximately the point of time, 70 days, where we had reached in our flow test, the curves for 640 acres and 160 acres began to deviate, and what this indicates is that during the 60-day flow period we had only shown that we were draining a minimum of 160 acres at that time.

It also showed us that we would have to extend our test substantially longer than the 60 days allowed to us in order to proof a larger drainage area.

Q If the Commission should establish temporary spacing for this area on 640 acres for three years, in your opinion would that be an adequate period of time in which to have actual production information to determine what the spacing ought to be for this pool?

A Yes, I do.

Q Why do you say that?

A Based on our projected performance on

wells like this, and other wells, I believe that something on the order of one year would be adequate to proof or to demonstrate the drainage area is on the order of 640 acres or less.

Q All right, sir, what's the next thing that you did?

A Since we were unable to look at performance history beyond sixty days with the data we have, we used data provided by Amoco in earlier hearings to see if our simulator was predicting drainage area similar to what Amoco had -- had demonstrated.

So the next exhibit I'd like to present is actually an exhibit from Amoco's earlier hearing.

Q All right, sir, I've marked as Exhibit Number Seventeen the exhibit that was introduced by Amoco's Exhibit Thirteen in their hearing.

Would you describe for us that exhibit, Mr. Hanley?

A Certainly. This is one of the four wells in which Amoco conducted a long term production test and the -- it shows the production rate history, the flowing tubing pressure history of the well, along with the cumulative production during the extended flow test.

Q What use did you use of this information, Mr. Hanley?

A What we did was to use the reservoir parameters listed on this exhibit and the production rate his-

tory shown on this exhibit to conduct our own simulation of Amoco's long term production test, and we what we obtained is shown in the next exhibit.

Q All right, sir, let's go to the Exhibit Number Eighteen.

All right, sir, if we take Exhibit Number Eighteen, now, what did you do?

A Well, in Exhibit Eighteen we show on the same scale as Exhibit Seventeen the rate and pressure history predicted by our reservoir simulator.

Q Okay, and what did you do with that information?

A We compared this to Amoco's results and found very good match with their data and also a good match with their simulation.

Q Can you take Exhibit Eighteen and overlay it on Seventeen and be looking at the same scale?

A That's correct, you can.

Q All right, sir, and when you make that comparison, what does that show you?

A It shows you that, first of all, our simulator predicts the pressure observed in the Amoco well and secondly, that the simulator agrees with Amoco's simulator data for the two drainage areas.

Q And what does that tell you about your simulator, Mr. Hanley?

A That the reservoir performance predicted

by the simulator agrees in both the short term and the long term with the production characteristics in the Bravo Dome Area.

Q All right, sir, then what did you do?

A Based on the properties which we evaluated in the various well tests in the ten wells, we simulated the performance of a typical well in the west area of the Bravo Dome Field.

Q And do you have that simulation in the form of an exhibit?

A Yes, I do. I have a number of exhibits. We can talk about them one at a time.

Q All right, sir, let's look at Exhibit Number Nineteen and have you tell us what this is.

A Exhibit Nineteen shows the production rate versus cumulative production performance of a typical well in the west area of the Bravo Dome Field. The properties used to generate these performance curves are listed in the righthand, upper righthand corner of the exhibit.

Q How did you select those reservoir properties or parameters?

A These are essentially average properties of the -- of the wells that either drilled -- were drilled by Cities Service or now operated by Cities Service.

Q All right, sir, what do you conclude from this exhibit?

A For the cutoffs and -- I could explain

those first.

We used some cutoffs in the -- in the simulation. We assumed that the well was produced into a 100 psi pipeline at an initial rate of one million cubic feet per day, and as the well pressure, as the well rate dropped, -- well, let me back up and try that again.

We put some constraints on the simulation.

Initially we assumed the well would be produced at one million cubic feet per day, which was typical of the rate in our flow tests.

At the point in time at which the wellhead pressure was reduced to 100 psi, we allowed the production rate to decline from thereafter, holding the wellhead pressure constant.

Then we assumed that the well had reached its economic limit at a production rate of 50 Mcf per day.

And we did this for two cases, one in which we had one well on 640 acres, and this is shown at the dashed line in the exhibit, and we did the same thing for the case where we had four wells on 640 acres. This is shown in the solid line in the exhibit.

And what the simulation showed us is that the same amount of reserves would be obtained with either one well or four wells on 640 acres.

Q All right, sir. What's the next thing that you did?

A We also have an exhibit which was based on the same sort of analysis in which we've compared one well on 640 acres to one well on 160 acres.

Q All right, sir.

A Okay. Exhibit Number Twenty shows on a different scale the same sort of data as Exhibit Nineteen and it illustrates with one well on 160 acres our rate per well will drop much more quickly than our production rate for one well on 640 acres.

Q How does that performance compare to the analysis that Miss Egg made on her production from her typical well using the one Mcf -- I'm sorry, one million cubic feet of gas production data?

A The typical well performance that was presented in this morning's testimony employed the same properties that were employed in this typical well performance curve and, in fact, the data seen in this figure was used to help construct the production performance, although not exactly as shown here.

Q All right, sir, what do you conclude from Exhibit Number Twenty?

A From Exhibit Number Twenty we again conclude that with one well on 640 acres we get four times the production we get on one well with 160 acres, again reinforcing the conclusion that we get the same amount of reserves whether we have one well per section or four wells per section.

The next thing that was done was to compare the performance of a typical well in this area with the typical well performance presented by Amoco previously.

Q All right, and did you make a comparison of your typical well performance with an Amoco typical well?

A That's correct.

Q And have you reduced that to an exhibit?

A Yes, I have four exhibits we made for this comparison.

Q All right, sir. All right, Mr. Hanley, would you identify for us Exhibit Number Twenty-one?

A Yes. Exhibit Number Twenty-one is a production rate versus cumulative production performance curve presented by Amoco at a previous hearing where the production performance was predicted for a typical well in the Bravo Dome Unit.

Q And in fact this is Amoco's Exhibit Number Sixteen from that prior hearing?

A That's correct.

Q All right, what then did you do?

A We simply replotted the data obtained in the previous exhibit on the same scale as the Amoco performance data for comparison.

Q All right, sir. All right, sir, we're looking at Exhibit Number Twenty-two now, Mr. Hanley. Describe for us what we do with Exhibit Number Twenty-two.

A Okay. Exhibit Number Twenty-two is plot-

ted on a scale such that it can be overlaid with Exhibit Number Twenty-one and the performance characteristics of the two typical well cases can be compared directly.

Q And when you make that comparison what do you conclude?

A There are two conclusions. The first is that the general character of the performance is similar in the two wells but the more obvious conclusion is that there is considerably smaller reserves per section in the West Bravo Dome Area for a typical well.

Q All right, sir, what then did you do?

A Next we looked at the case for an Amoco typical well where there were four wells per 640 acres versus one well per 640 acres.

Q And would you identify for us then Exhibit Number Twenty-three?

A Okay, Exhibit Number Twenty-three is again a production performance plot for a typical Bravo Dome CO2 Gas Unit well which was an Exhibit Number Fifteen by Amoco submitted in the May hearing.

Q Twenty-one and Twenty-two are the comparisons of one well on 640. Now Exhibit Twenty-three is the comparison of four wells on 640?

A That's correct.

Q All right. And do you have an Exhibit Twenty-four, then, that shows the simulation?

A Yes, I do.

Q And we will overlay, then, Exhibit Twenty-four on top of Twenty-three?

A That's correct; these are plotted on the same scale.

Q All right, sir. When you make that comparison, what does it tell you?

A The comparison in Exhibit Twenty-three and four tells you that -- the same thing that we found in Exhibit Twenty-one and Twenty-two, that the quality of performance of the wells, our typical well in the West Bravo Dome and Amoco's typical well in the Bravo Dome Unit, are similar, however, quantitatively we are dealing with much smaller reserves, cumulative production in the West Bravo Dome area.

Q Does that complete the study and the comparisons you've made using your computer simulator with the actual and projected productions from the various wells?

A Yes, it does.

Q Mr. Hanley, would you summarize for us what conclusions you can draw from having made this analysis?

A Yes, I can. The first conclusion is that the producing characteristics across the Bravo Dome Area are very similar and the second conclusion is that one well should adequately drain 640 acres.

Q You were present during Miss Egg's testimony this morning?

A Yes, I was.

Q You heard her make a comparison between the relative thicknesses of the Tubb gas formation in the West Bravo Dome?

A Yes, I did.

Q And she concluded that the reservoir factor or parameter that determined what one well would drain in terms of acreage was principally affected by permeability.

A That is correct.

Q Do you agree or disagree with her conclusion?

A I totally agree.

Q How does the permeability in the West Bravo Dome Area compare to the permeability in the Amoco spaced area?

A The wells which we conducted tests on showed a range of permeabilities which are very similar to the ranges of permeabilities found in the Amoco wells in the east, I guess, the east Bravo Dome.

Q Based upon the reservor parameters that you've studied and evaluated, do you have an opinion as to whether or not it would be reasonable to expect one well in the West Bravo Dome to have the capacity to drain 640 acres?

A Could you restate your question?

Q Yes, sir. I said based upon your study of the reservoir parameters in the West Bravo Dome Area, do

you have a conclusion with regards to the ability of one well to drain 640 acres?

A Yes. Our conclusion of my study is that one well can adequately drain 640 acres in the West Bravo Dome Area.

Q In terms of the temporary period for the spacing, Cities Service has requested a three year temporary period.

A That is correct.

Q On 640 acres and to further study the reservoir. During that period of time, Mr. Hanley, what type of information do you think would be obtained from the reservoir for further study?

A What Cities Service would propose to do is to, of course, carefully monitor the production and producing pressure history on the wells in the West Bravo Dome Area so that continuing simulation and evaluation of the wells could be done.

Secondly, we would perform periodic shut-in pressure tests to obtain data used for completion calculations.

Cities also would be willing and in fact plans to shut-in for long periods of time one or more wells to evaluate the drainage characteristics.

Q For purposes of my next questions, Mr. Hanley, I'd like to show you Exhibit Number Two, which is Miss Egg's structure map.

We might have you take a moment now, Mr. Hanley, and have you help us identify those wells within the spaced area that are operated by Amerigas. Can you do that from information you have?

A Yes, I can.

Q All right, sir, let's have you -- let's have it put on Exhibit Number One that's on the wall.

Mr. Hanley, would you please take a moment, sir, and indicate with the orange pen those wells within the proposed spaced area that are operated by Amerigas?

A There are twelve wells that I've indicated with an open orange circle on this exhibit which are operated by Amerigas in the western Bravo Dome region.

Q Mr. Hanley, for purposes of my question if you'll refer to Exhibit Number Two, you will note on that exhibit this morning Miss Egg placed a yellow line that runs from north to south through this area with the western side separating out the Cities Service wells and with the eastern side identifying and separating out the Amerigas wells.

Based upon your studies of the reservoir, Mr. Hanley, do you see any reasons why the spacing for the Cities Service wells and those of Amerigas ought to be treated differently?

A I can see no reason why those should be treated differently based on reservoir engineering studies.

MR. KELLAHIN: May I have just

a moment?

That concludes my direct examination of Mr. Hanley.

We move the introduction of Cities Service Exhibits Thirteen through Twenty-four.

MR. STAMETS: Without objection these exhibits will be admitted.

Are there questions of the witness?

MR. LOPEZ: Yes, Mr. Chairman, if I may have just a second.

MR. STAMETS: Yes. While you're taking a second we'll ask Mr. Hanley a couple of questions.

CROSS EXAMINATION

BY MR. STAMETS:

Q Mr. Hanley, you indicated on the Exhibit Two the Amerigas wells. There are some other wells which Miss Egg indicated were non-Cities Service wells, and I would like to determine the ownership of those.

Let's start out in 18 North, 30 East, in Section 7. There are two wells shown here and Miss Egg indicated that one of those was not Cities Service.

A Let me refer to another map, please.

MR. KELLAHIN: Mr. Chairman, there is an error in Exhibit Number Two in that wells along that boundary line are not completed in the Tubb formation,

except for one per section, and we'll have Mr. Hanley identify those for you. There's a drafting error on the exhibit.

MR. STAMETS: Okay. And also to the north in 19 North, 29 East, in Section 13 there is a well that Miss Egg did not indicate is a Cities Service well, and immediately to the south of that in Section 24 there is a temporarily abandoned well Miss Egg did not indicate is a Cities Service well.

A I'm having a little difficulty locating these wells.

MR. KELLAHIN: Let me take just a short break. I think we can straighten out the exhibit.

(Thereupon a short recess was taken.)

MR. STAMETS: Okay, Sally, I think we're ready to go back on the record.

Mr. Lopez, do you have -- well, while we were off the record the witness has come up and crossed off extra wells in Sections 25 and 36, 19 North, 29 East, Sections 30 and 31, 19 North, 30 East, and in Section 7, 18 North, 30 East, and identified two additional wells in 19 North, 29 East, Sections 13 and 24, as Amerigas Wells.

Now, Mr. Lopez, are there any questions of the witness?

CROSS EXAMINATION

BY MR. LOPEZ:

Q Mr. Hanley, I think you testified that there exist varying permeabilities within the area in question.

A That is correct and this is something that is typical in all reservoirs.

Q How do you determine what those permeabilities are?

A These permeabilities were measured permeabilities from the isochronal tests, and they represent not the absolute permeability but the actual effective permeability to gas, so it takes into account the effect of water saturation.

Q Is this near the well only?

A These tests, conducted over the period of time that we conducted them, represent an average over a radius of approximately 100 to 150 feet around the well; however, in our extended flow test we see the same properties extending for approximately 160 acres around the well.

Q Have you determined what you would consider a permeability cutoff?

A We did not consider a permeability cutoff in this analysis. I think that's not a physical limit permeability; it's an economic limit.

Q Now I believe your testimony was that your studies showed that the length of time in which you

were able to conduct the studies only showed an ability of the well to drain 640 acres.

A That's correct.

Q But that you had to rely on Amoco's studies that were conducted over a longer period of time in order to, I guess, program the simulator to develop the information you've put here today, is that correct?

A I don't understand the question. Would you repeat it?

Q Well, maybe I'll do it this way.

Why did you have to rely on Amoco's well information?

A We looked at Amoco's well data for two reasons, the first being to compare performance in the East Bravo Dome Area and the West Bravo Dome Area, and secondly, to check the performance of our simulator with long term production data, which we did not have available from our wells.

Q And why was that long term production data important?

A Well, the long term production data was simply used to establish that our simulator projecting long term productions was accurate.

Q Now, I believe you stated that you used a two dimensional radial gas simulator.

A That's correct.

Q Is it not true that the characteristics

between gas and carbon dioxide are appreciably different?

A They are different. Carbon dioxide is a heavier gas than natural gas if we're talking about methane, but we programmed the simulator with CO2 properties not natural gas properties.

Q So you did make the appropriate compensation for the --

A No, sir.

Q How did you do that? How did you make these --

A There are available mesurements of CO2 properties, the important properties, in the CO2 deviation factor, the Z factor, if you will, and the viscosity of gas is a function of pressure and temperature.

These available information properties were programmed into the simulator and used in all cases.

Q Now, on what basis did you make the assumption that four wells on a 640-acre unit would drain no more or no less than one acre on 640 acres?

A Well, that wasn't an assumption. That was a conclusion of our study.

Q And if you don't mind repeating, how did you reach that conclusion?

A We predicted the performance of one well in 640 acres for typical properties in the West Bravo Dome Area and projected it to a cutoff, which I cited, and then using a smaller drainage area, or actually using four wells

in the same drainage area, performed the same sort of analysis and found that for the same cutoff we will obtain the same amount of reserves.

Q Now this computer simulator had to accept a constant permeability, average permeability was used, and the same thickness of pay, is that correct?

A That's not necessary. The model will enable you to use a number of permeabilities in different grid blocks and any number of layers. Well, I think there's a limit of twenty layers that can be used; however, for a typical well we used constant permeability and thickness properties, assuming that they did not vary substantially over the drainage area.

Q Did you take into effect the amount of viscosity of CO2 in water and CO2 in solution?

A CO2 was the only mobile phase. CO2 gas was the only mobile phase in the reservoir during any of the tests. Since the water is immobile it had very little effect on the viscosity of the gas.

The gas was assumed to be water saturated and I believe it holds about 80 pounds of water per million cubic feet. I can't say specifically.

Q But couldn't you adjust the -- well, let me rephrase that.

Aren't the permeability and the thickness of pay interrelated? What I mean is, couldn't you adjust them upward and the other one downward and come to the same

conclusion?

A I don't understand your question.

Q Well, I think Miss Egg in this morning's testimony, by virtue of her cross sections, indicated that the thickness of pay throughout the Bravo Dome Area varies, and it varies within a 640-acre section.

Would you agree with that?

A I'm not sure that I do. Looking over the wide spacing where we're looking on most of these cross sections with five or six sections between wells, I think we see very gradual thinning of the net sands from southeast to northwest.

Q Is the difference in permeability in any way related to the existence of different stringers in a particular area of the reservoir?

What I mean is, would it be reasonable to conclude that the various stringers within a wellbore might have different permeabilities?

A Well, I think it would be feasible to assume that the permeabilities will vary vertically in the well.

In our tests the permeability which we calculate from our analysis is an average value for the perforated interval.

Also, in our tests we can measure during a pressure build-up following the shut-in during the isochronal test, and by looking at the characteristic behavior

of this pressure response get an indication of whether there are drastic changes in the permeability vertically within a well if we have layering effects and if there is a crossflow present, and we saw no evidence in the build-ups of the isochronal tests of that.

Q But wasn't your testimony that it was your opinion that the length of the test was not adequate in order to come to any meaningful conclusions in that respect?

A No, it certainly wasn't. I believe you're asking me about the vertical variation of permeability around the well.

Q I believe you stated that in conducting your studies that the -- that your assumption was that the water would remain static and that the CO2 would flow, is that correct?

A In evaluating the performance of the wells we tested, that's the assumption we made, right.

Q Over a twenty year period of production wouldn't the water tend to flow, as well?

A I think at a point when the pressure was reduced low enough the water probably would begin to flow.

Q And wouldn't that affect your conclusions of your study?

A It would not substantially affect the conclusions of it.

Q Do I understand your testimony here today that it is your opinion that four wells on a 640-acre unit

will drain no more reserves than one well on 640?

A Based on the reservoir study we've done, that is correct, using the cutoffs that I cited.

Q That's based on your studies. Do you think that's a practical conclusion as well?

A Yes, I do.

Q Then you don't believe that the more wells you drill, the more product you'll recover, as a general rule.

A Not in this case. I think we've been talking specific case.

Q Is it your opinion that the fact that the west side of the Bravo Dome Area has much thinner pay, that that fact alone doesn't affect whether or not one well will effectively and efficiently drain 640 acres?

A No, it doesn't. The thinning, in fact, on the west side of the Brave Dome Area has no relevance to the drainage.

There's another factor involved here. We have similar permeabilities across the whole area of the Bravo Dome. We have slightly higher pressures on the west area. This will enable us to have higher initial rates, so we should be able to drain the same area more rapidly on the western -- on the west side compared to the east side.

Q Based on your studies wouldn't it also be reasonable to conclude that one well could drain an area larger than 640 acres?

A That's wholly possible.

Q Then would you agree that the basis for Cities Service request here today is an economic consideration rather than the fact that one well can drain over a period of time 640 acres?

A I don't follow your logic.

Q Well, you just stated that it is certainly conceivable one well could drain an area larger than 640 acres and I believe thi agrees with Miss Egg's testimony this morning, and I think the point is that one well over a period of time can drain an area much greater than 640 acres so long as there's communication, and therefore, my question to her this morning and my question to you is, isn't the basis for Cities Service' application one based on economics rather than the fact that one well can drain 640 acres.

A I believe our -- mine conclusion that one well can drain 640 acres is not tied to economics but economics would certainly be important in evaluating how many wells are necessary or needed for efficient drainage of the area.

MR. LOPEZ: No further questions.

MR. STAMETS: Are there any other questions of the witness? He may be excused.

MR. KELLAHIN: Mr. Chairman, you asked this morning if we would provide you in our case with a copy of at least our understanding of the ownership

in the area and I think this will do it.

Mr. Chairman, I have a witness that will authenticate this exhibit, if necessary, but is there is no objection, I'd simply like to place as Exhibit Number Twenty-five our indication of what we think the ownership is within this general area.

And I show Exhibit Number Twenty-five to opposing counsel for his inspection and possible objection.

MR. STAMETS: If they don't have any problems without (not understood.)

MR. LOPEZ: We don't have any objection. We've got an exhibit that perhaps more completely tells the story.

MR. STAMETS: Okay. Does that conclude your direct case?

MR. KELLAHIN: It does, Mr. Chairman.

MR. STAMETS: Mr. Lopez.

MR. LOPEZ: I'd like to call Mr. Nutter.

DANIEL S. NUTTER,

being called as a witness and being duly sworn upon his oath, testified as follows, to-wit:

DIRECT EXAMINATION

BY MR. LOPEZ:

Q Would you please state your name?

A Dan Nutter.

Q Where do you reside?

A In Santa Fe, New Mexico.

Q Mr. Nutter, are you familiar with the application in this case?

A Yes, I am.

Q Have you been retained by Amerigas as a consultant in this case?

A Yes, I have.

Q Did you previously testify in the Amoco spacing case?

A Yes, I did.

Q Have you testified previously before the Commission and had your qualifications accepted as a matter of record?

A I have.

MR. LOPEZ: I offer Mr. Nutter as an expert.

MR. STAMETS: He is considered qualified.

Q Mr. Nutter, I'd ask you to refer to what's been marked Amerigas' Exhibit Number One and ask you to identify it.

A Exhibit One is a plat of the area in question. It's labeled Exhibit A, West Bravo Dome Unit Area, Harding County, New Mexico.

Q Was that an exhibit that was introduced in a previous hearing?

A No, I believe this exhibit has to do with the case that follows this case.

Q Oh, I see.

A It has to do with the Cities Service Unit Area, the West Bravo Dome Unit Area, which, by the way, is outlined in the heavy, dashed, blue line on that exhibit.

Q All right. What does it show, starting with the red line?

A Okay, the red line is the western and southwestern boundary of the Amoco Bravo Dome Carbon Dioxide Unit Area. The line transverses from the center of the upper part of the exhibit over to the east side of the exhibit and zigzags down to the bottom part of the exhibit.

To the east of the red line is the Bravo Dome Unit. To the west is acreage that as of now is not unitized.

Q Now would you describe what the black line shows?

A The black line is the area of application in this case today; however, we were not sure exactly what the boundaries were that the applicant was seeking for its 640-acre spacing in Township 19 North, Range 30 East.

At one point in the application it asked that Sections 30, 31, and 32 of that township be in this spacing case. At another point it asked that Sections 19 through 36 of that township be included, which would be the boundary of the pink line, the hot pink line Mr. Kellahin referred to this morning, and which I will now place on our Exhibit Number A by a funny-looking black pencil line.

Okay. Then the area that's included in the black outline on this exhibit, extending to the east and taking in one full township to the east of the area shown on the exhibit, is the area that's enclosed by the pink line on the -- on the exhibit there.

Q Cities Service Exhibit Number One?

A That's correct. It would be all of Township -- it would be the acreage that is shown outlined in black, plus, well, in -- the acreage is the same in Township 17, 18, 19, and 20 North, Range 29 East.

Then in Township 18 North, 19 North, the area would be all of Township 18 North, Range 30 East, Sections 19 through 36 of Township 19 North, Range 36 East, and all of Township 18 North, Range 31 East, would be included in the black area.

Q Now, what is that --

MR. STAMETS: Excuse me, Mr. Lopez, I believe that it would also encompass, if your map went far enough to the east --

A Another range is --

MR. STAMETS: -- the south half of the next township to the --

A Okay, okay. It will go over here two townships, then.

MR. STAMETS: No, no. No. The only thing -- the only thing you're leaving out is 19 North, 31 East, the south half of the township.

A Okay, 19 North, right, so this funny-looking line I referred to there keeps going east and I'll erase it off of here.

There's two townships in which the lower tier -- lower three tiers of sections are included, then.

Q Okay. What does the yellow area show?

A The yellow area is the acreage that's owned by Amerigas, and I might add that there is additional Amerigas acreage that is not shown on the exhibit on the townships that are east of the exhibit.

Q I notice that there are some acreage calculations on the exhibit.

A Yes, but since this thing has been modified I can't tell you exactly what they are. As far as we know, the Bravo Dome Unit comprises 43,153 acres.

Q Is that the West Bravo Dome Unit --

A The West Bravo Dome Unit, which Cities Service will be applying for in the next case.

The Amerigas and Schwartz acreage, which is one entity, within this area comprises 75,000 acres, ap-

proximately.

The West Bravo Dome 640-acre request is for 135,000 acres plus the additional acres that we didn't know about and which would be included in the hot pink line and by the black zigzag line I've drawn on here.

The Amerigas leases within the 640-acre spacing case on this exhibit only, not including their leases to the east, total 31,254 acres.

Q What would -- what effect would the approval of Cities' application in this case have on Amerigas?

A Well, in the first place you'll see in Township, for example, 18 North, Range 30 East, they'll own a large block of acreage which is completely colored yellow in each one of those sections. It's a large lease and they have many sections in which they own the entire section.

That would mean that they would be qualified to drill one well on their section.

If we go further to the west, where the leases are more chopped up, we would find that Amerigas has many of the leases which would, if you had 640-acre spacing, would have to be communitized, or force pooled, to form a 640-acre unit and Amerigas' acreage would be included in those 640 acres.

They have a few sections over in Township 19 North, Range 29 East, and down in 18 North, 29 East, where they have a full section, and would be limited to one well in their section; however, they would be force pooled

into many situations where they have smaller tracts of land and it would be contrary to the development they've been using for years on their acreage.

Q Is this effect any different than that that was present in Amoco's 640-acre spacing case?

A No, we're faced with the same thing we were in that previous case. The only thing is in the previous case they were coming at us from the east; now they're coming at us from the west.

Q Now I would ask you to refer to what's been marked as Cities Service -- or to the Cities Service B-B' cross section and with respect to that exhibit, I would ask you if the sand thickness increases from west to east.

A Okay, if the Commission will look at cross section B-B'.

We heard testimony here this morning and also this afternoon that the thickness of the sands increases as you go from west to east; however, they said it would make little difference on the extreme west side; that the main difference was over toward the Amoco area.

Well, I took the -- on Exhibit B-B', I took a scale and measured the yellow cross bands of porosity as indicated on that exhibit for the State -- Cities Service "DO" NO. 1 and for the Amoco 18-13-231G.

I find that if you tally the thickness of the yellow in the Cities Service "DO" No. 1 you have approximately 53 feet.

If you go to the State -- the Amoco 231G, you have 200 -- you have 63 feet.

So there's a substantial difference in those two wells.

Now granted those two wells are, if we go from the "DO" 1 to the 231G, and those two wells are -- that's on Exhibit B-B', and that would be going from the third well to the fourth well. Okay, that would be going from this point right here in Township 18 North, Range 31 East -- Range 30 East, I beg your pardon -- wait a minute.

MR. STAMETS: Where B-B and C-B cross is where you're going to start.

A Right, this is -- it would be from in Section 20 of Township 18 North, Range 30 East, to Section 23 in 18 North, Range 31 East. Now that is a difference of approximately eight miles, but we do see a definite thickening of the sands as you proceed across that 8-mile area.

Q And what do these changes in thickness of sand indicate to you?

A Well, let's look at the -- let's look at the next exhibit first.

Q A to A'?

A That would be cross section A to A'. You'll see the same thing only on a little bit different magnitude.

Now if we look at the second well there, the State "DC" No. 1, I tally 51 feet of yellow section de-

picted on that cross section.

If we go to the next well, which is the Amoco 311J, I tally 58 feet. Now these wells are much closer together. This is on A-A' and the "DC" 1 is the second well shown in Section 36 of Township 19 North, Range 29 East. The second well is in Section 31 of 19, 31, so those wells are not as far apart but you have a definite thickening of the sands going from one well to the other.

Now they've measured -- the point I want to make is that the intervening acreage as you go from the wells on the west side of these cross sections over to the wells in the Bravo Dome Unit, the interventing acreage is the yellow acreage and that's where the sand has thickened in there, and that's the effect that this case would have.

The case is based on economics that Cities Service calculated from the wells that were in the Cities Service Area to the west. They have applied the economics they derived from the wells on the west to the entire area that they're asking for the spacing for and we have a greater thickness of pay through this yellow area than they have over to the west in their proposed West Bravo Dome Unit.

Q How would this reflect on Amerigas' economics?

A The Cities Service economics have nothing to do with Amerigas' economics. Amerigas has a completely different economic picture than Cities Service and their

economics don't apply to the Amerigas acreage.

Q Was Exhibit One prepared by you or under your supervision?

A Yes, it was.

MR. LOPEZ: I'd offer Amerigas' Exhibit One.

MR. STAMETS: Without objection Exhibit One will be admitted.

Q Do you have anything further, Mr. Nutter?

A I don't know, do I?

Q No.

A Okay.

MR. KELLAHIN: I think our court reporter is going to need a break, Mr. Chairman. My questions of Mr. Nutter, I think, are going to take some time.

MR. STAMETS: Let's take about a fifteen minute recess.

(Thereupon a recess was taken.)

MR. STAMETS: The hearing will come to order.

Are there questions of the witness?

MR. KELLAHIN: If the Commission please.

CROSS EXAMINATION

BY MR. KELLAHIN:

Q Mr. Nutter, when you were referring to the area on your Exhibit Number One that you had outlined with the black boundary showing the proposed area in the West Bravo Dome that Cities Service has applied for 640-acre spacing, were you aware that the applicant had filed on September 6th, 1984, an amended application, which I show you now?

A No, we didn't receive a copy of that, I don't believe, Mr. Kellahin.

Q All right, sir.

A I never saw an amended application.

Q Has Mr. Hanley correctly identified on Cities Service Exhibit Number One the wells that are operated by Amerigas?

A As far as I could tell he had. Now, I was very confused by some of those wells that you had to strike from your Exhibit Number Two. I was concerned about some of those but I'll take his word for it that those wells don't exist, and outside of that, I think they are fairly well correctly identified.

Q All right, sir.

A Of course, Amerigas operates other wells to the east of that, also.

Q Within the area that Cities Service pro-

poses to space on 640 acres, how many wells does Amerigas currently operate in the Tubb formation?

A I can't tell you the exact count, Mr. Kellahin. I think he said there were twelve and then I think he added one. First he said thirteen and then he said twelve, and then he said thirteen, so I presume there are about thirteen.

Q All right, sir, for purposes of my question let's assume it's twelve or thirteen.

When you talk about those wells that Amerigas operates, Mr. Nutter, when was the last of those wells drilled?

A I can't tell you.

Q Can you tell us when any of these wells were drilled, Mr. Nutter?

A No, I don't have the dates that those wells were drilled.

I can tell you that Amerigas has plans for some future development in the area, however.

Q All right, sir, when you look at the twelve or thirteen wells that Amerigas has -- is the operator of in the proposed area, what is the spacing pattern that Amerigas has used for those wells?

A It varies. Now, if you'll go up into Section 29 of Township 19, 30, you'll see three wells in the west half of the section.

If you come down into Section 5 of 18,

30, you'll see three wells in the south half of that section.

In other places there's one well per section; other places there are two wells per section.

So the spacing is varied. Their drilling has been determined by the demand for their plant and the plant has had a certain market that it hasn't been necessary to drill a lot of wells, so they've drilled those wells and then as need be they would drill additional wells. That's why I can't tell you the dates they were drilled nor when the last one was drilled.

Q All right, sir. I'm looking at my copy of Exhibit Number One and the wells that Mr. Hanley has identified operated by Amerigas, and I am able to identify only three sections of all of the Amerigas acreage in which there are currently more than one well. Is that true or not?

A That's -- that's probably true. That would be the section that I mentioned, Section 29 of 19, 30; Section 20 of 19, 30; and Section 5 of 18, 30, all have more than one well in the section, either two or three to the section.

Q When you talk about the demand of Amerigas for its plant, what kind of plant does Amerigas operate?

A At the present time they're processing carbon dioxide into liquids; maybe some dry ice, too; dry ice, also.

Q Does the market for production from that plant currently exceed the deliverability or the capacity of its current wells to produce?

A The plant capacity, does the market exceed the capacity of the wells?

Q Yes, sir.

A No, no.

Q You have a greater capacity for production from your current wells than you have a market for.

A That's right. If we needed additional wells at this time, we'd drill the additional wells.

Q All right. For 1984 what are Amerigas' plans for additional development?

A I can't tell you the exact timetable, Mr. Kellahin. They do have plans to build a pipe, a gathering system, a dehydration system, and put gas into the pipelines that will be available in this area.

They will be selling carbon dioxide gas as gas, which they haven't done previous to now.

Q All right, if I understand Amerigas' plan for the development of its carbon dioxide reserves, it's a plan that is not unlike that used by Cities Service and Amoco but on a smaller scale.

A All the operators in this area are talking about putting gas in the pipeline, right.

Q All right.

You talked about Amerigas' acreage position in this proposed spaced area, Mr. Nutter. How long has Amerigas had its acreage position?

A Oh, they've owned many of these leases for many years, either Amerigas or their predecessors.

Q When we look at the Amerigas leased acreage, what kind of leases are we generally talking about? Are they State, Federal, or fee?

A Well, the bulk of the leases are fee leases. There are probably some State leases in there and possibly some Federals. I haven't looked at the land ownership, really.

Q Within the next three years, Mr. Nutter, can you tell us whether or not Amerigas will have any leases that will expire unless additional wells are drilled by Amerigas?

A No, I can't.

Q Can you tell us the specific number or the approximate number of additional wells Amerigas has planned or projected to drill within the next three years?

A Not at this time.

Q When we look at the wells that Amerigas operates within the spaced area, those twelve or thirteen, Mr. Nutter, do you have pressure information or production histories that you can share with us in today's hearing?

A I did not come prepared to present that, no.

Q All right, sir. I believe that you looked at Miss Egg's cross section B-B' and, correct me if I'm wrong, I think you took two wells some eight miles apart on that cross section --

A Right.

Q -- and you compared a net pay thickness of 53 feet or 52 feet versus 63 feet between those wells some eight miles apart.

A Between those particular wells, they ran from 53 to 63 feet on those two wells on B-B'.

Q All right, sir, am I correct in understanding, then, that the thickness between those two wells thins at a rate of just over one foot per section as it moves to the other well?

A Well, if you took it on the average I suppose that would be true.

Q Okay. Mr. Nutter, have you prepared a cross section of the logs of the Amerigas wells with any of the logs of the Cities Service wells that immediately offset it in the adjacent sections?

A No, I haven't. I don't have any cross sections.

Q You have made no effort, then, to determine whether the net pay thickness demonstrates a discontinuity between any of your wells and those operated by Cities Service?

A No, the only thing I can do is say that

the wells to the west have a thinner section than the wells to the east and that Amerigas is in between, so by logic it tells us we have more pay than Cities Service does to the west and that Cities Service's economics with their thin section does not apply to ours with the intermediate section.

Q All right, sir. Miss Egg presented us this morning with an exhibit showing her projections of the economics for this project from Cities Service's point of view.

Have you prepared a similar economic evaluation on behalf of your client?

A No, I haven't, because our economics, our company is a completely different type of company. We have completely different economics than Cities Service. Cities Service -- Amerigas is a gas producing or processing company and marketing company.

Q All right, that proposes in its plan of future operations to produce CO2 gas and sell it for secondary recovery operations, not unlike Cities Service.

A That's correct.

Q All right, sir. Would you agree with Dr. Hanley and Miss Egg that the only significant reservoir property or parameter when you discuss drainage areas is the permeability factor?

A That's the most important factor.

Q All right, sir, can you tell us what the

relative permeability is for any of the Amerigas wells in your area?

A No, I can't. The only thing I'd rely on is that the permeability has been measured to the east. Cities Service had a core here to the west. The permeability they both stated decreased as you go to the west, so I believe that the permeability again would be intermediate in our area.

Q Have you made any engineering calculations to determine the drainage radius for any of the Amerigas wells?

A No, we haven't. I haven't.

Q Can you tell us what the current wells that Amerigas operates, what their producing rates are?

A I don't know what their producing rates are.

Q Are you proposing for Amerigas that the spaced area that Cities Service has applied for be a spaced area that excludes all of the Amerigas acreage?

A I'm proposing that your application be denied, Mr. Kellahin.

Q Without regards to the ownership involved in the unit.

A That's correct.

MR. KELLAHIN: Nothing further, thank you.

MR. STAMETS: Mr. Nutter, will

there be another witness who can tell us when the last well was drilled by Amerigas?

A We hadn't planned on another witness. We can probably give you that date. I don't know.

MR. STAMETS: That would be fine. That would be sufficient after the hearing.

A Okay.

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

MR. LOPEZ: Nothing further.

MR. STAMETS: You have no other witnesses? All right.

Any closing statements?

MR. KELLAHIN: Yes, Mr. Chairman, we do.

MR. STAMETS: We will allow Mr. Kellahin, who is the applicant in this case to go last.

MR. CARR: And I'll just have a brief statement for Amoco.

MR. STAMETS: Why don't you go first, Mr. Carr?

MR. CARR: May it please the Commission, Amoco Production Company suppports the application of Cities Service for 640 acres throughout the area covered by this application.

We presented data in May and believe at that time and also the data presented here today

constitutes substantial evidence which would support an order for temporary rules in this area spacing it on 640 acres.

The purpose for these rules, like most Oil Conservation Commission rules, is to insure orderly and prudent development of, in this case, CO2.

It seems logical to us that when you do this you start with the largest spacing possible and then as more data becomes available you can reduce that spacing if in fact the technical information warrants that.

We, as operator of the Bravo Dome, have responsibility for operations within that unit. The only thing we're concerned about and would request is that any rules which affect acreage within the unit are consistent with those rules that have already been promulgated, except, of course, as to the size of the spacing units.

We believe that although the approach in particular ways used here today by Cities may in some respects vary from that used by Amoco, we believe that both approaches are sound and both would support an order and that we urge you to grant the application for we feel that if you do not, you will be requiring the drilling of unnecessary wells and that if you grant the application you will carry out your statutory duties to prevent waste and protect correlative rights.

MR. STAMETS: Thank you, Mr. Carr. Mr. Lopez?

MR. LOPEZ: May it please the Commission, Mr. Carr raises a point that I'm sure the Commission at the appropriate time rules on the motion that I made and that's before us with respect to deleting the overlapping area that was already considered in the previous hearing.

If the Commission please, it's essentially Amerigas' position, and I think a sound position, that the burden is on Cities Service to show that one well can effectively and efficiently drain the area in question.

Based on its own expert testimony, Dr. Hanley, it was testified that it would require one year testing in order to confirm any reliable data as to the drilling radius of the -- draining radius of a well in the proposed area.

We believe that this application of Cities Service, unlike that of Amoco, is no less than a couple of things: First, it's an attempt to force Amerigas into a unit that it has not yet joined and at this point does not have intentions of participating in. To grant the application would essentially be to force Amerigas' significant acreage position into the Cities Service proposed unit, thereby allowing them the opportunity to force pool our acreage and commensurately, in the event of prorationing, reduce our ability to develop our acreage on any denser spacing pattern than one acre -- one well per 640

acres.

It also seems to us to be a bold attempt to secure their lease position in the area with the right to drill as few wells as possible in order to develop their acreage.

We believe that there is nothing that has changed here today, no new information that wasn't available or presented at the Amoco hearing, that would change the results in any regard and that the effort by Cities Service to end run an order that now stands should not be allowed or entertained by this Commission.

We feel that Cities Service has failed to meet its burden with respect to establishing need to change the statewide spacing rules, because that's essentially what they're trying to achieve, and that their application should be denied.

MR. STAMETS: Mr. Kellahin?

MR. KELLAHIN: Mr. Chairman, the elements of proof necessary for a spacing case are different from those elements of proof necessary in a unit case.

There are four basic elements of proof for a spacing case.

First of all, you need to establish that there is a common source of supply, a reservoir that is separate and distinct unto itself. The undisputed testimony is that the Tubb formation, as depicted by Miss

Egg on any one of her exhibits, constitutes a separate and distinct source of supply upon which a unit can be designated and declared.

The second element of proof is to demonstrate that there is geologic continuity across the proposed area to be spaced. As you can see from the outline, the only geologic evidence presented is that of Miss Egg's. Her testimony and her exhibits demonstrate that there is reasonable geologic continuity across the Tubb formation.

We requested and invited Mr. Nutter to demonstrate to us any of the wells that showed a discontinuity. He selected out two that demonstrated a thinning of the sand interval and you saw that over an eight mile interval that thickness reduced itself by something less or more than a foot per section. We contend that that's adequate continuity.

In addition, we invited Mr. Nutter to show us something about his wells or those wells that Amerigas operates. We invited him to show us some -- some correlations between those logs and the Cities Service logs. He has not done so, so the only impression you have in the record is that there is no material difference between those wells in terms of their geology.

There is no reason, then, to take out from this area the Amerigas wells; certainly no geologic reason we're aware of.

The third element of proof is one to demonstrate that for a temporary period there is a reasonable probability that one well will have the ability or the reservoir capacity to drain a large area.

Dr. Hanley has shown his elaborate study and investigation into this reservoir. He has determined for you that based upon the flow test, that his well he selected for the flow test has exceeded 160 acres and its flow has not yet encountered a boundary and that, as he's projected on his computer model, he would see that it's going to have the capacity to drain more than 160 acres.

His testimony was that within three years, and that three-year period provides for a year's production, allowing Cities Service to get its wells connected into a gathering system and get those wells producing, would be a reasonable period of time in which to support the continuation of spacing. If that evidence and data is not developed, then it would be up to the Commission to determine whether spacing reduces itself to 160.

In the meantime, what happens that prejudices anyone? Let's examine, first of all, whether there's any prejudice occurring to Amerigas.

We asked Mr. Nutter what the plans of development were for Amerigas. He could not tell us with any specificity. We do not know that development of Amerigas' acrege on 640 acres for the temporary period of three years will do them any adverse effect at all. Appar-

ently it doesn't. They have not seen fit to bring us any economic calculations that would show otherwise. The only assumption you can make from the record is that it does not.

Let's examine what happens if the area that Amerigas controls in terms of their leases is arbitrarily excluded from the 640 spacing. Here in fact what occurs. I think you can see it very graphically on Mr. Nutter's exhibit, if you confine the spacing area to those areas within the proposed Cities Service unit, you can see the irregularity to that boundary, and what that does, as anyone can see, is it will expose that boundary to wells offsetting it spaced upon 160 acres, and the testimony has been that if there's wells on 160 they're unnecessary wells.

And so in that three year period the unit, if it's operated on 640s and drills one well is exposed in a great portion of its boundary to offsetting wells that can be drilled as close as 160 acres.

That not only is ridiculous, it's absurd.

The final factor of the four elements in a spacing case is the economic consideration. Our witnesses have testified to the fact that in this area the thickness of the gas reservoir is such that economics are very important. We do not have the luxury of having a great thick section as Amoco does, where Amoco, even if they guess wrong and drill wells on 160s can still make econmic wells.

Here, if we drill wells on less

than 640, the projection, and undisputed projections are that those wells will be unnecessary.

We think it's apparent and incumbent upon the Commission to approve the application as requested.

Now, how would you go about doing it? We would propose this for you, Mr. Chairman, that you would space the area as applied, 640 acres, using rules that are not unlike those in the Amoco Area, and that you require Amerigas to come in during some grace period and justify those three sections in which they currently have more than one well.

That's not a novel idea. It's one the Commission used less than a year ago in the Gavilan Mancos Pool. We had a pool in the San Juan Basin where there was a question about whether the Mancos was going to be developed on 160 versus 320 acres. There were currently existing in that pool wells on 160-acre spacing. The Commission did not simply separate out pool rules based upon ownership. They didn't simply, arbitrarily exclude out those sections in which there were more than one well in a half section. They said that there will be a grace period in which the operator of those wells will come forward and present evidence as to why those sections ought to be grandfathered out. We think that was an intelligent decision then. We think that decision ought to apply intelligently to this fact situation, particularly in light of the fact

that Amerigas has presented absolutely nothing at all today. It's ridiculous and a waste of our time if the burden is only on the applicant, which we have met today, to present a case and those cases are defeated when the opposition can come in here and say, we don't want it. The Commission has not decided cases on that basis. They've decided cases for more than thirty years based upon substantial evidence and the undisputed, overwhelming, compelling evidence, substantial, is that 640-acre spacing is appropriate, and we would request that you so approve.

MR. STAMETS: Mr. Lopez, we're going to overrule Mr. Lopez, but we, the Commission will take into account those issues raised in your motion in considering what sort of order to write in this case, and also we plan to take administrative notice of relevant testimony from the earlier Amoco Braco Dome 640-spacing case.

We also would ask that both the applicant and Mr. Lopez write proposed orders making those findings that you consider appropriate in this case.

MR. LOPEZ: We'll be glad to. It will be much easier than the last case.

MR. STAMETS: All right, thank you.

If there is nothing further, then, this case will be taken under advisement.

MR. LOPEZ: Thank you.

C E R T I F I C A T E

I, SALLY W. BOYD, C.S.R., DO HEREBY CERTIFY that the foregoing Transcript of Hearing before the Oil Conservation Division was reported by me; that the said transcript is a full, true, and correct record of the hearing, prepared by me to the best of my ability.

Sally W. Boyd CSR

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION
STATE LAND OFFICE BLDG.
SANTA FE, NEW MEXICO

3 June 1987

EXAMINER HEARING

IN THE MATTER OF:

Case 8352 being reopened pursuant to the provisions of Division Order No. R-7737, Harding County, New Mexico.

CASE 8352

BEFORE: DAvid R. Catanach, Examiner

TRANSCRIPT OF HEARING

A P P E A R A N C E S

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MR. CATANACH: Call next Case Number 8352.

MR. TAYLOR: In the matter of Case 8352 being reopened pursuant to the provisions of Division Order No. R-7737, which order established special rules and regulations for the West Bravo Dome Carbon Dioxide Gas Area in Harding County, including a provision for 640-acre spacing units. Interested parties may appear and show cause why the West Bravo Dome Carbon Dioxide Gas Area should not be developed on less than 640-acre spacing and proration units.

MR. CATANACH: The applicant in this case has requested -- or the Cities Service has requested in this case that it be continued to the July 15th Examiner docket and at this time what we want to do is obtain the names of all interested parties who appeared here today on behalf of that case to make them part of the record so that they may be notified should the case be recontinued.

What appearances do we have?

MR. KELLAHIN: Mr. Examiner, I'm Tom Kellahin appearing on behalf of Cities Service Oil and Gas Corporation.

We have filed previously to the docket call today a request for a continuance. Cities

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION
STATE LAND OFFICE BLDG.
SANTA FE, NEW MEXICO

15 July 1987

EXAMINER HEARING

IN THE MATTER OF:

Case 8352 being reopened pursuant to the provisions of Division Order No. R-7737, Harding County, New Mexico. CASE 8352

BEFORE: Michael E. Stogner, Examiner

TRANSCRIPT OF HEARING

A P P E A R A N C E S

For the Division:

For the Applicant:

C E R T I F I C A T E

I, SALLY W. BOYD, C.S.R., DO HEREBY CERTIFY the foregoing Transcript of Hearing before the Oil Conservation Division (Commission) was reported by me; that the said transcript is a full, true, and correct record prepared by me to the best of my ability.

Sally W. Boyd CSR

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 8352, heard by me on 15 July 1987.

, Examiner
Oil Conservation Division

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION
STATE LAND OFFICE BUILDING
SANTA FE, NEW MEXICO

26 August 1987

EXAMINER HEARING

IN THE MATTER OF:

Case 8352 being reopened pursuant to the provisions of Division Order NO. R-7737, Harding County, New Mexico.

CASE 8352

BEFORE: David R. Catanach, Examiner.

TRANSCRIPT OF HEARING

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MR. CATANACH: Call next Case 8352.

MR. TAYLOR: In the matter of Case 8352 being reopened pursuant to the provisions of Division Order Number R-7737, which order established special rules and regulations for the West Bravo Dome Carbon Dioxide Gas Area, Harding County.

MR. CATANACH: Are there appearances in this case?

MR. KELLAHIN: If the Examiner please, I'm Tom Kellahin from the firm Kellahin, Kellahin & Aubrey, Santa Fe, New Mexico, appearing on behalf of Cities Service Oil and Gas Corporation.

MR. CATANACH: Are there any other appearances?

MR. HECKEL: I'm Pete Heckel, appearing on behalf of Amerigas.

MR. HEFLEY: James Hefley, I'll appear on behalf of Amerada Hess Corporation.

MR. CATANACH: I'm sorry, what was your name, sir?

MR. HEFLEY: Hefley, H-E-F-L-E-Y.

MR. SOMMER: Karl Sommer of Sommer, Udall and Harwood, appearing on behalf of Ross Car

bonics.

MR. CATANACH: Anybody else?

How many witnesses are we going witnesses are we going to have here?

MR. KELLAHIN: Mr. Examiner, Cities Service is a proponent for the continuation of 640-acre spacing and I have three witnesses.

MR. CATANACH: Are there going to be any other witnesses in this case?

Will the witnesses please stand and be sworn in?

(Witnesses sworn.)

MR. KELLAHIN: Mr. Examiner, I'll call as my first witness Rebecca Egg, that's E-G-G. Miss Egg is a petroleum geologist for Cities Service Oil and Gas Corporation.

REBECCA EGG,

being called as a witness and being duly sworn upon her oath, testified as follows, to-wit:

DIRECT EXAMINATION

BY MR. KELLAHIN:

Q Miss Egg, for the record would you please state your name?

A My name is Rebecca Anne Egg.

Q By whom are you employed?

A Cities Service Oil and Gas Corporation.

Q And what is it that you do for Cities Service?

A I'm working as a reservoir engineer in the Midland District Office.

Q Have you previously testified before the Oil Conservation Commissin of New Mexico?

A Yes, I have.

Q And in what capacity did you testify?

A I testified as a geologist over the area of the West Bravo Dome.

Q Would you summarize for the Examiner today what has been your educational background, both as a geologist and as an engineer?

A In 1981 I earned my BS degree in petroleum engineering from Texas A & M.

In 1983 I got my BS in geology from the University of Texas at the Permian Basin.

And in 1985 I earned an MBA from the University of Texas, Permian Basin.

Q Okay. Did you originally testify before the Oil Conservation Commission in Case 8352, heard as a Commission case on September 26, 1984?

A Yes, I did.

Q And that was the hearing that established the temporary rules for the West Bravo Dome Area in Harding County, New Mexico?

A Yes.

Q What participation did you have in that case, Miss Egg? What did you do for that case?

A I had evaluated the logs, cores, pressure data, in the West Bravo Dome Area and on several wells in Amoco's Bravo Dome Unit.

Q At that hearing did you have a geologic opinion and did you express that opinion to the Commission in September of '84 concerning the suitability of the West Bravo Dome Area for 640-acre spacing?

A Yes, I did. I saw that there was no reason geologically why one well couldn't drain at least 640 acres.

Q Let me direct your attention to what we have marked as Cities Service Exhibit Number One. Let's take a moment and orient the Examiner as to the information

indicated on that display.

Let me first of all have you simply identify what this is.

A This well shows portions of Harding, Union, and Quay Counties, which encompasses the Bravo Dome Area.

Q Is this a display that you prepared or was compiled under your direction and supervision?

A Yes, it is.

Q And you have updated it to August of 1987?

A Yes.

Q When we look at the display, will you identify for the Examiner what is indicated by the yellow line?

A The yellow line is the area where 640-acre spacing has been permanently established.

Q And that is commonly referred to as the Amoco Bravo Dome 640-acre area?

A Yes, it is.

Q In my questions to you, Miss Egg, as we go through your presentation, when I refer to the Amoco Bravo Dome Area I will mean the area outlined in yellow.

When we look at the Cities Service West Bravo Dome Area, how is that indicated on the display?

A The area that we're applying for spacing

has a pink outline.

Q And that is the approximate area that was approved for temporary rules by the Commission in Order R-7737 back in 1984?

A Yes, it is.

Q Within the Amoco Bravo Dome Area there are some arrows of different colors. Would you identify what the lighter colored, or they appear to be brown, arrows? There are three of those on the display?

A The brown arrows point to the wells where long term flow tests were performed.

Q And that was part of Amoco's presentation to the Commission several months ago in making their rules permanent?

A Yes.

Q What are the four green arrows?

A The green arrrows are their shut-in pressure monitor wells. These wells were shut-in while pressure was monitored as production took place around them.

Q When we look to the west, there is a portion outlined in a green rectangle. What is the significance of that?

A Some reservoir simulations were performed in this area.

Q And to your knowledge, they were per-

formed by whom?

A They were performed by Ed Hanley.

Q And who does Mr. Hanley work for?

A Cities Service Oil and Gas.

Q When we look at the red dots in the western area, what are those?

A The red dots are on wells that are located within the Cities Service West Bravo Dome Carbon Dioxide Gas Unit.

Q On the display there is four or five lines connecting various wells one to the other. Are those lines of cross sections?

A Yes, they are.

Q Were those lines of cross sections prepared by you for the original hearing?

A Yes.

Q And did they form part of your opinion and testimony at that hearing?

A Yes, they formed an important part.

Q Okay. Let's turn, let's save the display as a reference exhibit, and let's turn to Exhibit Number Two. What is Exhibit Number Two?

A Exhibit Number Two is a map of the top of the Tubb sandstone.

Q In addition to your original geologic

opinions in 1984, have you re-examined those opinions in light of the available new geologic evidence that you've examined in this area?

A Yes.

MR. KELLAHIN: Mr. Examiner, at this time we tender Miss Egg as an expert petroleum geologist.

MR. CATANACH: She is so qualified.

Q Let me have you summarize for us, if you will, what are the basic opinions you expressed to the Commission back in 1984 concerning the suitability of spacing the West Bravo Dome on 640 acres?

A After my study I concluded that the Tubb sandstone is continuous across the application area, after a review of the logs that are available in that area, and that because of that continuity there is no reason for a well not to drain at least 640 acres.

Q Subsequent to that original opinion some new geologic information has come to you, has it not?

A Yes, it has.

Q And has any of that information caused you to change your original opinion?

A No.

Q Let's turn to Exhibit Number Two and have

you now describe for us your geologic interpretation the structure map as depicted on this display.

A The Tubb sandstone dips to the south or the southeast across this area.

Q Do you see any discontinuity in the structure or other structural features in here that would cause areas in the West Bravo Dome to be isolated one from the other?

A No, there are no such features.

Q On the display you've -- on Exhibit Number Two you have some red dots. What do those indicate?

A The red dots are the wells that have been drilled in the area since the 1984 hearing.

Q And have you examined information available from the logs for those wells?

A Yes.

Q And does any of that information cause you to change your original structure map for this area?

A No. The -- those logs, the information from those logs fit nicely with my former interpretation.

Q Let's turn now, if you will, to Exhibit Number Three. Would you identify Exhibit Number Three?

A Exhibit Number Three is cross section A-A' and it runs from the West Bravo Dome Area over into the Amoco Unit.

Q And if we look on your Exhibit Number One, it is the top of the two lines of cross section running horizontal on that display?

A Yes, it is.

Q All right, let's start with the far eastern end of that display with A' and have you summarize what's occurring in the Tubb sandstone as we move to the west.

A As we move to the west, the Tubb standstone does thin; however, the sands do appear to be continuous until the point where they thin.

Q Can you identify for us the geologic parameters that exist in the Amoco Bravo Dome Area and how those geologic parameters are similar or dissimilar to the West Bravo Dome Area?

A Our porosities, the porosities between the two areas are similar, roughly 18 percent.

Our permeability that we have calculated from our pressure testing is also similar to what they have calculated.

The only difference that is notable is the thinning of the net pay.

Q In your opinion what significance is the thinning of the net pay in terms of establishing spacing that's appropriate for the West Bravo Dome?

A The thinning has no significance.

Q Let's turn now to Exhibit Number Four, and would you identify that cross section for us?

A Exhibit Four is cross section B-B', which also runs from the West Bravo Dome Area into the Amoco area.

Q And if we start with B', the far eastern end of the display, and move to the west through the West Bravo Dome area, describe for us what's occurring in the Tubb sand.

A Once again you see the sand stringers thin; however, the same continuity exists until a point where those sands pinch out.

Q What geologic opinion do you have concerning the continuity of the Tubb sand in the western Bravo Dome insofar as you would want to drill wells either on 640 spacing or some smaller spacing in order to encounter all of these sand stringers in the Tubb?

A From a review of these cross sections a well drilled on 640 acres should drain the -- that section.

Q Will it or will it not encounter the same sand stringers that you would encounter if you were drilling on smaller spacing?

A The sand stringers would be penetrated, all be penetrated by a well on 640-acre spacing.

Q So it's your opinion that we're not mis-

sing or isolating stringers that would not be produced if we were to continue with 640-acre spacing in the West Bravo Dome.

A No, we would not.

Q Let's turn to Exhibit Number Five. All right, now we're moving a different direction through the West Bravo Dome. If you'll look at Exhibit Number One, help us orient ourselves as to how this cross section cuts through West Bravo Dome.

A Exhibit Five is cross section C-C' and it runs from the northern part of our West Bravo Dome Unit down to the -- in a southeasterly direction outside, to a location outside the unit and outside the application area.

Q Again describe for us, Miss Egg, what is occurring as we examine the cross section in this manner through the West Bravo Dome.

A The sands thicken as you move to the southeast; however, as these wells are spaced, oh, approximately three to six miles apart, you see a great deal of continuity still.

Q All right, let's turn to Exhibit Number Six and again, if you'll use Exhibit One, orient us as to the line of cross section for Exhibit Number Six.

A Cross section D-D' runs north/south through the 640-acre application area.

Q And describe for us what geologic opinions you can reach from an examination of the cross section.

A I can conclude that the sands are continuous.

Q Do you see, based upon all your lines of cross sections and your geologic examination of the West Bravo Dome, any geologic reason that would cause you now to conclude that development of the West Bravo Dome ought to be on something other than 640-acre spacing?

A No, I don't. My conclusions now are the same as they were in 1984.

MR. KELLAHIN: That concludes my examination of Miss Egg. That's our geologic presentation.

We have two other witnesses, one of which is an engineer to talk about his reservoir simulation studies that he has made of the West Bravo Dome.

CROSS EXAMINATION

BY MR. CATANACH:

Q Miss Egg, are your porosities pretty continuous throughout the unit?

A The magnitude of porosity?

Q Yes.

A Yes, for the most part they are.

Q How about the permeabilities?

A Our testing has been limited to a handful of wells but as I understand the data, they are also -- there are some variations, but they are roughly the same.

MR. CATANACH: What is the significance of the model study area? Is there any -- can somebody else testify to that?

MR. KELLAHIN: Yes, sir.

MR. CATANACH: Will you have evidence on bottom hole pressures?

MR. KELLAHIN: There is some pressure information available and we'll have to ask Mr. Hanley what use he's made of that information.

MR. CATANACH: I guess I don't have anything else at this time.

The witness may be excused.

MR. KELLAHIN: I've neglected to do so, we would like to move the introduction of Miss Egg's Exhibits One through Six at this time.

MR. CATANACH: Exhibits One through Six will be admitted into evidence.

MR. KELLAHIN: Mr. Examiner, we'd like to call Mr. Ed Hanley.

ED HANLEY,

being called as a witness and being duly sworn upon his oath, testified as follows, to-wit:

DIRECT EXAMINATION

BY MR. KELLAHIN:

Q Mr. Hanley, for the record would you please state your name, sir?

A My name is Edward James Hanley.

Q Mr. Hanley, by whom are you employed and in what occupation?

A I'm employed by Cities Service Oil and Gas Corporation in Tulsa, Oklahoma. I work in their Production Technology Group and I supervise a unit which performs reservoir evaluation and simulation studies.

Q Would you summarize for the Examiner what has been your educational background?

A Yes. I received my education in mechanical engineering from Purdue University and earned a BS degree in 1973, MS in 1975, and PhD in 1978.

Q Would you describe for us what has been your employment experience?

A Yes. Since that time, since 1978, I've been employed with Cities Service Oil and Gas in several ca-

pacities.

Q Would you summarize what those capacities are or were?

A Certainly. Initially I worked as a research engineer where I specialized in well testing applications, and taught our company's schools in that area.

Subsequently I worked in our Houston office as Region Reservoir Engineer responsible for all our reservoir activities in the Gulf of Mexico.

And since that time I've been employed in my present position.

Q At the September '84 hearing of the Commission in the original case that established temporary 640-acre spacing for the West Bravo Dome, were you a witness for Cities Service Oil and Gas Corporation?

A Yes, I was.

Q And in what capacity did you testify at that hearing, Mr. Hanley?

A I testified as an engineering witness in relation to a reservoir study we had performed in the West Bravo Dome Area.

Q Have you continued with your reservoir studies for the West Bravo Dome Area?

A Yes, I have.

MR. KELLAHIN: We tender Mr.

Hanley as an expert reservoir engineer.

MR. CATANACH: He is so qualified.

Q Mr. Hanley, at this time I would like you to take a moment and perhaps we can use Exhibit Number One, the first display, and have you discuss for us the studies and opinions you originally reached back in the September, 1984, hearing, and start with an explanation of the type of data that you studied for the original hearing.

A Well, during 1984 we conducted a number of tests. We measured pressures and performed isochrone (sic) flow tests on ten wells in the West Bravo Dome Area.

We also performed an extended sixty-day long term production test on one well in the West Bravo Dome Area.

Using data obtained from those tests we evaluated several things, one being the reservoir properties in the West Bravo Dome Area; second being completion efficiencies in those wells; and the third, appropriate drainage areas for the West Bravo Dome Area.

In addition we examined data available from Amoco on their wells in the Bravo Dome Area. Particularly we looked at the long term flow tests and compared the results of our testing in the West Bravo Dome Area with the performance of the wells in the Bravo Dome Area.

Q Based upon those studies what opinions and conclusions did you express to the Commission in September of '84?

A There were several opinions expressed, the primary of which were that the performance characteristics of the wells in both the West Bravo Dome and Bravo Dome areas were very similar. The permeabilities were similar and this was the primary controlling factor.

The primary difference in the West Bravo Dome - Bravo Dome Area, is that there is a thicker pay sand in the Bravo Dome Area.

Additionally we determined that one well would efficiently and effectively drain 640 acres.

Q Subsequent to the September '84 order that established on a temporary basis 640-acre spacing for the West Bravo Dome, would you describe for us what further studies you have made of the West Bravo Dome?

A In the West Bravo Dome Area, since that time we have not had any significant production on our carbon dioxide wells but we have monitored well pressures in the area.

There has been some offset production from some of our wells which we have studied and we've also studied the long term performance in the Bravo Dome Area to see if our conclusions from 1984 were still valid.

Q Let's turn to an examination of how you have updated and refined your reservoir studies of the West Bravo Dome and how they have related an integrated themselves with the Amoco Bravo Dome, and to commence that presentation, let me ask you to take Cities Service Exhibit Number Seven as a starting point and identify that exhibit for us.

A Exhibit Number Seven is a copy of an exhibit that was presented by Amoco a few months ago in their spacing hearing for the Bravo Dome Area, and what it shows is a long-term performance on one of the wells which is indicated by a green arrow in Exhibit Number One.

And the performance of this well is shown by the solid lines on the figure.

We show flow rate, flowing tubing pressure, and the cumulative production of the well. Also shown on the figure is the original prediction made by Amoco as to the performance of this well. That's shown as the dashed line.

Q On the top third of the display the dashed line under the solid line is the Amoco projection or simulation of performance for the well?

A That was their simulation from 1984. What their simulation was based on was a constant flow rate for the well, as shown in the lowest curve, but what subse-

quently occurred was they produced into a constant pressure flow line, so the well performed differently than was originally predicted, and in fact, it performed better than originally predicted.

Q In the rectangle there is some reservoir parameters indicated on the display. What use was made of those parameters?

A Amoco then subsequently, after obtaining this additional data of over 1000 days in their long term flow test, they used this parameters which they determined prior to 1984 to model the performance of the well based on the new producing condition of constant wellhead pressure --

Q Let's look --

A -- and the results of that simulation by Amoco is shown in Exhibit Number Eight.

Q All right, let's turn now to Exhibit Number Eight. We're looking at Amoco Exhibit Five, which we're using as Cities Service Exhibit Eight?

A That's correct.

Q All right. Describe for us what Amoco then did in revising its Exhibit Four and displaying that information now on what they introduced as Exhibit Number Five and what we're using as Exhibit Eight.

A Exhibit -- our Exhibit Number Seven and Exhibit Number Eight show the same production performance

histories for the subject well. The difference on Exhibit Number Eight is that there are solid lines which represent Amoco's new performance prediction for the well, and these are based on controlling the flowing tubing pressure.

They show on the figure, on the lowermost curves, what the predicted performance of the well would be for two drainage areas, for a 160-acre drainage area and for a 640-acre drainage area, and it's apparent from the figure that the actual well performance matches reasonably well with the 640-acre drainage area.

Q Have you examined the method by which Amoco simulated the well performance and modeled its production?

A Yes, I have. In fact, I met with Amoco, obtained the detailed production data and re-simulated the performance of this well using our own simulators.

Q All right. When you talk about simulators, would you describe the basic elements or components of a simulation of well performance?

A Yes. Basically we're using a computer simulator in this case called three dimensional, three phase, finite difference model, in which we input reservoir parameters such as permeability, porosity, water saturation, wellbore condition, and pressure, and either by controlling pressure or controlling rate, predict the performance of a

well.

Q Is this something you do on a regular basis?

A Yes, it is.

Q Were you able to put in the reservoir parameters and data that Amoco supplied to you for their well in the Bravo Dome Area and make your computer duplicate or simulate the performance that Amoco demonstrated on their simulation?

A I did take the data obtained from Amoco and used it directly without any changes in our computer simulator and was able to simulate the performance of this well.

Q All right, sir, what then did you do?

A Well, I'll say Exhibit Nine shows the performance of the well that I obtained and I've plotted it on the same scale as the Amoco exhibit so it would be easier to refer to.

On Exhibit Number Nine the green curve is the actual well performance. The red curve is what the performance of the well would -- would be from our simulator for 640-acre spacing, and the blue curve is what the performance of the well would be using 160-acre well spacing.

And similar to Amoco's results, it's

clear that this well is draining 640 acres and not 160 acres.

Q Having been able to duplicate Amoco's simulation of their well in the Bravo Dome, and used that information up to that point, what then did you do in order to examine Cities Services West Bravo Dome Area?

A Okay. Our objective in examining the Amoco long term performance was to verify that we could with our simulator predict the performance of a well with these characteristics over a long period of time. So the next step was to use typical parameters from the West Bravo Dome Area and predict the well performance for different drainage areas over a long period of time.

Q Let's turn to Exhibit Number Ten and have you identify for the Examiner the parameters you utilized for the West Bravo Dome Area.

A Okay, Exhibit Ten is a list of what are typical or average parameters for the West Bravo Dome Area. These are the same parameters which we submitted during 1984 in the original spacing hearing. They have not changed since that time.

Would you like me to read them, enumerate them?

Q No, sir, you might indicate in what ways your parameters are different or vary to any material degree

from the parameters that Amoco used in the Bravo Dome Area.

A Certainly. The average net pay, as I've already mentioned, is much less in the West Bravo Dome Area than in the Bravo Dome Area. Our average net pay in the West Bravo Dome Area is about 26 feet, whereas in the example well, which is shown in Exhibit Seven and Eight from the Bravo Dome Area, the net pay is about 104 feet. So we're considerably thinner.

The average porosity is about the same in both areas.

The average pressure in the West Bravo Dome Area is somewhat higher than in the Bravo Dome Area.

The average permeabilities are about the same in both areas.

And we both have the same gas in both areas, so the gas properties are identical.

Q All right. You take your reservoir simulation and put in the West Bravo Dome parameters and what did it show you?

A Okay, the results I obtained are shown in Exhibit Number Eleven.

Q Okay, let's turn to Exhibit Eleven. Again show us how to read the display and then describe for us the conclusions you reached from that information.

A Okay. As input data to the simulator, we

used the same flowing tubing pressure that Amoco had experienced during their long term flow test and that's shown as -- in the center of the figure.

On the lower part of the figure there are two curves. These are predicted flow rates. The red curve is the predicted flow rate for 640-acre drainage and the blue curve is the predicted flow rate for 160-acre drainage area.

The very top of the figure there are two corresponding curves, a red curve showing the cumulative production for 640-acre drainage, and the blue curve showing cumulative production for 160-acre drainage.

The conclusion from this performance prediction is that one well will efficiently and effectively drain 640 acres using typical properties in the West Bravo Dome Area.

Q Having studied the Bravo Dome Area from this particualr perspective using the simulation, have you tried any other approaches to analyzing what would be the appropriate spacing for the West Bravo Dome Area?

A Yes, we have. There is some production offsetting some of our -- some of our wells in the West Bravo Dome Area and we studied this area to determine what that offset production, how that would impact the performance on our wells.

Q All right, let's go through and see how -- what methodology you used to see what impact actual production was having in the West Bravo Dome. How did you go about making that study?

A Well, initially we looked again to the Bravo Dome Area. Amoco had several pressure monitoring wells in that area, which are shown in Exhibit Number One with the green arrows. These wells had production from adjacent sections, which impacted the pressure in their pressure monitoring well.

So our first step was to examine the reservoir performance and the pressure history in that part of the reservoir to determine if we could predict what it would be in the West Bravo Dome Area.

Q Let's refresh the Examiner's recollection about how Amoco conducted that study and let me direct your attention to what we've marked as Cities Exhibit Twelve, and it is the same exhibit as Amoco used as Exhibit Fifteen in their hearing.

Let me have you identify Exhibit Number Twelve.

A Exhibit Number Twelve is a locator plat showing the location of one of Amoco's pressure monitoring wells and the location of producers surrounding that well.

This is one of four pressure monitoring

wells that Amoco had.

Q Okay. Let's turn to Exhibit Number Thirteen now and have you identify that exhibit.

A Exhibit Thirteen is again an exhibit which was submitted by Amoco in a recent hearing as Exhibit Number Eleven-B and what this shows is two things. One, the actual pressure history of this pressure monitoring well, and secondly, a performance prediction based on a computer simulator study of the area performed by Amoco.

Q Were you also able to make your computer simulation of the performance of this fact situation duplicate Amoco's results?

A Yes, we met with Amoco and obtained the detailed production information on the eight wells surrounding this well and using that as input to our reservoir simulator, predicted what the pressure change should be in this pressure monitoring well and the results of that prediction are shown in Exhibit Number Fourteen, where our results are very similar to those of Amoco and very close to the actual performance of the pressure monitoring well.

Q Having been able to duplicate Amoco's simulation of the pressure monitoring well in the Bravo Dome Area, did you input pressure parameters from the West Bravo Dome Area into your model to see what would occur?

A Yes, we did.

Q All right, can you describe for us how that was done?

A What was done in the West Bravo Dome Area was initially to examine pressures, bottom hole pressure measurements which were obtained in some of our wells.

The -- I guess we're getting out of order here.

Q We'll catch up with you. How about let's -- we'll identify Exhibit Fifteen, simply identify that for us.

A Okay. Exhibit Number Fifteen is a summary of bottom hole pressure measurements which were made in July of this year on a number of the West Bravo Dome Area wells.

Q This is information that you put into the simulator and see what occurs, right?

A Well, no, that's not the way we use this data --

Q All right.

A -- but I'll describe that as -- as we go along here. All of these pressures, incidentally, were corrected to a common depth so they could be compared with each other and that depth was 2500 feet above sea level.

Q Let me have you identify Sixteen at this point, too.

A Okay, Exhibit Number Sixteen is a summary of some production from a number of wells operated by Amerigas, which directly offset the pressures, the pressure -- the wells upon which we -- we measured the pressure during July, 1987.

Q Okay. Let's go through and identify -- we'll come back to these, but let's go through and identify Exhibit Seventeen at this point.

A Okay. Exhibit Number Seventeen is a plot showing the production combined from all of the wells shown in Exhibit Sixteen over a period of time between 1982 and March of this year. This data was obtained from public sources.

Q All right, and let's go to Exhibit Eighteen now and identify the survey area.

A Okay. Exhibit Number Eighteen, now, is our -- what we called our model study area or model survey area, and shown on this exhibit by the blue symbols are the wells which we measured the bottom hole pressures on as listed in the Exhibit Fifteen.

Also shown in the figure are the -- by red symbols in the figure, are the Amerigas wells upon which we have production data between 1982 and 1987.

Q Taking this data, then, describe how you utilized the data and how you use that information in order

to model the study area.

A Okay. What was done in -- in this model study, since we don't have detailed information about the permeabilities and reservoir properties in each section in this area, we used the typical reservoir properties for the West Bravo Dome Area, which are shown in Exhibit Number Ten, to predict the performance, the pressure distributions in this area as these wells shown as the red symbols are produced.

Q And what results did you reach, Mr. Hanley?

A When we predicted the well pressures for this area, as we input the historical production on these wells, it resulted in the pressure, simulated pressure distribution shown on Figure or Exhibit Number Nineteen, and this exhibit can be overlain on the Exhibit Number Eighteen to show what sort of match we have between our measured pressures and the simulated predicted pressures.

And what we find is that there is a pressure, a low pressure area around the Amerigas wells, which one would expect, and that the pressure is predicted to gradually increase away from those wells.

And we find reasonable, what I would consider reasonable agreement between the predicted pressures and the actual pressures measured at our offset wells.

Q Having analyzed the West Bravo Dome from this approach, what can you ultimately conclude about the appropriate spacing for the West Bravo Dome Area?

A Well, the conclusion from this study in the model survey area is that we are seeing drainage from a few wells over a large area; that the sand is continous over these areas, and that a single well can adequately and efficiently drain 640 acres.

Q Apart from the Amoco exhibits, Mr. Hanley, were the balance of your exhibits, I think they're marked Seven through Nineteen, were those prepared by you or compiled under your direction and supervision?

A Yes, they were.

MR. KELLAHIN: We move the introduction of Exhibits Seven through Nineteen.

MR. CATANACH: Exhibits Seven through Nineteen will be admitted into evidence.

MR. KELLAHIN: That concludes my examination of Mr. Hanley.

CROSS EXAMINATION

BY MR. CATANACH:

Q Mr. Hanley, when you did your simulation, as I understand it, all you did was put in the reservoir parameters of the West Bravo Dome Area?

A That's right. In our simulation of the -- of the -- in a study area, we simply use the typical parameters for the West Bravo Dome Area. Our intent was not to exactly match the pressures but to see if it was reasonable that the pressure profiles we saw were due to production at the offset wells, and our conclusion of the work was that indeed it is due to that.

Q Okay, Cities Service doesn't have any production history in any of these wells at all, Mr. Hanley?

A Other than the original testing which was done in 1984, no, we don't have production on these wells.

Q Have you done any -- I guess you have done some reserve calculations. How do the reserves compare under a tract in the West Bravo Dome to the -- to the Bravo Dome Area?

A Well, the primary factor there is the thickness and the reserves are in direct proportion to the thickness. We have a slightly higher pressure in the West Bravo Dome Area but the reserves per section, due to the thickness, are much higher in the Bravo Dome Area.

Q How do you explain the difference in pressure in the two areas?

A I don't have an explanation for that. There is a, what I would consider a significant difference in pressure, and we are structurally high to the Bravo Dome

Area.

In the areas I've studied I've seen no evidence of -- locally over areas such as we've described in our study area, no evidence of any discontinuities.

So I don't have an explanation for the difference in pressures.

Q Assuming that the permeability was -- was constant throughout the area, it would be the same, is that correct, the pressure would be pretty much the same?

A Should be.

MR. CATANACH: Mr. Kellahin, is it your intent to continue these pool rules on a temporary basis or --

MR. KELLAHIN: Yes, sir, I was going to ask Mr. Hanley and the next witness those questions, but it is our proposal to you that we would like to continue 640 spacing on a temporary basis. The request is that that temporary period be three years after the establishment of actual production.

My third witness will describe for you what the status is of the project and can describe in more detail than I can the reasons he's selected for that request. But at this point we are not asking that the rules be made permanent, but we do believe that there are sufficient reasons to continue on a temporary basis 640 spacing.

MR. CATANACH: Okay, I don't have anything further of this witness at this time.

MR. KELLAHIN: I have a couple of questions to follow on Mr. Catanach's questions, Mr. Hanley.

REDIRECT EXAMINATION

BY MR. KELLAHIN:

Q Let me address to you the amount of reserves in place under a section in the West Bravo Dome versus the Bravo Dome, what impact does spacing have on the amount of reserves in place in both areas?

A Well, the main impact is on economics. If we have in the West Bravo Dome Area significantly lower reserves per section, the economics are much more sensitive to the number of wells put on that section.

Q In a simple way with a larger amount of reservoir in place in the Bravo Dome it can support wells drilled on denser spacing than you could in the Western Bravo Dome Area.

A That's right, from an economic point of view.

Q Let me ask you your opinions on the period of time that you would recommend to the Examiner that the 640 spacing rules be continued. I assume it is your

opinion that those rules ought to be continued?

A Yes, it is, and it's my opinion they should be continued until we've obtained enough production data that we can verify our model studies and determine that 640-acre spacing is appropriate and that in comparison with the Amoco production data it took approximately three years.

MR. KELLAHIN: That concludes my questions of Mr. Hanley.

RECROSS EXAMINATION

BY MR. CATANACH:

Q Mr. Hanley, have you in fact calculated any economic data pursuant to drilling one well versus two wells in the area?

A No, I haven't.

MR. CATANACH: That's all I have of Mr. Hanley.

ROBERT D. HUNT,

being called as a witness and being duly sworn upon his oath, testified as follows, to-wit:

DIRECT EXAMINATION

BY MR. KELLAHIN:

Q Would you please state your name and

occupation?

A My name is Robert D. Hunt. I'm Manager of Engineering for Cities Service Oil and Gas Corporation.

Q Mr. Hunt, would you summarize for the Examiner what has been your educational experience?

A I received a BS degree in petroleum engineering in 1970 from the University of Oklahoma.

Q And would you summarize for us what has been your employment experience as an engineer?

A Since graduation I've been employed by Cities Service in various capacities beginning with assignment in Oklahoma City as Production Engineer through 1972, at which time I worked in reservoir engineering through 1975, at which time I worked at a -- was transferred to Tulsa, Oklahoma, in a special drilling operations group for a year. I went to Denver in 1976 as a Region Petroleum Engineer. I moved on to Gillette, Wyoming, as a Unit Production Manager with our secondary recovery unit there, where I stayed until 1980. I moved in 1980, stayed there until '86, and through June '86 through February of '87 I was Production Manager of the Rocky Mountain Region, and since February of this year I've served in my present capacity.

Q Describe for us your present responsbilities for your company insofar as it affects the West Bravo Dome Area of Harding, Quay, and Union Counties, New Mexico.

A Our office in Midland is responsible for overseeing that area. Our engineering staff which Miss Egg works in reports to me and I oversee their activities, which includes the general monitoring of these types of projects, such as West Bravo Dome.

MR. KELLAHIN: We tender Mr. Hunt as an expert petroleum engineer.

MR. CATANACH: He is so qualified.

Q Mr. Hunt, let me have you describe for us what the current status is of Cities Service Oil and Gas Corporation's operation of the West Bravo Dome Unit Area and then let me ask you some follow-up questions.

A Okay. Currently, of course, the present status of operations is that we have not, unfortunately, been able to develop the West Bravo Dome any further than we had developed that unit in 1984, and at that time the plans were to develop the West Bravo Dome to provide CO2 for us and our working interest owners in the West Bravo Dome for EOR projects throughout the Permian Basin.

Of course we all realize what happened to the price of oil and the precipitous decline of the price put the EOR projects on the shelf, which ultimately resulted in the lack of a market for CO2 from West Bravo Dome.

Q Let me have you describe for us the state

of planning and development apart from actual drilling and production, the state of the planning for the unit in order to produce and market the CO2 from West Bravo Dome?

A We have made and are continually updating the plans for development of West Bravo Dome, even as recent as the last two or three months, we have dusted off the plans for evaluating the economics of development of West Bravo Dome, which would include the laying a 16-mile pipeline over to the Amoco Bravo Dome Area installation of a 50-to-75 million cubic feet a day plant compression site, and of course, the full development of the West Bravo Dome would require some additional drilling and installation of gathering facilities.

This type of planning we are doing concurrently looking at the economics of developing Bravo Dome to provide CO2 for EOR projects which we believe, depending on what the price of oil does, could be on the upswing over the next two or three years.

We are directing ourselves towards being able, hopefully, to provide CO2 from West Bravo Dome to ourselves and our working interest owners in the time frame of late 1990. Of course this depends on a lot of things, what the price of oil does and some of the other factors that are going to affect how fast we can get West Bravo Dome developed, electric service, et cetera.

Q Is 640-acre spacing for the West Bravo Dome and the continuation of those temporary rules an integral part of Cities Service's ability to produce and market the CO2 from this area?

A Oh, we certainly, definitely economically, would not be able to develop West Bravo Dome on any more dense spacing.

Q Do you have a recommendation to the Examiner as to what period of time you would request he continue the temporary rules for the 640-acre spacing in the West Bravo Dome?

A I would concur with Mr. Hanley's recommendation that the temporary rules be maintained as they are until such time as we are able to verify with hard facts our simulation studies, and it appears as though that would be approximately three years after the beginning of production.

MR. KELLAHIN: That concludes my examination of Mr. Hunt, Mr. Catanach.

CROSS EXAMINATION

BY MR. CATANACH:

Q Mr. Hunt, when do you anticipate starting to sell (not clearly understood.)

A Well, as I said, the timing of development of West Bravo Dome depends, if we started right now we

would be talking one to three years to obtain a power source, so we have put money on our budget request for 1988. We're going through our budget process right now. We are not sure how we're going to shake out with being able to fund and develop West Bravo Dome.

It's my understanding that some of our working interest owners in Bravo Dome would like to take gas by no later than late 1990, and I would -- I feel like that it will probably take that length of time in order to do the types of things that it will take to get that project on line, plant design, obtaining electrical contracts, that type of thing.

Q So we're talking a period of five years from now, or something?

A Probably, before we can actually see the kinds of pressure drops that would verify beyond any doubt that -- that we are in fact draining in excess of 640 acres.

Q Why do you feel you need a three year evaluation period?

A We were basing that based on our simulation studies of being able to have substantial pressure drops. That's more or less what we've predicted. It didn't look as though if we elected one year production it was enough, you know, to just stand right out and prove our contention.

Q Mr. Hunt, are you under any kind of drilling constraints in the unit as far as -- or drilling commitments?

A I believe, I believe we do have one or two leases within the unit where we have some -- some driling commitment. I'm not familiar with that, the land situation very well, but I think we have one section where there's a problem and the rest of the -- rest of it is around 1992, I think, before we need to have some leases going (inaudible).

Q Is this mostly Federal acreage?

A It's approximately what percent -- let's see, approximately, it's less than -- a little over 10 percent Federal acreage right now.

No, excuse me, I'd like to correct myself.

When the unit was originally formed we had less than the mandatory -- we had less acres, Federal acres, than what was required for it to be a Federally supervised unit, which -- and ultimately, with an expansion, there were some additional Federal acres included, which, I think it's resulted in the majority of the acreage being Federal acreage.

MR. CATANACH: I don't think I have any more questions of the witness.

Are there any other questions of this witness? If not, he may be excused.

MR. KELLAHIN: Mr. Examiner, that concludes our presentation for Cities Service.

MR. TAYLOR: We have a telegram we'll put in the record, I (unclear) received it yet, from Ted Hart, who I assume represents Armand Smith and he is protesting Cities Service's application and he's protesting the extension of temporary rules. He says they should be made permanent and spacing should be put on 320 acres and the application should be denied for lack of development, but I guess he didn't appear and didn't file anything, so we'll just put that telegram in the file.

MR. CATANACH: Are there any other statements or comments to be made at this time?

MR. HEFLEY: Yes, sir, I'd like to make a statement on behalf of Amerada Hess Corporation.

MR. CATANACH: Go ahead, sir.

MR. HEFLEY: My name is Jim Hefley. I'm the Manager of the Carbon Dioxide Supply for the Amerada Hess Corporation.

Amerada Hess is a working interest owner in the West Bravo Dome Carbon Dioxide Unit, as well as Bravo Dome, and is currently taking product in the amount of about 85-million a day from this area of New Mex

ico for use in Amerada Hess operated and joint venture EOR projects in West Texas.

We support the findings of Cities Service and believe that 640-acre spacing is essential to the establishment of long term supplies for our markets and is also essential for the economic development of the project.

Carbon dioxide business is very competitive. If the field would be drilled on less than 640 acres, I'm quite concerned that it would make the product non-competitive for use in the West Texas markets.

Our present plans are to add projects in West Texas, commencement with firming of oil prices starting in 1989, whereby we should be able to take the product, from this product in late 1989 or 1990.

That's the end of my statement.

MR. CATANACH: Thank you.

Are there any other statements at this time?

Is there anything further in Case 8352?

If not, it will be taken under advisement.

(Hearing concluded.)

C E R T I F I C A T E

I, SALLY W. BOYD, C.S.R., DO HEREBY CERTIFY that the foregoing Transcript of Hearing before the Oil Conservation Division (Commission) was reported by me; that the said transcript is a full, true, and correct record of the hearing, prepared by me to the best of my ability.

Sally W. Boyd CSR

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 8352, heard by me on August 26, 1987.

David R. Catanach, Examiner
Oil Conservation Division

NEW MEXICO OIL CONSERVATION DIVISION

STATE LAND OFFICE BUILDING

STATE OF NEW MEXICO

CASE NO. 8352

IN THE MATTER OF:

Case 8352 being reopened pursuant to the provisions of Division Order No. R-7737-A.

BEFORE:

MICHAEL E. STOGNER

Hearing Examiner

State Land Office Building

November 21, 1991

REPORTED BY:

DEBBIE VESTAL
Certified Shorthand Reporter
for the State of New Mexico

ORIGINAL

A P P E A R A N C E S

FOR THE APPLICANT:

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BY: W. THOMAS KELLAHIN, ESQ.

EXAMINER STOGNER: I'll call the next case, No. 8352, which is in the matter of said case being reopened pursuant to the provisions of Division No. R-7737-A, which order established temporary special rules and regulations for the West Bravo Dome Carbon Dioxide Gas Area in Harding County, New Mexico, which included a provision for 640-acre spacing units.

Because production history from these wells is still not available and since there is no apparent basis for making any permanent decision on this pool at this time, Oxy USA, Inc. -- I'm sorry -- yes, Oxy USA, Inc., which is now the company which took over City Service Oil & Gas Corporation, which was the original applicant in this case, has further requested that in the objection -- I'm sorry -- in the absence of objection that these current rules, including the 640-acre spacing units, be continued for a period of two years following the date of first production from that pool.

I'm going to call at this time for any appearances and/or testimony or statements.

MR. KELLAHIN: Mr. Examiner, I'm Tom Kellahin of the Santa Fe law firm of Kellahin,

Kellahin & Aubrey. I'm appearing today on behalf of Oxy USA, Inc., in support of our motion.

EXAMINER STOGNER: Are there any other appearances? Are there any objections?

There being none, thank you, Mr. Kellahin. This case, 8352, will at this time be taken under advisement to consider extending the current pool rules for an additional time to extend two years past the date of first production from this pool.

Case 8352 will be taken under advisement.

(And the proceedings were concluded.)

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. (Reopened) 8352 heard by me on 21 November 1991.

Michael E. Stogner, Examiner
Oil Conservation Division

CERTIFICATE OF REPORTER

STATE OF NEW MEXICO)
) ss.
COUNTY OF SANTA FE)

I, Debbie Vestal, Certified Shorthand Reporter and Notary Public, HEREBY CERTIFY that the foregoing transcript of proceedings before the Oil Conservation Division was reported by me; that I caused my notes to be transcribed under my personal supervision; and that the foregoing is a true and accurate record of the proceedings.

I FURTHER CERTIFY that I am not a relative or employee of any of the parties or attorneys involved in this matter and that I have no personal interest in the final disposition of this matter.

WITNESS MY HAND AND SEAL NOVEMBER 27, 1991.

Debbie Vestal

DEBBIE VESTAL, RPR
NEW MEXICO CSR NO. 3