CASE 7198: AMOCO PRODUCTION COMPANY FOR TEMPORARY SPECIAL RULES, UNION, HARDING, AND QUAY COUNTIES, NEW MEXICO

Case No.

7198

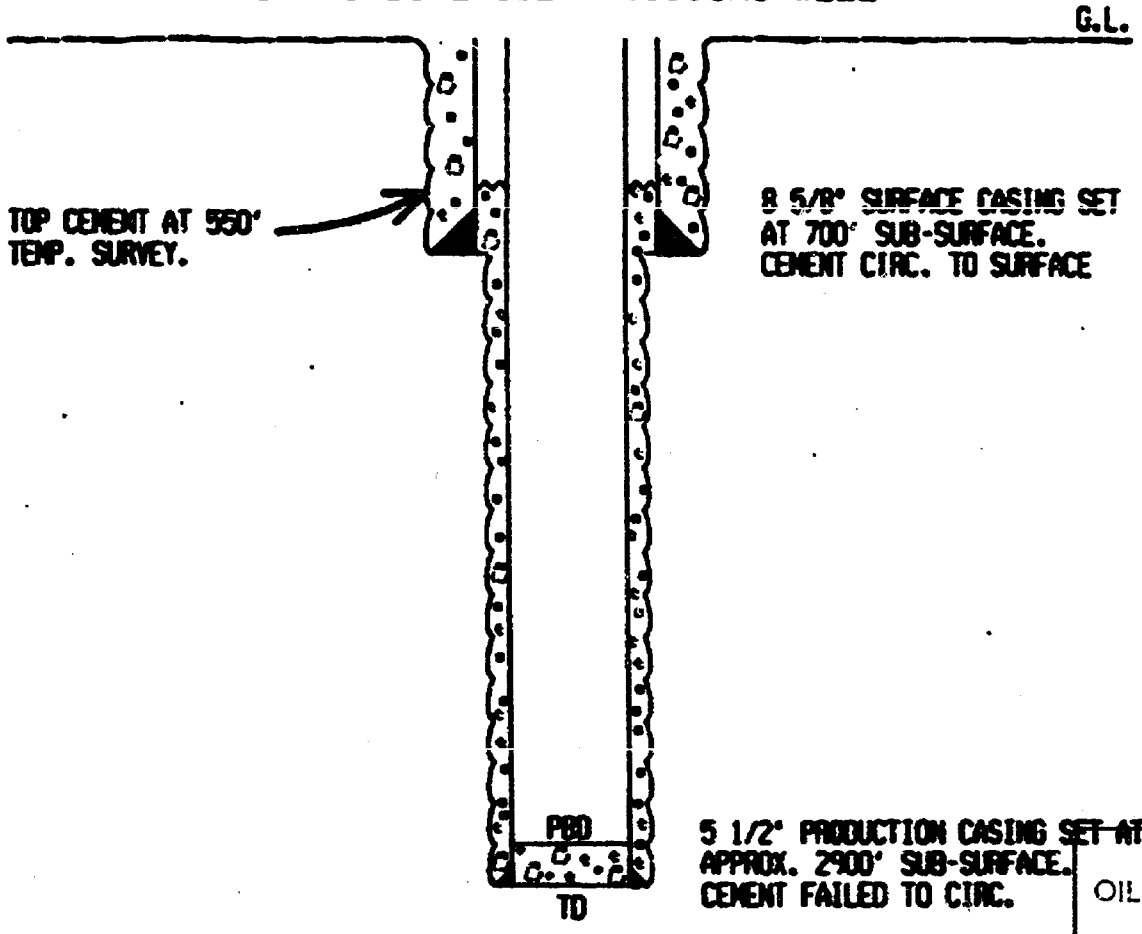
Application

Transcripts

Small Exhibits

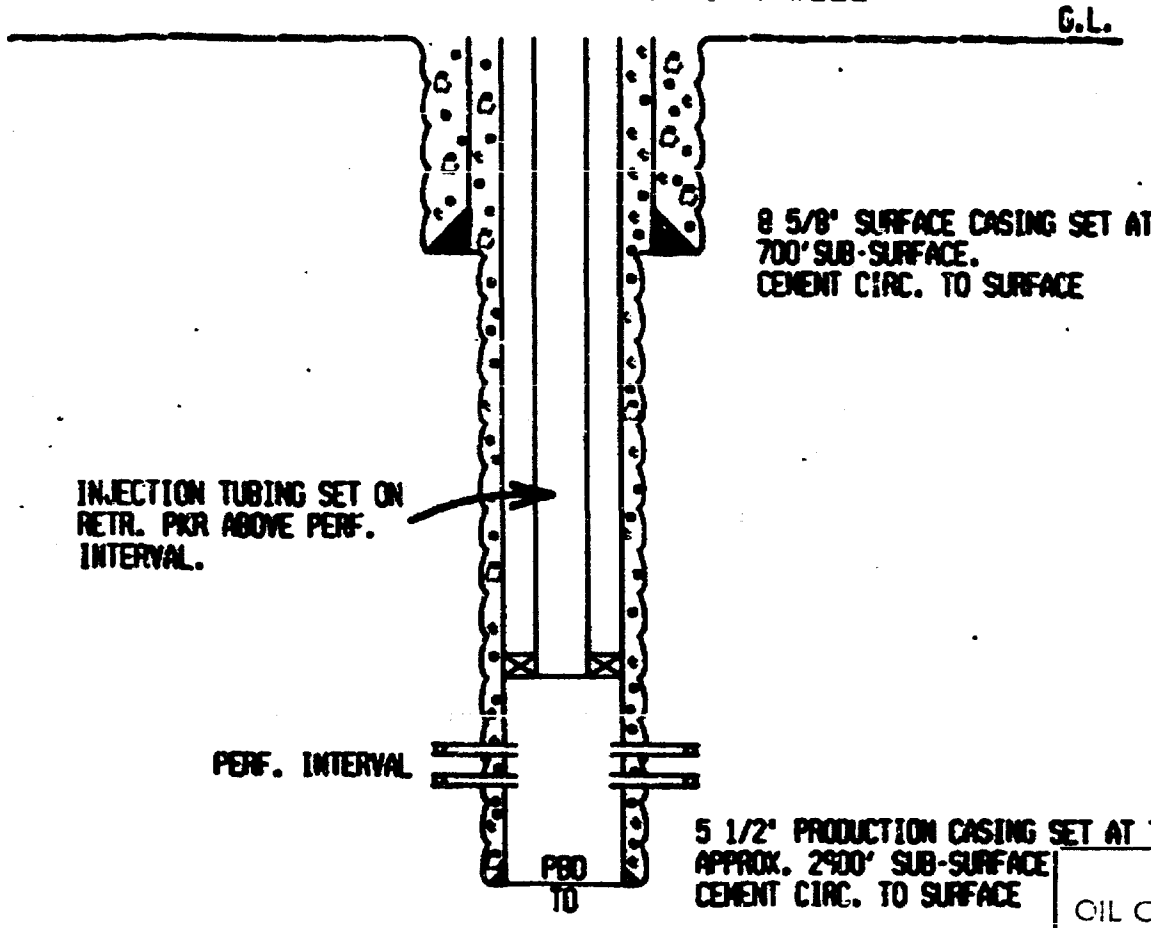
ETC

TYPICAL CASING AND CEMENTING PROGRAM
BRAVO DOME CO2 PRODUCING WELL



BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
Case No. 7198 Exhibit No. 3
Submitted by Amoco
Hearing Date 3-18-81

TYPICAL WELL BORE SKETCH
BRAVO DOME CO2 INJECTION WELL



BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
Case No. 7198 Exhibit No. 4
Submitted by Amoco
Hearing Date 3-18-81

TIMING CALCULATION FOR AN INITIAL 25 PSI RESERVOIR PRESSURE DECREASE HEIMANN NO. 1 AND STATE FI NO. 1 AREA BRAVO DOME CARBON DIOXIDE GAS UNIT

Description of Test Site:	5 miles x 5 miles
Total Acres In Test Site:	10240
Development Density:	640 acres
Net Wells Inside Test Site:	15 producers 1 pressure observation
MMCF of CO_2 To Remove To Lower Initial Reservoir Pressure 25 psi:	15,200
Time To Remove 15200 MMCF At 1000 MCFPD per Producing Well:	2.78 years

BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
Case No. 7198 Exhibit No. 16
Submitted by Amoco
Hearing Date 3-19-91

INITIAL DEVELOPMENT PLAN
BRAVO DOME CARBON DIOXIDE GAS UNIT

1. A central gathering system will be installed ultimately in approximately each quadrant of the productive area of the unit.

2. Drilling will be concentrated 640-acre development for initial production with the exception of scattered locations which will be on a less dense spacing for the purpose of obtaining additional reservoir data.

3. A pressure observation well will be located in the center of a minimum of a twenty-five well block of 640-acre development in each quadrant to furnish information on CO_2-in-place and areal drainage on 640-acre spacing. A highly accurate pressure measuring device will be run periodically in the observation well to monitor the pressure. A well defined initial pressure will be obtained prior to any production in each test site.

4. When a twenty-five psi pressure change is obtained in the observation well in any test site or when three years of unit production to a pipeline has occurred, spacing rules for the unit will be reviewed as appropriate with the Oil Conservation Division.

BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
Case No. 7198 Exhibit No. 17
Submitted by Amoco
Hearing Date 3-18-81

TIMING CALCULATION FOR AN INITIAL 25 PSI RESERVOIR PRESSURE DECREASE HEIMANN NO. 1 AND STATE FI NO. 1 AREA BRAVO DOME CARBON DIOXIDE GAS UNIT

Description of Test Site:	5 miles x 5 miles
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BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
Case No. 7198 Exhibit No. 16
Submitted by Amoco
Hearing Date 3-18-81

INITIAL DEVELOPMENT PLAN
BRAVO DOME CARBON DIOXIDE GAS UNIT

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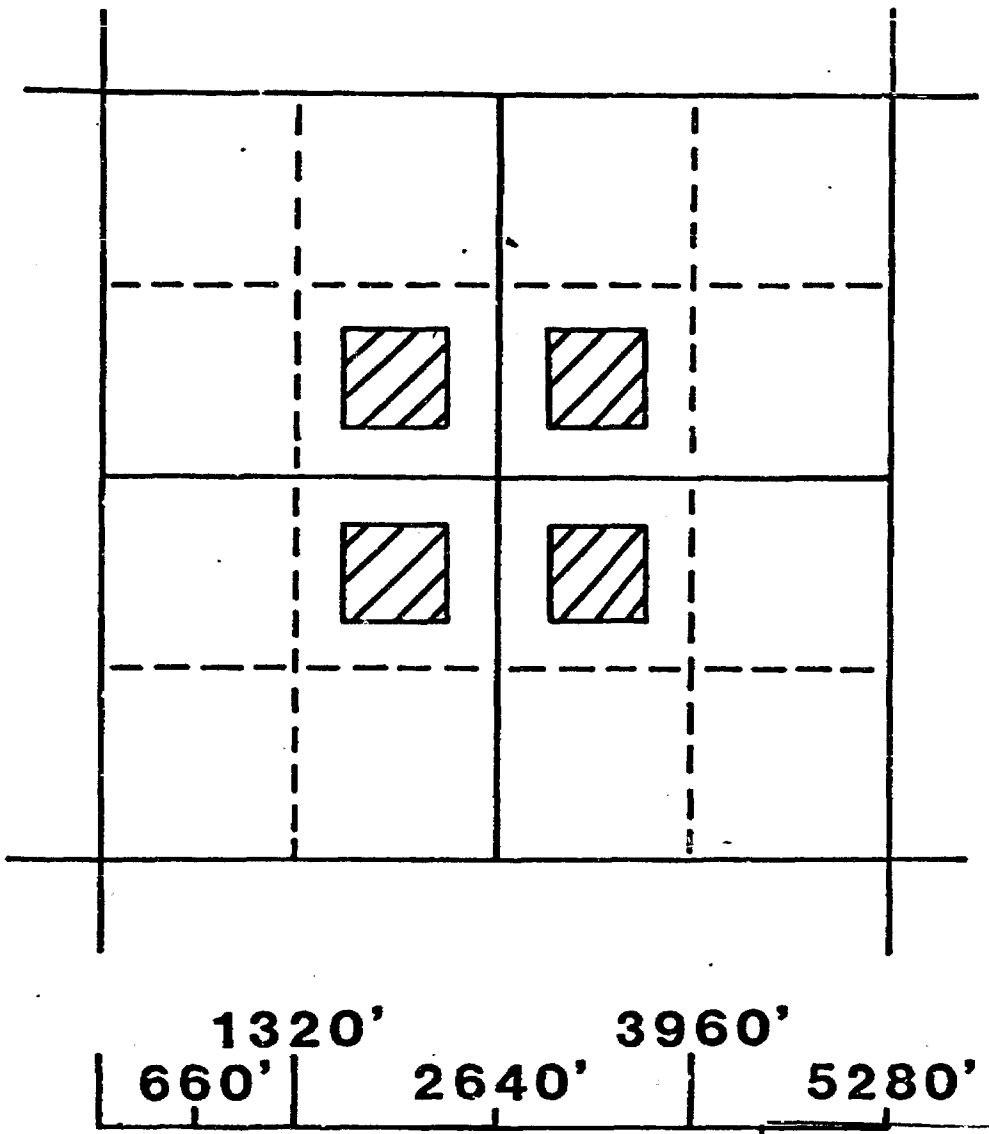
4. When a twenty-five psi pressure change is obtained in the observation well in any test site or when three years of unit production to a pipeline has occurred, spacing rules for the unit will be reviewed as appropriate with the Oil Conservation Division.

BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
Case No. 7158 Exhibit No. 17
Submitted by Amoco
Hearing Date 3-18-81

Bravo Dome CO_2 Gas Unit

640 Ac. Spacing With Conventional

Well Locations: 1650'/330'



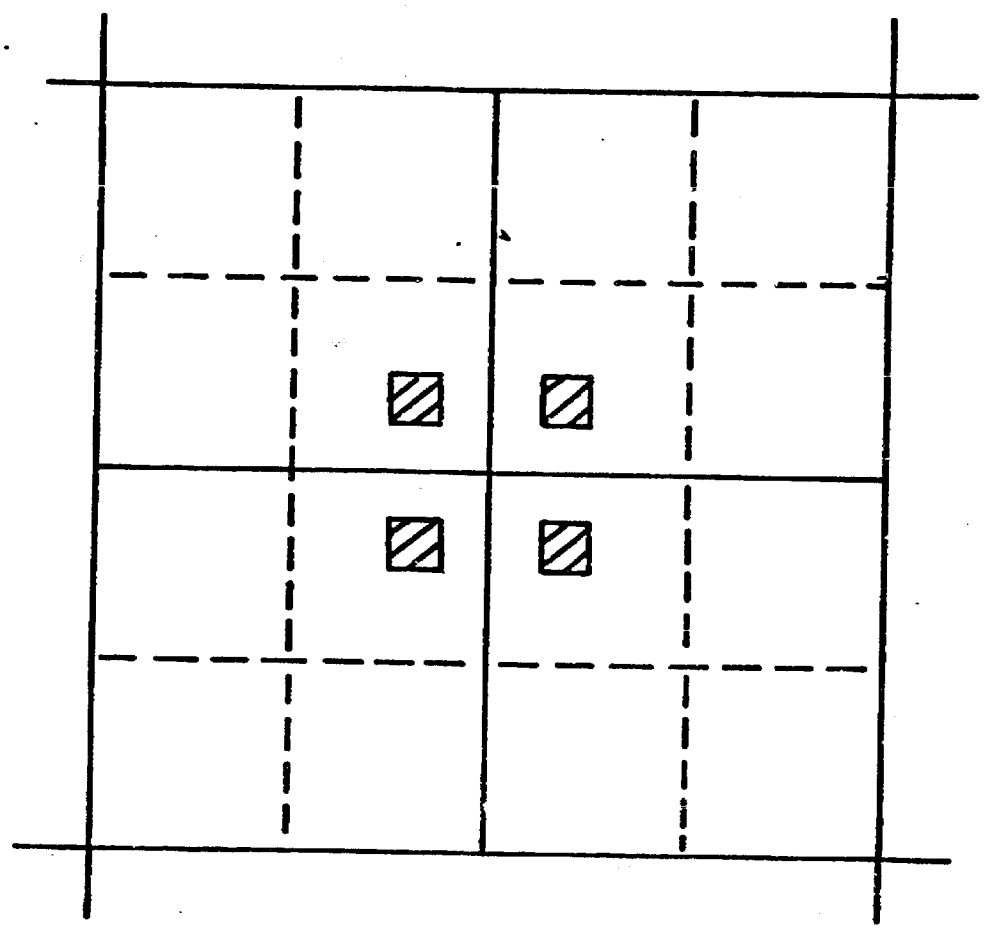
Scale

BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
Case No. 7198 Exhibit No. 6
Submitted by Amoco
Hearing Date 3-18-81

Bravo Dome CO_2 Gas Unit

640 Ac. Spacing

Well Locations: 1980'/330'

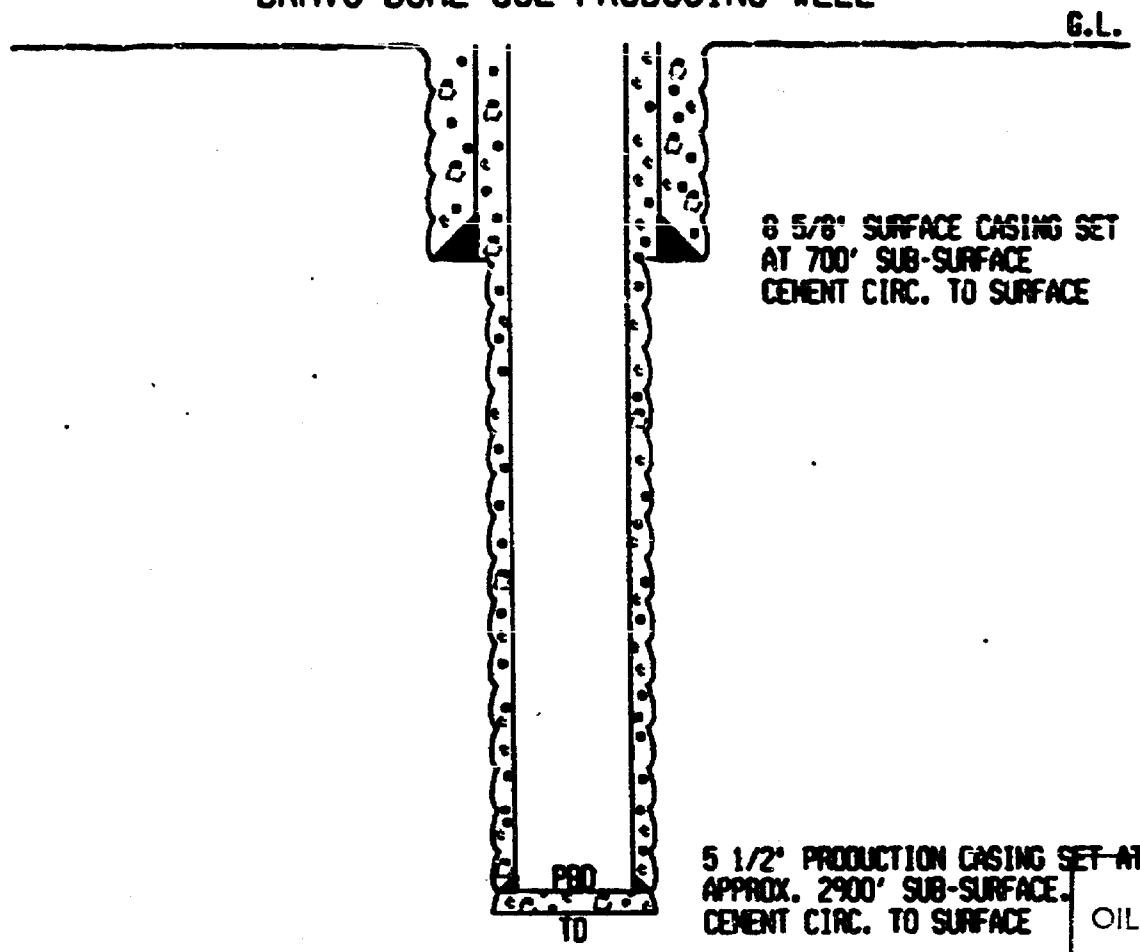


660' 1320' 2640' 3960' 5280'

Scale

BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
Case No. 7198 Exhibit No. 5
Submitted by Amoco
Hearing Date 3-18-81

TYPICAL CASING AND CEMENTING PROGRAM
BRAVO DOME CO2 PRODUCING WELL



BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
Case No. 7198 Exhibit No. 2
Submitted by Amoco
Hearing Date 3-18-81

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION
STATE LAND OFFICE BLDG.
SANTA FE, NEW MEXICO
18 March 1981

COMMISSION HEARING

IN THE MATTER OF:

Application of Amoco Production Company for temporary special pool rules, Union, Harding, and Quay Counties, New Mexico.

CASE 7198

BEFORE: Commissioner Ramey
Commissioner Arnold

TRANSCRIPT OF HEARING

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MR. RAMEY: The hearing will come to order.

Call Case 7193.

MR. PADILLA: Application of Amoco Production Company for temporary special rules, Union, Harding, and Quay Counties, New Mexico.

MR. RAMEY: Ask for appearances at this time.

MR. CARR: May it please the Commission, my name is William F. Carr, of the law firm Campbell, Byrd, and Black, P. A., in Santa Fe, New Mexico, appearing on behalf of Amoco Production Company.

I am appearing in association with Guy Buell, of the law firm Scott, Douglass, & Keeton, Austin, Texas, and Mr. Clyde Mote, with Amoco Production Company in Houston.

MR. COFFIELD: Conrad Coffield, with the Hinkle Law Firm of Midland, Texas, appearing on behalf of protestants, Amerigas and Schwartz Carbonic.

Appearing with me will be Mr. Walter Healy, General Counsel for the two corporations mentioned.

MR. KELLAHIN: I'm Tom Kellahin of Santa Fe, New Mexico, appearing on behalf of Cities Service Company and Amerada Hess in support of the application.

MR. RAMEY: Any other appearances?

I would ask that all witnesses stand at this time and be sworn.

(Witnesses sworn.)

MR. RAMEY: Mr. Buell, Mr. Carr you may proceed.

MR. BUELL: May it please the Commission I'd like to call as Amoco's first witness, Mr. Jim Allen.

MR. HEALY: I wonder if I could make a brief motion at the outset before the witness begins?

MR. RAMEY: Mr. Healy.

MR. HEALY: Amerigas learned last Friday the 13th that the spacing rules being considered today would probably affect the acreage position that they -- they have.

We have a witness who can testify today but we really haven't had sufficient time to adequately prepare testimony or bring along any exhibits.

I'd like to enter my objection for the record to the lack of notice sufficient to allow Amerigas to prepare testimony and exhibits complete enough to protect our interests, and I'd like to also make a motion to postpone the hearing or in the alternative to permit a contin-

uance of the hearing until a later date to allow for addi tional testimony or exhibits, should that be in order to protect our interests.

MR. BUELL: May I respond rather briefly?

MR. RAMEY: You may respond, Mr. Buell.

MR. BUELL: Thank you. I'd like to have identified as Amoco's Exhibit A a letter from UGI.

(The reporter marked Amoco Exhibit A for identification.)

MR. BUELL: This letter will speak for itself, may it please the Commission, but it is in response to a letter from Richard Ogden, who is with Amoco. He transmitted a copy of our letter dated February the 6th requesting this hearing before the Commission, and this letter from Mr. Manus McHugh, III, Vice President of UGI, referred to our letter of application which was transmitted to them February the 20th.

So I think they've had ample notice, both legal and constructive, to certainly prepare for this hearing.

We resist any postponement, any continuance, or any recess.

MR. HEALY: If I could respond to that exhibit and statement.

The letter that was sent to UGI refers to special pool rules that would be applied to the Bravo Dome CO Gas Unit, Union, Harding, and Quay Counties.

Now, when we first say that wording we thought it meant that it applied only to the property that was included in the unit. We have not joined the unit so that we assumed, of course, that it didn't affect our properties.

Now, Mr. McHugh's letter was an attempt to clarify that, and even today I'm not completely clear what the area to be covered by this spacing rule changes today covers and I'd like to ask Mr. Buell if he would clarify that for the record.

MR. BUELL: May it please the Commission, a careful reading of Mr. McHugh's letter will clearly indicate that he was talking about the outer boundary of a 640-acre spacing unit.

MR. HEALY: I don't believe that answers my question, though, as to what area exactly it covers; whether it's the acreage that's included in the unit, that's committed to the unit, or whether it's acreage that's bounded by the outer boundary of the unit, including acreage that hasn't been committed. That's the first question.

And the other question we have is whether the application, due to the publication that was given

to it by the Commission, covers the entire three county area. I think, if you'll refer to the docket, it says to the Bravo Dome Carbon Dioxide Gas Area without identifying the acreage. And that could presumably include the entire Bravo Dome Field.

MR. BUELL: Are you through?

MR. HEALY: Yes.

MR. BUELL: May it please the Commissioners, our Exhibit A simply shows that they knew at an early, early date that a hearing had been requested.

The official docket notice was published within the prescribed statutory time for notice. So certainly, UGI had notice that the hearing had been requested. They had legal statutory notice of the way the Commission had docketed it, so I again urge that we continue this hearing, and no recess, no postponement, no continuance, that we start and finish it here today.

MR. RAMEY: Mr. Healy, it appears that you have had sufficient notice, both through the letter from Amoco and through the legal procedures of the Commission and Division. So your motion for continuance is denied.

MR. HEALY: Fine. I'd like to enter my objection to that point for the record -- in the record for appeal.

JAMES C. ALLEN

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

DIRECT EXAMINATION

BY MR. BUELL:

Q. Mr. Allen, would you state your complete name, by whom you're employed, in what capacity, and in what location, please?

A. Yes, sir. My name is James C. Allen. I'm a Senior Petroleum Engineering Supervisor with Amoco Production Company in Houston, Texas.

Q. Have you testified at prior hearings before this Commission and are your qualifications as a petroleum engineer a matter of public record?

A. Yes, sir.

MR. BUELL: Does the Commission consider Mr. Allen qualified?

MR. RAMEY: Yes, sir.

Q. Mr. Allen, in connection with your testimony here today I direct your attention to what has been identified as Amoco's Exhibit Number One.

A. Amoco's Exhibit Number One is a map of the Bravo Dome Carbon Dioxide Gas Unit area.

MR. BUELL: Off the record, please, Mrs. Boyd.

(Thereupon a discussion was had off the record.)

Q Mr. Allen, how have you identified the outer boundary of the Brave Dome Unit?

A The outer boundary is identified by a heavy black line.

Q All right, sir. We're going to recommend certain operating rules here today on a temporary basis. What is your recommendation to this Commission as to the area which will be guided and governed by these temporary rules that we're recommending?

A My recommendation is that these rules apply to all the area within the outer boundary of the Bravo Dome Carbon Dioxide Unit.

Q That would include all the windows within the unit, acreage that is not committed to the unit, that is clearly reflected by Exhibit Number One?

A Yes, sir.

Q All right, sir, let's go now to the operating rules that you're recommending. Do you have a

recommendation as to surface casing?

A. Yes, sir I do. The recommendation on surface casing is identical really, to the statewide rule in that we will set sufficient surface casing to protect all fresh water zones and cement will be circulated to the surface.

Q. All right sir, in that connection now I wish you'ld direct your attention to what has been identified as Amoco's Exhibit Number Two. What is Exhibit Number Two?

A. Exhibit Number Two is a typical and cementing program for an Amoco well in the Bravo Dome Carbon Dioxide Unit.

If you'll notice, in this example we show surface casing at 700 feet. We're not requesting a depth per se, but this is the program which Amoco is using at this time.

Q. Mr. Allen, do you have an extra copy of your Exhibit Number Two? I've misplaced mine.

A. I think they're in my briefcase.

Q. Thank you, Mr. Allen, I now have a copy of Exhibit Two.

I believe you made it clear that while this schematic diagram reflected on Exhibit Two shows 700

feet of surface casing, we're not recommending that that be incorporated in any kind of a surface casing rule?

A. No, sir.

Q. Has Amoco, based on a rather area-wide study concentrated in our areas of development, determined that 700 feet will in all probability protect all fresh subsurface water in areas where we're actively drilling?

A. Yes, sir, we have.

Q. And that's the reason that you show that 700 feet of surface on Exhibit Two?

A. Yes, sir, and also this is what we submit on our forms for application to drill.

Q. All right, sir, and you're recommending that this operating rule for surface casing have cement circulated to the surface?

A. Yes, sir.

Q. Do you have a recommendation to make about production string?

A. Yes, sir, I do. And again, this is reflected in our application for permit to drill, is that the production casing will be set through the Tubb formation in almost all cases and cement will be circulated back to at least the surface casing, or back into the surface casing.

Q All right, sir, do you have any other comments on Exhibit Two?

A Well, I could point out that this exhibit does show that cement on the production casing is circulated back to surface. In most of the wells which we have drilled on our current program, to my knowledge, essentially all the wells except maybe one or two have circulated back to surface.

Q All right, turn your attention now to what has been identified as Exhibit Three. Is that a schematic diagram similar to Exhibit Two that simply shows that in this case it was impossible to obtain circulation of cement to the surface?

A Yes, sir, that is correct.

Q What do you recommend as an operating rule in the event an operator is unable to obtain circulation on his production string back to the surface of the earth?

A I recommend that the top of the cement behind the production string be determined by either a temperature survey or some other suitable tool. We would recommend a temperature survey, and that it be furnished the conservation board.

Q So the Conservation Commission, or Division, as the case may be, will also have -- always have in its files the top of the cement behind the production

string.

A. Yes, sir.

Q. All right, sir, do you have a recommendation to make, kind of an optional recommendation, that on the Form C-103 of the Commission that if the Commission so desires, the cementing company that does the cementing can sign the form C-103 rather than a company or operator representative?

A. Yes, sir. The current procedure in filing the 103 shows the cementing and casing program. At the present time the producing company signs the Form C-103. If the Commission so desires, we would suggest that this be modified that when a 103 is submitted for the casing and cementing program, that it be signed by the cementing company.

Q. All right, sir, do you have any other operating rule that you're recommending to be incorporated into our temporary order?

A. Not regards casing and cementing, no, sir.

Q. So we're through with casing.

What about -- do you have any recommendation to make with regard to administrative approval to the injection of CO_2?

A. Yes, sir. I do. Amoco intends to run -- or anticipates running several long term flow tests within the Bravo Dome Unit between this time and prior to sales from the Brave Dome Unit to pipeline. We would like to have incorporated into these rules authority for the Division to grant administrative approval to inject carbon dioxide for test purposes only.

Q. The primary purpose will be to test the different surface facilities, and that's the reason we'll conduct these injection programs. Is it possible to conduct an interference test in conjunction with the injection of CO_2, the primary purpose would be to test surface facilities, and will we also incorporated that if it is possible?

A. Yes, sir, we will. It will also give us the opportunity to evaluate long term well deliverability, stimulation techniques, and this sort of thing.

Q. All right, sir, in conjunction with the injection of CO_2, will you turn your attention now to what has been marked and identified as our -- Amoco's Exhibit Number Four? What is that exhibit?

A. Exhibit Number Four is a schematic wellbore diagram. If you'll notice, it's essentially the same as Exhibit Number Two, except I have incorporated the production tubing which will be set on a packer immediately

above the perforated interval.

Q. All right, sir, is there any reason why a well that has been used as an injection well for CO_2 for the testing purposes you mentioned could not be converted and the flow reversed and it become a producing well?

A. No, sir, in fact we'd probably do that.

Q. Although Exhibit Four is labeled a schematic diagram of the mechanical equipment in an injection well, is that also Amoco's plan for completing our producing wells?

A. Yes, sir, it is.

Q. Will you describe that? We'll set a packer immediately above the perforations, as I see this exhibit, and produce CO_2 through the tubing?

A. Yes, sir. In addition, we will load the back side of the tubing with inhibited fluid and that will be monitored for any possible casing or tubing leaks.

Q. So while this is labeled a typical wellbore sketch of an injection well, it's also typical of the way we will complete our producing wells.

A. Yes, sir.

Q. Do you have any more comments on Exhibit Four?

A. No, sir.

Q. All right, sir, I believe this case as docketed, it's going to be our recommendation that spacing units of 640 acres be adopted by the Commission for the area within the outer boundaries of the Bravo Dome Unit.

A. That is correct.

Q. Let me direct your attention to what has been identified as Amoco's Exhibit Five. What is Exhibit Five?

A. Exhibit Number Five shows the orthodox well locations which would be permitted under a location pattern of 1980 feet from the outer boundary and 330 feet from any quarter quarter section.

Q. Is that a rather rigid well spacing pattern in your opinion, Mr. Allen?

A. Yes sir, it is rather rigid.

Q. The areas, as reflected by this exhibit, all tend to be almost in the center of a 640-acre spacing unit. Is my observation correct?

A. They'll be located essentially in the center 160 acres of the 640, yes, sir.

Q. All right, sir, turn your attention now to what has been identified as Amoco's Exhibit Six. What is that exhibit?

A. This is the same type of exhibit, showing

the orthodox locations for wells with well locations being 1650 feet from the outer boundary, 330 feet from the quarter quarter sections, and these are rules which I believe are now applicable in the Indian Basin Field.

Q. This is the more recent well spacing pattern for a 640-acre spacing unit that has been adopted by this Commission, is that correct?

A. On 640, yes, sir.

Q. Yes. Yes. Is some of the terrain within the outer boundaries of the Bravo Dome Unit rather rough terrain, so to speak?

A. Yes, sir.

Q. Which one of these spacing patterns, well spacing patterns, as reflected by Exhibit Five and Six, do you recommend be adopted by the Commission?

A. I'd recommend number -- Exhibit Number Six. It allows more flexibility in locating the wells. It would probably also allow us to utilize existing roads somewhat better than more rigid, and I think it would also reduce the number of unorthodox locations due to topo reasons.

Q. Is it Amoco's policy in the areas of the Bravo Dome Unit which we're developing to utilize the existing roads to the maximum possible extent?

A. Yes, sir.

Q And the spacing pattern, well spacing pattern represented by Exhibit Six would give us more opportunity to utilize existing roads?

A Yes, sir, it would.

Q Mr. Allen, do you have anything to add to your testimony: any questions that I have overlooked asking you?

A No, sir.

MR. BUELL: May it please the Commission, that concludes my direct of Mr. Allen. I tender him for cross examination at this time.

MR. RAMEY: Thank you, Mr. Buell. Any questions of Mr. Allen?

MR. HEALY: Yes.

MR. RAMEY: Mr. Healy.

CROSS EXAMINATION

BY MR. HEALY:

Q On the question of casing and cementing, is a temperature survey required in all cases?

A I don't believe it is required, no, sir. We routinely run when we cement a well and cement does not circulate to surface.

Q Then a temperature survey wouldn't be

required if cement circulated to the surface.

A. That's correct it would not be required.

Q. Then on the question of injection well conversion, is a packer required in all cases?

A. I believe the rule for injection wells normally does require a packer. I could be mistaken in that, but we do plan to run a packer.

Q. Does that imply that packers would be required in all producing wells?

A. In this case, Mr. Healy, I did not specify including a packer rule in our application. All I was showing the Commission was the manner in which we would equip our injection wells.

Q. And on the question of spacing, I just wanted to be clear, you've commented on the recommended pattern for the spacing of wells in 640-acre spacing, if adopted, is that correct?

A. Yes, sir, the last two exhibits.

Q. But you haven't commented on whether 640-acre spacing is warrented by any evidence as better than 1640-acre spacing.

A. Mr. Healy, I did recommend 640-acre spacing, the reason being that it will provide for a more uniform and orderly development within the Bravo Dome Unit

area.

Q. I'm sorry, I didn't hear that recommendation in your direct testimony.

Could you amplify the reasons for recommending the 640-acre spacing?

A. Yes, sir. The primary reason is to provide for an orderly and uniform development within the area. 640-acres would certainly do that. In addition, I think it would add incentive to more -- to accelerate wider drilling within that area.

Q. Do you think it would prevent waste and permit recovery of the maximum amount of CO_2 out of the field?

A. Yes, sir, I do. By utilizing a 640-acre spacing initially I think we can assure that unnecessary wells will not be drilled.

Q. Can you explain or expand on your data that led you to those conclusions?

A. Primarily the geological data which has been presented at previous hearings. It showed the probability that we can drain 640 is there.

Q. I'd like to clarify for the record whether we're incorporating material in previous hearings. I was under the impression that we were going to treat this as a fresh consideration of the whole subject and look at --

consider documentary testimony -- evidence by way of exhibits, as well as complete testimony for the record as to whether or not spacing is proper or not.

MR. RAMEY: Mr. Healy, there has been no request for incorporation of any testimony from any previous hearings today.

MR. HEALY: Thank you.

MR. RAMEY: I personally think you're asking Mr. Allen questions that he hadn't testified to.

MR. HEALY: I don't believe he testified to that on direct. I was just trying to establish that --

MR. RAMEY: Perhaps he shouldn't answer or perhaps his counsel should make some kind of a statement. Mr. Buell?

MR. BUELL: May it please the Commission, the Commission can consider anything in this record from the previous hearings with regard to this hearing without any specific motion for incorporation being made. I have no objection to incorporating any record that Amoco has made relating to Bravo Dome specifically into this case.

MR. HEALY: I have no objection either. I'd like to repeat my earlier comments on that testimony, that I believe it's insufficient to establish 640-acre spacing as proper, particularly with regard to prevention of waste.

MR. BUELL: May it please the Commission, frankly I don't understand Mr. Healy's area of concern. Could you elaborate, Mr. Healy? Maybe I'm just having difficulty understanding.

MR. HEALY: Well, the basic question on this spacing issue is whether 640-acre spacing per well is the best method of recovering the maximum amounts of CO_2 out of the Bravo Field economically.

Our position is that it is not; that 160-acre spacing, based on our own experience in our corner of the field, is the most that we should consider by way of spacing. and if we go to 640-acre spacing, there's a possibility and even stronger, likelihood, that we will not recover all the CO_2 that's in the field when we go back and infill drill later on, and we have -- we have a witness here who will expand on that point. I don't want to testify myself, but I think Mr. Buell knows my position from the last hearing, and up to this point I haven't heard anything to change our position, and that's why I was trying to have the witness explain his recommendation, which, as I say, I don't think there's any record by direct testimony.

MR. RAMEY: I don't think Mr. Buell asked him to make any recommendation as to 640-acre spacing. I think he was just covering the rules.

And I assume, Mr. Buell, you will have more witnesses to go into the merits of 640-acre spacing.

MR. BUELL: Yes, sir, I certainly will, Mr. Ramey, and I would suggest if Mr. Healy has evidence that one well would only effectively and efficiently drain 160 acres, that he should present it in opposition to our case for 640-acre spacing.

MR. HEALY: Absolutely. My original question to the witness was to make it clear that he hadn't recommended anything about the merits of 640 acre spacing.

MR. RAMEY: Well, I think your -- I think your questions to Mr. Allen are a little premature on -- or on a subject that he hasn't covered in his testimony. And I think this will probably be covered by the next two witnesses, perhaps.

MR. HEALY: Fine. What I have established is that he hasn't commented on the merits of the change, just the spacing matter.

MR. RAMEY: Any other questions of Mr. Allen? Mr. Nutter?

QUESTIONS BY MR. NUTTER:

Q Mr. Allen, now you propose that these rules would be applicable to the Bravo Dome Unit area. Now

there are lands within that unit area, as outlined on your Exhibit A, there, that are not committed to the unit, are there not?

A. Yes, sir, I believe that I actually testified that we wanted these rules to apply to all area within the outer boundary of the unit, so those windows --

Q. Whether they were committed or not?

A. Yes, sir.

Q. Okay. Now there are wells within that unit area that have been drilled on lands, that have lands dedicated to them, of less than 640 acres, are there not?

A. Yes, sir, there are.

Q. Now, the statutes of the State of New Mexico provide that carbon dioxide production would be treated in the same manner by this Commission and Division as natural gas, or hydrocarbon gas production. I presume that would include rateable take.

Now, what provision have you made in your proposed rules for rateable take on those wells that had less than 640 acres dedicated to them?

MR. BUELL: May it please the Commission, that's not an engineering question. I'll answer it if it's a legal question.

There's no provision that the rules we

are recommending are for ratable take, that are in the statutes of New Mexico and the New Mexico Oil Conservation Commission or Division rules.

MR. NUTTER: Well, I'm wondering what provision your rules are making, Mr. Buell, whether they're making any provision for rateable take and the protection of correlative rights, or if you're just going to overlook that question in the proposed rules.

MR. BUELL: May it please the Commission we have not overlooked that question. That question arises automatically out of the existing statutes and the Division and New Mexico conservation rules.

There are many gas pools and gas areas in New Mexico that are not prorated. Rateable take comes into the picture after a pool or an area is prorated.

The recommended rules we're making here today will not affect the existing wells, topside or bottom, from a standpoint of their production, from the standpoint of the acreage that is currently assigned to them, whether it's 40 acres or 160 acres.

MR. NUTTER: I beg to differ with you, Mr. Buell, because rateable take has nothing to do with proration. Rateable take is rateable take. Prorationing is limiting production to market demand.

MR. BUELL: Prorationing is also the mechanism that this Commission uses to enforce rateable take.

MR. NUTTER: Again I beg to differ with you, Mr. Buell, because the Commission on numerous occasions in the past has issued rateable take orders in the absence of proration orders.

MR. BUELL: All right, I'll say this, Mr. Nutter, to shorten this, if any operator within the outer boundaries of the Bravo Dome Unit feels that he is being subjected to unrateable take, then I would suggest that he come in, the example that you mentioned, Mr. Nutter, and apply for rateable take order.

MR. NUTTER: But presumably an operator who has a 40-acre tract dedicated to a well within the unit boundary would be limited to 1/16th of the production of a well on a 640-acre unit if rateable take were enforced, is that correct?

MR. BUELL: No, Mr. Nutter, that is not correct.

MR. NUTTER: What would he be limited to?

MR. BUELL: He'll be limited to the amount of CO_2 that he can deliver and sell, just like a natural gas well.

MR. NUTTER: And under rateable take that would be on an acreage basis per unit, wouldn't it?

MR. BUELL: If the Commission would decide that it took an acreage basis for rateable take, yes.

MR. NUTTER: Okay, we'll leave this for a minute.

Q Now, Mr. Allen, there have been no defined limits to any gas pool in the Bravo Dome Unit area or in the adjoining gas production areas, have there?

A Not to my knowledge.

Q Now is there any reason to believe that any pool is -- the productive limits of any pool are going to stop at the outer boundary of the unit area, although some of those pools probably extend into the unit area and outside the unit area?

A Mr. Nutter, I don't think that the productive limits have been completely rigidly defined in this area. This is one of the reasons for a temporary request rather than permanent rules.

Q As a matter of fact, the known productive area, particularly on the southwest side of the Bravo Dome Unit area, extends beyond the unit boundary, is that correct?

A Yes, sir, there are some wells over there outside the unit area.

Q So assuming that that would be one common source of supply within the unit area and outside the unit area, you're proposing two different spacing patterns for the same pool, is that correct?

A The wells outside the outer boundary would be a different rule than we're requesting for the inner boundary. That is correct. However, rights would be protected by the unit drilling whatever wells necessary to protect those correlative rights in those areas.

Q Do you know of any cases where the Commission has established two separate spacing patterns for a given pool?

A Mr. Nutter, I know of some field that butt up against each other where spacing is 320 in one section and 160 on another. I can think of at least one field where the interior is on 160's and the wells around it are on 320's, yes, sir.

Q But do you know of any cases where the Commission has two separate spacing patterns for any given pool?

A For a given pool, no, sir.

Q So we would have under your proposal there, we would have 640 acres in the unit portion of a pool and 160 acres for the non-unitized portion of a pool, is

that correct? Under your proposed rules.

A. The 640-acre, which we propose in our rules, apply to the Bravo Dome Unit Gas Area. We may find that there may be more than one common source of supply within it as we develop it, in which case special field rules such as could be adopted for the interior wells now existing, could be applied for a hearing, and notice of said hearing.

Q. I'm not talking about the pools inside the unit area. I'm talking about the pools that cross the unit boundary. You'd have 160-acre spacing on the outside and 640-acre spacing on the inside of the unit, is that correct?

A. Initially that would be the case: however again I mention that along, particularly, the west line, that wells necessary to protect correlative rights would be drilled.

And again I point out that our rules do not tie us to only one well in 640 acres.

Q. Mr. Allen, I grant you that your application was for 640-acre spacing rules in the Bravo Dome Unit area, and I prepared the legal notice for this case and made it apply to the Bravo Dome gas producing area, because of that very fact that there are pools that are going to cross the unit boundary, and that would be in

violation of past Commission policy to create pool rules of one spacing size for one pool and another spacing size for the other part, and knowing full well that some of those pools are going to cross the unit boundary is the reason that that advertisement of this case was prepared in the manner that it was.

MR. NUTTER: I believe that's all the questions I have of Mr. Allen.

MR. RAMEY: Any other questions of Mr. Allen? Mr. Stamets.

QUESTIONS BY MR. STAMETS:

Q. Mr. Allen, did I understand you correctly to say that the surface casing rules are essentially identical to the statewide rules?

A. Mr. Stamets, as I recall Rule, I think it's 107, I think it's required to circulate cement back on the surface casing, and that casing be set to sufficient depth to protect fresh water. Our intent is to see that surface casing is set to a sufficient depth to protect all known fresh water sands and that the cement be circulated to the surface.

Q. So the Commission wouldn't have to rewrite that rule --

A No, sir, they would not.

Q You also suggested that the cementing company could sign the 103. If the Commission decided not to do that, would you have any objection to a separate form being designed for the cementing company to sign relative to their operations, which would be submitted with the 103?

A I would have no objection at all, Mr. Stamets. The reason for utilizing the 103 was in an attempt to just not add another sheet of paper for the Commission to handle.

Q Then you discussed injection of CO_2 for test purposes. Under those conditions, would that CO_2 be a dry stream? Would there be any liquids associated with it or would you only inject dry CO_2 gas?

A Injection which we plan to do the injection here would be dry CO_2, after dehydration.

Q And what time period are you looking at for the length of this type of test?

A We haven't really specified any time period. In fact, at this moment I don't know whether we've actually picked a site where we want to run an injection -- or a long term flow test.

I would assume, though, that in the case we'd be looking at a period in excess of six months.

Q. And --

A. It could be as long as a year.

Q. Six to twelve months, then? Mr. Allen, are you familiar with the -- what's called the Southeast Chaves-Queen Gas Area?

A. I am familiar that there is one there, Mr. Stamets. I have not familiarized myself in detail with it.

Q. Is that an area with special pool rules that doesn't bear a pool definition in itself?

A. I don't recall that -- that it does. It may.

Q. Well, let me suggest to the Commission that they may want to review that. I believe that that's what the record will shows there.

How about the Basin Dakota pool rules? Are you familiar with those?

A. No, sir, I'm not.

Q. I would suggest that perhaps that's another area the Commission might want to look at to see a situation where one set of rules could exist, and if something is discovered that's different later, different rules could be applied within the same horizontal boundaries.

Do you have any idea at this time how

many wells exist within the boundaries of the -- of the unit, which wells are not Amoco wells, and which wells are on 160-acre spacing?

A. Mr. Stamets, I don't know whether all the wells -- to the best of my knowledge this map shows all the wells that exist, and I believe within the Libby area there's -- we showed seven wells. Whether they have dedicated 160 acres to each one, or not, I assume that they have.

Also --

Q. The Libby area, could you define that somehow?

A. Yes, sir, the area I'm speaking of is located in Township 20 North, Range 31 East, southwest portion of that township.

Q. The wells in there have names like Schwartz 1-X, DeBaca 1, DeBaca 2 and so on?

A. Yes, sir.

Q. Okay.

A. The number of wells within the unit area, I believe we have approximately about 111 at this -- at this time.

Q. Those are all under Amoco's authority and dedicating 640 would be no problem, is that correct?

A. That is -- that is correct. I think

that number does include the wells which were drilled for our interference testing, and which, of course, were 660 feet apart, so we would have some problems there.

Q. Now, in response to Mr. Nutter's questioning, I thought I heard you say this, and if you didn't, would you please let me know.

I think I heard you say that this would be an area with special rules, but if there were pools clearly defined within this area, there would be no -- and perhaps even crossing the line -- you would see no reason why pool rules could not be adopted for those individual pools which would be different from the Bravo Dome rules?

A. I see no reason at all. In fact, that was the way I foresee this, that if areas do develop where the 640 is not applicable, after notice and hearing, special rules could be adopted for that specific area.

MR. STAMETS: That's all.

MR. RAMEY: Mr. Ulvog?

QUESTIONS BY MR. ULVOG:

Q. Mr. Allen, I realize that you're talking here about just temporary pool rules, but quite often temporary pool rules become permanent, so I think it's pertinent to find out a couple of things.

For instance, what would your disposition be of produced water?

A. Mr. Ulvog, to my knowledge at this time, I guess we'd have to haul it or use an evaporation pit. When we have sufficient water that has to be disposed of, I would recommend that we would probably try to drill a disposal well and would comply with what the rules are of the Commission for that purpose.

Q. Would this apply to the entire unit area then? Would this be -- would this be part of your recommendation for pool rules, that this be incorporated in there and that it apply to all of the producing area that you intend to --

A. I'm not recommending that we specifically write it into it. I believe the statewide rules cover that pretty well.

Q. And now with respect to the - some type of bond log, temperature survey, and so on, to determine where your top of cement is when it's not circulated, or you get a tieback on the production casing to the surface, does this also apply to all wells within the unit area?

A. I would recommend that, yes, sir.

MR. ULVOG: All right.

MR. RAMEY: Mr. Padilla.

QUESTIONS BY MR. PADILLA:

Q. Mr. Allen, has Amoco run any new flow tests or interference tests since the last 640-acre application?

A. Did you say flow tests or interference tests?

Q. Either.

A. I don't believe we have, other than just the completion testing for a few days but not -- not any interference test, per se.

Q. In other words, since the last hearing on 640-acres for this area, 640-acre spacing for this area, you have not made any additional testing to -- as far as interference tests or flow tests?

A. Not interference tests, no, sir, flow tests.

Q. Have you done any other type of testing to determine drainage?

A. Mr. Padilla, I don't think that we can, as we said before, can actually determine the -- we feel that the opportunity, and the probability, that we can drain 640 does exist, which I think our subsequent witnesses will show, but to actually see interference on a 640-acre

basis would take production, which, of course, we have no outlet at this time.

So we do need to establish production for a significant length of time to actually see what I would think would be a meaningful interference test under 640-acre spacing.

Q. I think what you just told me was that you haven't done anything as far as drainage testing.

A. That was actually running tests, that is correct, to my knowledge.

MR. PADILLA: I have nothing else.

MR. RAMEY: Do you have a question, Mr. Buell?

MR. BUELL: I have one question on re-direct, Mr. Ramey.

REDIRECT EXAMINATION

BY MR. BUELL:

Q. Mr. Allen, I failed to ask you, I think you covered it in your cross examination, but for the record to be clear, you're not recommending that our order prohibit the drilling of more than one well to a 640-acre spacing?

A. No, sir, I'm not.

Q. And any well that could be located on

a 640-acre spacing unit within the purview of the well spacing pattern that this Commission adopts in their order, could be drilled by an operator simply by applying for a permit to drill a well and drilling it at a permitted, orthodox location?

A. Yes, sir.

MR. BUELL: That's all I have, may it please the Commission.

I would like to formally offer our exhibits, Exhibits One through Six, inclusive.

MR. RAMEY: And Exhibit A, also? Are you offering that?

MR. BUELL: Exhibit A also. I forgot Exhibit A.

MR. RAMEY Okay, Amoco's Exhibits A, and Exhibits One through Six, will be admitted.

MR. HEALY: May I ask another question on recross in response to the redirect?

MR. RAMEY: Certainly.

RECROSS EXAMINATION

BY MR. HEALY:

Q. Is there any penalty that can flow from asking for a permit to drill an additional well that's not

permitted by the temporary spacing rule on a 640-acre basis?

A. We are speaking now about, say, a second or third well on a 640-acre spacing unit?

Q. Right.

A. At this time there would be none unless proration were established. There would be no penalty.

Q. Then it's possible that prorationing -- that there could be prorationing that would limit the production?

A. It's possible, that should the deliverability far exceed the market that could occur.

MR. RAMEY: Any other questions? Mr. Allen, you may be excused.

MR. RAMEY: Let's have a fifteen minute recess.

(Thereupon a recess was taken.)

MR. RAMEY: Are you ready to press upward and onward, Mr. Buell?

The hearing will come to order.

MR. BUELL: We'd like to call next, Mr. Commissioner, Mr. May.

BRUCE I. MAY

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

DIRECT EXAMINATION

BY MR. BUELL:

Q. Mr. May, would you state your complete name, by whom you're employed, in what capacity, and what location, please?

A. My name is Bruce I. May. I'm employed by Amoco Production Company as a petroleum geologist. Houston, Texas.

Q. Have you testified at prior Commission hearings and hare your qualifications as a petroleum geologist a matter of public record?

A. Yes, they are.

MR. BUELL: Are there any questions as to Mr. May's qualifications as a petroleum geologist?

MR. RAMEY: No questions, Mr. Buell. He is considered qualified.

Q. Mr. May, by way of background, when were you first given the geological assignment to work in the Bravo Dome CO_2 area?

A. August of 1979.

Q. Since that time have you continued to study and geologically work the Bravo Dome area?

A. Yes, I have.

Q. Approximately how much of your time have you spent since August of 1979 just working the Bravo Dome area?

A. 100 percent.

Q. 100 percent of your time. Do you recall when you were given the assignment in August of 1979 approximately how many wells, date from which you had to make a geological study?

A. Yes, approximately 42 wells.

Q. How many wells, approximately, do we have at this time?

A. I believe we have, let's see, 111 over 111.

Q. Over 100 percent increase from a standpoint of well data alone.

A. That's correct.

Q. All right, sir. In your continuing studies, were you given the assignment to undertake a study to improve Amoco's well completion techniques?

A. Yes, I was.

Q. Approximately what date did you undertake that study?

A. I undertook it approximately August of 1980.

Q. At the time that you undertook that study there was no contemplation that the work you were doing in that connection would ever be used for a spacing hearing like this one today?

A. No, it was not.

Q. Have a lot of the exhibits that you will present, your geological exhibits, they were prepared strictly in connection with that study and not specifically for this hearing today.

A. That's correct.

Q. And some of your geological exhibits were prepared specifically for this hearing, is that correct?

A. That's correct, also.

Q. All right, we'll try to point those out as we go along.

What was your study to improve our completion technique, what did it primarily consist of, just in a general fashion, Mr. May?

A. Well, the study was primarily looking at the core data that we had collected from approximately 42

wells, 41 wells, to be exact; core data, plus the density logs that we had from those wells; taking that data, cross-plotting that data to adjust it to a calibrated porosity, and then in turn using the core data and the permeability measured in the core data to generate gamma ray permeability depth plots.

Q. Would it be a fair summary to state that the objective of your study was to make sure that Amoco was exposing in their completion of CO_2 wells the maximum possible amount of pay?

A. Yes, that's true.

Q. Is there any way you geologists and engineers can factually determine permeability in a rock other than purported?

A. No, there is not.

Q. In the geological and engineering professions, primarily geological, is there a scientific technique available to you where you can relate not only porosity obtained from a core, but permeability obtained from a core to an electric log?

A. Yes, there is, using a cross-plotting technique of density porosity and the core porosity, and the core porosity versus the permeability, we can determine permeability from a density log.

Q. Would that be measured, technical, or scientific tool you were using in your study to assure that in our completion we were exposing all possible pay, CO_2 pay, to the wellbore?

A. Yes.

Q. All right, sir, in connection with that technique, let me direct your attention to what has been identified as Amoco's Exhibit Number Seven. I'm going to ask you to come over to where it's hanging on the wall, and since you're moving away from the reporter, I'm going to ask you to speak up distinctly and project. Also, unfortunately, you're going to have your back to both the reporter and the Commission, so you'll really have to project.

A. Okay.

Q. Is Exhibit Seven a graphical presentation, a pictorial presentation of the cross plotting techniques that you used in making your completion study?

A. Yes, it is.

Q. All right. It appears to be divided into two parts. The upper portion has a broad, general heading of Calibration Technique, and the bottom part of it has a series of graphs and plots and insert map.

Let's start first on the upper portion. What is the first item on the lefthand side of the upper

portion of Exhibit Number Seven?

A. This side is a density porosity log based on a limestone matrix that we received from Schlumberger when they -- after we drilled the well and they logged it.

Q. Is it customary on at least the initial set of logs, or suite of logs, as some people call them, to run a log with a tool calibrated on a limestone matrix, even though you know you're logging a sandstone?

A. Yes, traditionally that has been the case.

Q. Also, do you have a simple formula or equation by which you can convert the limestone matrix to a sandstone matrix?

A. Yes.

Q. Have you made that correction on the upper portion of your Exhibit One?

A. Yes, I have. The log indicated here --

Q. By "here" you're pointing to the center log of five logs on the upper portion of Exhibit Seven?

A. That's correct. Here I've used a 2.68 sandstone matrix for the porosity, and the dark line indicated here is that porosity on a 2.68 matrix.

Q. So it's corrected on the middle log on

the upper portion of Exhibit Seven?

A. That's right.

Q. All right, let's go now to the next log to the right of the density log, and let's see, that was on Amoco's State "FI" No. 3 Well, is that right?

A. That's correct.

Q. What is your next log on the upper portion of Exhibit Number Seven?

A. This is the actual core analysis that we received from CORE Laboratories. We cored the upper portion of the Amoco State "FI" No. 3, and this is the porosity mreasured from CORE Laboratories.

Q. Now you're pointing to the characteristics, or the wiggles, on the righthand side of the CORE log, is that correct?

A. Yes, that's correct.

Q. What is on the left?

A. On the left of the depth column we have permeability that they measured at CORE Laboratories.

Q. And what's on the extreme left?

A. The extreme left is a gamma ray, which is used to shift the core data to better match the density porosity log.

Q. All right, sir. Now we need to go to

the center log on the upper portion of Exhibit Seven that we've mentioned before, or do we need to go now down to the lower portion of Exhibit Seven?

A. I might just want to point out that this dark line under this third column here --

Q. And you're pointing to the log, the middle log, the third from the left?

A. That's correct.

The solid line is the density porosity in the sandstone matrix. Also plotted here is the -- in a dashed line - is the core porosity that we received from CORE Laboratories, so you can have visual comparison of both of those.

Q. All right, sir, now let's go down to the lower portion of Exhibit Number Seven, and let's start with the graph in the lower lefthand corner. Were you working up on that graph cross plot of porosity?

A. Yes, I was. What I did was, I took the density porosi and also the core porosity from all wells that we had cored within the field, 41 cores, and cross plotted them to see a relationship between density porosity and actual core porosity.

Q. So you had available to you in making your study the density logs of 41 wells and core data from 41

wells.

A. That's correct.

Q. And directing your attention back now to the upper portion of Exhibit Seven did you go through this same procedure that we're showing on the upper portion of Exhibit Seven with respect to all 41 wells?

A. Yes, I did.

Q. All right, sir, now let's go back to the lower lefthand graph or plot on the bottom of Exhibit Seven. After you put all of these data points on from your density porosity and from your core porosity, what then did you do?

A. I drew a line through the massive area of points, indicating that there was a relationship between the core porosity and the density porosity. That line is indicated here in red.

Q. All right, sir, and the upper portion of this graph we're talking about in the lower lefthand corner of Exhibit Seven, I notice your red line, your cross plot or your median line, in the upper righthand corner goes through an area that appears to be predominantly white. Can you explain that?

A. Yes. When we Xeroxed this, this particular area is solid black. When we Xeroxed it, due to the reflections of black, it didn't come out totally dark, and

it came out a little white in that particular area, but that is a solid concentration of points.

Q. So you just had so many points in here, this area that we're talking about, that it was black and as a result of Xerox reproduction or however you produce it, instead of coming out black it came out white?

A. That's correct.

Q. All right, sir, now that was using data on 41 wells, the density logs, and the core data. It appears that you have a very wide scattering, or I might even call it a shotgun scattering, of your data points in which you had to draw your cross plot or median line. Did you do anything to confirm in your own mind that you had actually drawn your cross plot line in the proper place?

A. Yes. I took the wells with the least amount of scatter, a total of 16 wells that seemed to have -- not have the shotgun pattern, and I cross plotted those up here in --

Q. Now you say "up here", we're moving now to the graph just above the graph in the lower lefthand corner of Exhibit Seven?

A. That's correct.

And I saw this same type of straight line relationship and I felt confident that the line I'd

drawn down here was the correct line for this relationship between density porosity and core porosity.

Q. And the sixteen wells you used on your confirmation curve are listed in the righthand portion of the graph?

A. That's correct.

Q. All right. Let's go to the insert map now in the upper righthand portion of the lower portion of Exhibit Seven, and it appears to be an inset map of the outline of the unit area and you have some wells colored with the various symbols. What's the significance of that?

A. The symbols indicated in here that are colored are wells that I used in the two top cross plots, indicating that -- where I took these wells over here to confirm my line down in the lower lefthand corner, they were actually geographically distributed throughout the field and were not concentrated within one particular area.

Q. All right, sir, and then you found that using the sixteen wells with fewer scatter points, that you would draw approximately the same cross plot line in that manner as you had using all the wells.

A. That's correct.

Q. All right, we now have a cross plot of porosity, density log porosity versus core porosity. What's

the next thing that you did?

A. The next thing that I did is I took the density porosity based on a sandstone matrix, using the computer I entered it into this relationship and generated what I call a calibrated porosity.

Q. You're now pointing to the upper portion of the exhibit, the fourth log from the left?

A. That's correct.

Q. And it says it's calibrated porosity.

A. That's right.

Q. What does that show?

A. This shows the actual core calibrated porosity, the dark line, and also, dashed is the actual core porosity that we got from CORE Labs.

Q. So you can actually make a comparison here to see that if your porosity cross plot, how it compares with the porosity from the density log alone on the Amoco State "FI" No. 3?

A. That's correct.

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

A. The next thing I did is I took those 41 cores and I cross plotted the core porosity and the permeability, and again I found the relationship between the core

porosity and permeability.

Q. And then you drew your cross plot line.

A. That's correct.

Q. Really, the ultimate goal of this technique is to be able to relate permeability to the log of a well.

A. That's correct.

Q. All right, sir, now on your permeability cross plot did you find you had the same kind of a shotgun scattering of points that you had on your porosity cross plot?

A. Yes, I did find quite a few points that were a shotgun pattern.

Q. Did you make a similar study of permeability on a fewer number of wells to confirm the accuracy of your cross plot using all wells?

A. Yes. What I did is I took 13 of the best -- 13 of the wells that lacked that shotgun pattern and cross plotted core porosity versus permeability.

Q. You're now pointing to the graph immediately above the permeability cross plot on the lower portion of Exhibit Seven.

A. That's correct.

Q. And what did you do after you plotted

those points?

A. I drew a line through those points indicating that relationship using these 13 wells. I went down and compared that to what I'd drawn for the total wells, and it was good agreement.

Q. All right, sir, and again, as was the case in porosity, the wells you used on your confirmation curve are indicated by the symbols on the insert map on Exhibit Seven?

A. That's correct.

Q. And do they, as was the case in the porosity show that while you had selected these wells for a specific purpose, the fewer most scatter points, that we do have good geographical distribution throughout the entire Bravo Dome Unit area?

A. Yes, we do.

Q. All right, sir. Now, once you have your cross plot of permeability, how do you get it to an ordinary density log or electric log?

A. Okay, what -- what I did is I took the calibrated porosity here, the second -- in the second depth plot second to the right, and entered it into this relationship here.

Q. Now "here", you're pointing down to the

cross plot of permeability?

A. That's correct. And generated a permeability. We did this with the computer and as a result we generated a depth plot of the permeability in that particular well. This appears to be --

Q. Now you're now directing your attention to the last log on the right of the upper portion of Exhibit Seven.

A. Yes, that's correct.

Q. What do we depict by that log?

A. We depict the calculated permeability, which is the solid line on this depth plot on the righthand side. We also have the actual core analysis for the "FI" No. 3 that we got here from CORE Laboratories, and we plotted those on this depth column so one can visually see how this calculated permeability compares with the actual permeability from core analysis.

Q. All right, sir, now is this technique a technique that is accepted and customarily used in the industry?

A. Yes, it is.

Q. Is it a 100 percent accurate?

A. Technique? No, it is not a 100 percent accurate technique.

Q. Is it accurate enough that companies expend capital in reliance on its accuracy?

A. Yes.

Q. Is it your understanding that Amoco is going to use the work you have done to improve their completion techniques in not only future drilled wells but go back in in wells that are already completed and conform with what your geological study recommended?

A. Yes.

Q. All right, sir, do you have any other comments on Exhibit Seven?

A. No, I do not.

Q. Let's go to Exhibit Eight, which is cross section EX-EX'. Is this an exhibit that you prepared, using your completion technique study, that you prepared this exhibit specifically for this hearing?

A. That's correct. This was prepared just for this hearing.

Q. Now you'll have a subsequent number of cross section exhibits. Do they use the same format as you are using on Exhibit Eight, cross section EX-EX'?

A. Yes, they use the same format.

Q. All right, let's go through the format. Let's start with the upper portion and then work our way down

into the body of the cross section.

What format did you use on Exhibit Eight?

A. What I did is I have depth plots of calculated permeability for the three wells. Above each well I have a number which corresponds to the number of an index map on the righthand side of this cross section, indicating the distance between wells on this map. Also the distance between wells is indicated up here in between the numbers at the top of the cross section.

Q. So you have a key well number, starting with number one, and two, and three of this exhibit. In other exhibits it will be four going from left to right.

In addition to identifying the well from which the log was taken, is the normal log heading.

A. That's correct.

Q. All right, sir, now what wells did you use in this particular section?

A. I used the Amoco State No. 1 "FI"; the Amoco State No. 2 "FI"; and the Amoco No. 1 Anglin.

Q. All right, sir, looking at this exhibit I see that the two state wells are only 660 feet apart and the Anglin well is some 2-1/2 miles to the south.

A. That's correct.

Q. All right, sir, let's go back to Exhibit

Seven once more, and I'll ask you in doing your completion improvement study, what permeability cutoff did you use?

A. I used one millidarcy permeability cut-off. I felt that one millidarcy gas could flow through that permeability.

Q. So it's your geological recommendation to Amoco that any intervals that have at least permeability of one millidarcy be exposed to the well.

A. That's correct.

Q. Not only in completion but so that any stimulation techniques that follow, that interval will be subjected to stimulation?

A. That's correct.

Q. All right, sir. Now I think we're ready to go back into the body of your Exhibit Eight.

Why don't -- we followed the same format that you followed in presenting cross sections in previous Commission hearings, did we not? To bring our recollection up to date and refresh everyone's memory, what is the area across this section, left to right, directionally it would be north and south, that you've colored in blue?

A. What I've done is I've hung these cross sections on top of the Tubb, base of the Cimarron anhydrite. What you see colored in here in blue is the Cimarron anhydrite,

which is my stratigraphic marker.

Q. Is the Cimarron anhydrite the caprock that forms a trap for the CO_2 that we find in the Tubb?

A. Yes, sir, it is.

Q. All right, sir. Now, I'm going to skip down to the bottom on you, and go down to the lowest line that you have running from left to right across this section. What does that represent?

A. The line, the wavy line that is colored in brown at the base of the cross section, is the top of the Basement, labeled appropriately.

Q. All right, sir, now let's go back to the body of your section. Based on your cross plotting technique of permeability, what are you depicting on this exhibit between the Cimarron Anhydrite and the Basement rock?

A. What I'm depicting is the permeability in the section that we have perforated or above which we have a -- above a bridge plug.

So I have correlated here everything that's perforated or above which we have a bridge plug if that well had one.

Q. All right. What is the significance of the area on this exhibit below the top of the Cimarron Anhydrite that you have shaded in orange?

A. Everything that is shaded in orange has a permeability greater than one millidarcy.

Q. Now I notice there are not many on this particular exhibit but there are some intervening white streaks. What are they? Now I see that that's where you have permeability of less than one millidarcy?

A. Yes.

Q. All right, sir. As I recall, State "FI" No. 1, State "FI" No. 2, key number wells numbers one and two on this exhibit, were used in a previous short term interference test that was run. Is my memory correct?

A. Your memory is correct.

Q. The third well on your exhibit, the Anglin, it has not been involved in an interference test, is that correct?

A. No, it hasn't.

Q. What I wish you would do is compare the rock in wells one and two on this section that have in excess of one millidarcy permeability, one with the other. In other words, compare wells one and two, key wells one and two.

A. Looking at the wells one and two, we can see a great deal of section that is greater than one millidarcy permeability that is in continuity with these two wells, the "FI" 1 and 2; a great deal of the section

has permeability greater than one millidarcy.

Q So just looking at this exhibit and the rock colored orange, permeability of one millidarcy or greater, you have no difficulty in seeing the continuity between these two wells?

A. No, I don't.

Q And as I recall, all the pressure draw down, pressure interference, was experienced in those two wells.

A. Yes, it was.

Q All right, now let's go over and examine the reservoir rock in the Anglin Well, some 2-1/4 miles to the south. What do you find there?

A. Again I find a great deal of permeability of greater than one millidarcy in the section that I can correlate to the Amoco State No. 2 "FI". A great deal of section has permeabilities greater than one millidarcy.

Q Do these data indicate to you that there is a geological probability when we go from the known, I say known from the standpoint of pressure interference, to the unknown, now I'm referring to the Anglin Well, that you have continuity of reservoir rock of one millidarcy or greater, to the extent that it is a geological probability?

A. Yes, I believe it's a geological

probability that -- that the State "FI" No. 2 and the Anglin are in continuity, based on permeability.

Q. And is it clearly indicated that one well, at least in this particular area, would be able to drain a large area?

A. Yes.

Q. Let me ask you one general question before we leave Exhibit Eight.

When you were just working with logs that were available to you, density logs, on wells that were located on a linear distance miles away from each other, did you have difficulty in correlating the perforated intervals in one well to the perforated intervals in another well?

A. Yes, I did.

Q. Prior to the time that you did your cross plotting work did you have any idea that you would see the continuity of reservoir rock of one millidarcy or greater permeability as we see reflected on Exhibit Number Eight?

A. I never dreamed it would be this way.

Q. So at least on this section, and we'll get to the other sections later, you have no difficulty in correlating from one well to another well a continuing interval of one millidarcy or greater permeability?

A. That's true.

Q Do you have any other questions you'd like to -- any other testimony you'd like to add to your Exhibit Eight?

A Yes, I would like to point out that the Amoco State No. 1 "FI", what appears from the "FI" No. 1 to the "FI" No. 2, one can see a great deal of discontinuity in the log character, but again, these two wells were found to be in pressure communication.

Q We do not see that in the similarity of log character when we are working with intervals of one millidarcy or greater permeability?

A That's true.

Q All right, sir, are you ready now to go to your Exhibit Nine?

A Yes, sir.

Q I believe it is over here on the far wall and I'm going to have to ask you to really speak up clearly.

Now we won't go into the format again. We've gone through that, I think, with enough clarity for the record.

Let me ask you first to go to the insert map on Exhibit Number Nine and speak to the surface trace of this cross section.

A. This particular cross section, the well number one, which is outside the unit, is towards the northwest, and we continue on eastward across the unit. This is essentially a west-to-east cross section through the northern portion of the unit. The unit boundary is outlined here, in yellow and green.

Q. And do you also have on this insert map on Exhibit Nine, not highlighted in red, but the surface traces of other sections that run through the length and breadth of the Bravo Dome Unit?

A. Yes.

Q. Are we at an exhibit now that you prepared in connection with your completion technique and not specifically for this hearing?

A. Yes.

Q. All right, speaking to the cue numbered well No. 1, the one that's outside the unit area, is this well on the northwest side of the pinchout line that is near the northwest outer boundary of the Bravo Dome Unit?

A. This particular well, the Amoco No. 1 State "FB" is fairly close to the pinchout line of the Tubb. It still has a little section left in that well but it's rapidly thinning, to the northwest.

A. All right, let's move along to the east,

key numbered well No. 2 is within the boundaries of the Bravo Dome Unit.

A. That's correct.

Q. And then moving on to the east, almost to the eastern boundary of the Bravo Dome Unit but still inside Bravo Dome Unit, is your key well No. 5, is that correct?

A. That's correct.

Q. All right, sir, would you briefly describe the continuity of zones of one millidarcy or greater permeability that we find up in the northwest corner of our unit as we approach the porosity pinchout line?

A. Looking at the Amoco No. 1 Poling, we can see that we still have quite a bit of section greater than one millidarcy permeability.

As we go towards the northwest, we lose that permeability, and by the time we come to the Amoco No. 1 State "FB" we don't have any section with permeability greater than one millidarcy.

Q. All right, let's go over to well key No. 3, do we see a thickening of the zones that have permeability of one millidarcy or greater?

A. Yes, we do. We see an increase going from the No. 1 Poling to the No. 1 State "FF", an increase in the section that contains permeability greater than one

millidarcy.

Q. All right, sir, although in well key No. 2 the zones that you colored orange are one millidarcy permeability or greater, are more scattered.

Let me ask you this: Do you have any difficulty in correlating from key numbered well 3 back to the west zones that are permeability of one millidarcy or greater?

A. No, I don't. There are a few zones or intervals of greater than one millidarcy that are gone by the Amoco No. 1 Poling, but there are intervals of greater than one millidarcy that one could correlate between the No. 1 Poling and the No. 1 State "FF".

Q. So while we're seeing a different rock characteristic, comparing the area of Exhibit Number Eight with Exhibit Number Nine, you still find that you can correlate and that we do have continuity of zones containing permeability of one millidarcy or greater?

A. That's correct.

Q. Do you have anything else you'd care to add about Exhibit Number Nine?

A. No, I don't.

Q. All right, let's move now to what has been identified as Amoco Exhibit Number Ten, a similar cross

section, identical in format and I'll ask you to go to the insert map and describe for the record the area through the unit that this section traverses.

A. This section traverses a southeast/northwest cross section going across the unit, starting with the Amoco No. 1 State "FB" to the northwest outside the unit.

Q. Is that the well that was the number one well on Exhibit Nine?

A. That's correct. Coming down towards the southeast is the CO_2-in-Action No. 1 Kutz, which is outside the unit.

Q. All right, sir, and again from the northwest to the southeast, as we saw to a degree on Exhibit Number Nine, we see in the northwest the zones are more scattered where you have permeability of one millidarcy or greater, and let me ask you this, looking at wells numbered key numbers two, three, and four, can you still correlate even in this area wells of -- zones of permeability of one millidarcy or greater?

A. Yes.

Q. And then we see as we move to the southeast a gradual thickening and growing closer together of the areas you've colored in orange.

A. That's correct.

Q. And we're seeing on the last wells, key numbers six, seven, and eight, a situation similar to that on your Exhibit Number Eight.

A. That's correct.

Q. Do you have anything -- any additional questions you'd like to add on that?

A. No.

Q. Not questions. Any comments?

A. No, I don't.

Q. All right, let's go now to Exhibit Eleven, cross section C-C', again same format.

A. That's correct.

Q. I direct your attention to the insert map on the righthand side and would ask you to explain for the record the surface path that this section follows.

A. This particular section goes from the north to the south along the east side of the unit, starting in the north with the Amoco No. 1 State "FT" and eventually ending with the CO_2-in-Action No. 1 Kutz. It compares the north/south ends of the section.

Q. All right, sir, again in the interest of time, I'll ask you if you can correlate through the length and breadth of this section, starting on the north and going all the way over into Texas, continuity of zones with perme-

ability of one millidarcy or greater?

A. Yes, we can.

Q. Now I haven't bothered to point out, Mr. May, but on our exhibits where the well has been perforated, you show the perforations, and it's obvious from some of the work that you have done that there is additional pay in the -- some of our wells that we've already completed that needs to be exposed to the wellbore, is that correct?

A. That's correct.

Q. And this section, as was Ten and Nine, were prpared in connection with your completion technique and not for this hearing.

A. Correct.

Q. All right, you've got to walk across the hall again.

We're to Exhibit Twelve now, which is cross section D-D'. I'll ask you to go to the insert map on the righthand side and state for the record the surface path that Exhibit Twelve traverses.

A. Exhibit Twelve traverses again a north to south pattern in the central portion of the unit, starting in the north with the Amoco No. 1 State "HM" and eventually ending in the south with the Amoco No. 1 State "GX".

Q. All right, sir, and in the interest of time, I'll ask you if on this section you can correlate zones of one permeability or greater as being continuous throughout the length and breadth of the area that this cross section traverses?

A. Yes, I can correlate zones of greater than one millidarcy across this section.

Q. All right, sir, let's go now to Exhibit Thirteen, cross section E-E'. Is this an exhibit that you prepared especially for this hearing?

A. Yes, it is.

Q. And what was the purpose of preparing this exhibit?

A. This exhibit was prepared to show wells that are approximately one mile apart, approximately 640-acre set spacing.

Q. All right, sir, now I'll ask you to go to the insert map on this section, and where is our surface area that we're traversing here?

A. Our surface area here is basically an east to west cross section, starting with the Hutcherson No. 1-B and traversing in an east/west manner all the way to the Hutcherson E-1.

Q. All right, sir, and on Exhibit Twelve

do you find many zones of one millidarcy or greater permeability that you can correlate from well to well even though the wells are a mile apart? And across the length and breadth of this cross section.

A. Yes, there are many zones that can correlate across this particular cross section.

Q. These zones that you're correlating are one millidarcy permeability or greater which will certainly flow gas?

A. That's correct.

Q. All right, sir, let's go now to Exhibit Fourteen, cross section F-F'. Was it prepared specifically for this hearing?

A. Yes, it was.

Q. And again, so that you can show continuity between wells located approximately a mile apart?

A. That's correct.

Q. Go to the insert map there and state for the record the surface area traversed by this cross section.

A. Again this cross section is an east/west cross section, starting with the Hutcherson E-7 and finally ending in the east with the Hutcherson E' No. 1.

Q. All right, sir, and I'll ask you the

same question I asked on Exhibit Thirteen. Do you find many zones of one millidarcy permeability or greater that you can correlate from well to well, although the wells are nearly one mile apart, all the way across the area that this cross section traverses?

A. Yes. There are many zones we can correlate greater than one millidarcy across that particular cross section.

Q. All right, let's go now to Exhibit Fifteen, the last of your cross section exhibits, and this too was prepared specially for this hearing. I'll ask you to go to the insert map and detail the area that this section traverses.

A. This particular cross section is a north/south cross section. The northernmost well on this cross section is the Hutcherson B No. 15 and finally the southernmost well on this particular cross section is the Hutcherson B No. 13.

Q. Okay, and again do you find many zones one millidarcy or greater permeability that you can correlate from well to well, although the wells are generally about a mile apart, all the way across the area that this exhibit traverses?

A. That's correct.

Q In your opinion, based on all of the geological work that you've done, and particularly on our last three exhibits, Thirteen, Fourteen, and Fifteen, do you see a geological probability that one well in this reservoir could drain an extremely large area?

A Yes.

Q I think you can go back to the witness chair now, Mr. May.

Or maybe for cross examination purposes you might want to stay down here. I'm sure that there will be some questions relating to these exhibits.

Do you have anything else that you'd care to add to your testimony, any question that I omitted to ask?

A No, I can't think of anything.

MR. BUELL: That's all we have by way of direct for Mr. May at this time, and we tender him for cross examination.

MR. RAMEY: Any questions of Mr. May?

CROSS EXAMINATION

BY MR. HEALY:

Q Mr. May, you've presented quite an array of complex data. Let me ask you some general questions to

put it in perspective.

How many total acres are there in the unit boundary?

A. I believe there are approximately one million acres.

Q. Do you know how many townships that covers?

A. Approximately, what, forty-two.

Q. Now, the wells that were included in this study, you said that there were forty-two wells, is that correct?

A. That's correct, forty-one wells.

Q. Forty-one wells?

A. Forty-one, that's correct.

Q. And those wells, had they already been drilled before the last hearing on this spacing issue?

A. No, not all of them had been drilled. Some of them were still --

Q. Can you identify how many were?

A. I can't, --

Q. Drilled after the date of that hearing?

A. I cannot at this time tell you a positive number.

Q. Do you have -- can you tell me generally

where the newer wells would be located in the total unit area?

A. The newer wells are -- most of them are located within the Hutcherson lease area, which is over here in Township 19 North, 33, 34 East.

We have drilled several other wells around the area, but most concentration is within this area.

Q. For the record, if I can -- well, maybe you can identify that as east or west or south. I just want to get in the record where exactly --

MR. BUELL: The area that Mr. May was referring to, and he identified it by township and range, is located in, I'd say, the east central portion of the unit.

Q. Now, just so I'm clear on this, so you have core data from wells that were drilled subsequent to the hearing that was held last year with this newer core data that's included in this study reflected in the exhibits?

A. Which particular hearing?

Q. The hearing last March at which you testified. I think the date was March 11, 1980.

A. There is new data, it's obvious.

Q. New core data.

A. New core data. The wells may have been drilled and completed but we may have -- there may have been

a two or three month lag in getting the actual core analysis to us. Once we core a well, we do not instantly get that core analysis. It has to be analyzed by CORE Laboratories, but there is a lag time.

Q. Now, I think you -- well, let me ask you this. In addition to the study of cores did you do any interference testing?

A. I'm not an engineer.

Q. I'll reserve the question.

MR. BUELL: The record is clear that no additional pressure interference tests have been run.

Q. Now, in a number of cases in describing your conclusions on your study of core data reflected in the exhibits, you said that there was a correlation between wells that you could demonstrate. I wonder if you could explain that more fully, as to how you established a correlation?

A. What I did is I used one millidarcy as a cutoff and correlated intervals of greater than one millidarcy between wells. I also correlated the intervals of less than one millidarcy. That was the criteria used for these correlations.

Q. Is there a way to relate particular zones, pay zones, from one well to another well so that you're clear that they're continuous throughout the area that you're

studying?

A. There are intervals of permeability in the same stratigraphic position that one can correlate from well to well of greater than one millidarcy ; that is what I saw.

Q. I wanted to ask, in your study whether any of the exhibits reflect the area in the southwest portion of the unit?

A. Core data was used from the Amoco State No. 1 "FN" and I believe the Amoco State No. 1 "HN" in my cross plot technique. That core data was honored, but I did not use any of my -- I did not have any cross sections that went through that area.

Q. I see. Let me focus your attention on Exhibit Ten, and particularly with cross section B-B, which I believe is located in the southwest portion of the area.

I believe Wells Numbers Three and Four, if you'd point those out on the exhibit.

A. Right here. I believe that cross section goes from northwest to southeast. This is the trace of that particular cross section. It does not go across the southwestern portion of the area.

Q. Are those the wells that would come closest to the southwest portion?

A. I believe there are several wells, other wells that are closer to that area, but I did not use them in my cross sections.

Q. Okay, how far apart were those Wells Three and Four?

A. Wells Three and Four were 660 feet apart.

Q. Okay, and what acreage coverage would that give you if you drew a circle?

A. I believe that's 50 acres. I'm not that sure.

Q. And would you describe or characterize the correlation between pay zones in those two wells as being good, or perhaps you can characterize them?

A. Between those two wells there were intervals that I could correlate that had greater than one millidarcy. There were also intervals that -- that were greater than one millidarcy that were found in the No. 2 State "FD" that I did not find in the No. 1 State "FD".

But the correlation is fairly well, I believe, between the -- between those two wells.

Q. Do you think that the data that you have on those two wells, other wells on the western side of the unit, allow you to extrapolate those findings to the entire unit?

A. Yes, I believe they do, based on the data that I have at this present time, and based on my cross plot technique and honoring all the data, even though it was on the western side of the unit, I believe I could make the established correlation.

Q. Let me ask you, looking at the unit as a whole, how would you characterize the porosity and permeability characteristics in the north as compared to the south and the east as compared to the west?

A. Generally toward the northwest, or when you go westward, you have an increase in the permeability less than one millidarcy. As one goes down towards the southeast we have an increase in the section of greater than one millidarcy.

Q. What would that lead you to conclude regarding the relative drainage of the areas, parts of the unit? Is the east better than the west and the north better than the south?

A. Well, certainly there was less section of greater than one millidarcy, but if one millidarcy has the ability to flow gas, I assume that -- that you have the ablility to drain a large area.

Q. On the data that you've studied did you find pressure differences from well to well?

A. I'm not an engineer. I do not study --

Q. Your study did not reflect the --

A. No, it did not.

Q. -- differences in pressure?

A. No, it did not.

Q. In the selection of wells, I think you said you excluded wells -- or you used wells that showed a lack of a shotgun pattern. I'm not clear what -- what that means, why it was picked as a standard for selecting wells.

Will you amplify that?

MR. BUELL: Mr. May, be sure you understand the question. If you don't understand it completely, ask Mr. Healy to restate it.

A. Perhaps that would be best.

Q. Well, let me restate it.

You said your study included forty-one wells as a start.

A. That's correct.

Q. But your exhibits today reflect data on sixteen wells, and I believe you said the sixteen wells selected had a lack of a shotgun pattern. In other words, you picked them as representative of the forty one wells.

I'd like you to amplify that because I don't understand it.

MR. BUELL: I think he's now on Exhibit Seven, Mr. May, so --

MR. HEALY: Yes, what I want to --

MR. BUELL: -- go back over to Exhibit Seven and I believe you all can communicate a little better.

A. What I used, I drew the line through the total core data and then used the wells that -- that lacked a shotgun pattern to verify this line.

So this line is --

Q. What do you mean by shotgun pattern? Were there dots far above the line and also dots far below the line on the wells that you did not use?

A. For this particular upper cross plot, is that what you're talking about?

Q. Yes. I'd like to have that answered on all of the ones that show plotting based on the representative wells. In other words, was there a shotgun pattern encountered on each of the plots that you drew?

A. Well, there's a wide dispersal of points on either side of the line. I think that is, to me, somewhat of a shotgun pattern, yes.

The concentration of points was along this line.

MR. BUELL: Now, "along this line",

you're referring to the cross plot in the lower lefthand portion of Exhibit Number Seven.

A. That's correct.

Q. Let me ask you this. There were twenty-five wells that were not included in your plot, and are you saying that those represented such a wide swing from the norm that's plotted on your graph that you didn't feel they should be used?

A. No. The reason the shotgun pattern wells were not used in this particular plot is that they could have fit this curve and they could have fit, perhaps, due to their dispersal, a wide angle of -- a wide orientation of that particular line. So they -- because of the wide dispersal of points, what I wanted to do was better check the line that I had drawn down here for the total wells by using the wells that -- that showed the least amount of scatter.

Q. Let me ask, on wells -- do you recall on wells that were part of the forty-one that were included in the original scope of the study which were finally excluded because they showed the shotgun pattern, do you know how many were in the southwest portion of the forty-one?

A. I didn't exclude forty-one.

Q. No, I'm saying the forty-one you started

with. How many of those that were excluded from the plot here are in the southwest corner?

A. None of them. In fact, we used both the -- on the up end we used both the relationship between porosity permeability and the relationship between density and porosity core porosity.

Q. Did you have -- are there other wells that have been drilled in the southwest corner of the unit?

A. Do you mean outside our southwest boundary or --

Q. No, within the unit boundary but by anyone other than Amoco?

A. I believe CO_2-in-Action drilled the McCarty Well in that area. They are not part of our company. That's the only one I can think of offhand.

That particular well is located right here.

MR. BULL: "Right here" is not getting in the record.

A. 18 North, 31 EAst, in that particular township.

Q. Okay, are there wells that have been drilled by AmeriGas or Schwartz Carbonic in that southwest part of the unit boundary?

A. Yes, there are. There are some wells in that area.

Q. Did you consider any data from those wells in making your study?

A. Yes, I would have used them, but they're all neutron logs and this particular calibration is based on density logs, which we believe best represents the porosity.

We tried neutron logs and they did not show a relationship, so we felt that the neutron logs were unreliable.

And all the logs that are within this area were all neutron logs. If they had been density logs we would have included them in the study.

Also, if there had been core data, we would have included it in the study.

Q. I'm not clear, can you characterize a little more precisely how much more reliable the density logs are than the neutron logs? Is it a much more accurate process or -- I'm not clear how much more weight the density log has compared to a neutron log.

A. Well, --

Q. In your own opinion, that is.

A. I believe in this particular area density logs best represent the porosity within the Tubb. I did not

exclude the neutron log for any reason. I cross plotted it against the core porosity and there was absolutely no relationship whatsoever.

The density log I believe best porosity tool that we have within the Bravo Dome area.

Q. In geological analysis, is production history another way to demonstrate porosity or permeability?

A. It certainly exhibits there's gas present but, no, I did not use production data as an indication of porosity/permeability, and that is an engineering question, I believe.

I'm strictly concerned with the rock.

Q. Right. All I'm asking is in studying the rock is production history a factor?

A. No, it is not.

Q. I think you testified that the technique that you used is generally recognized as a geological method. Can you tell me whether you know of any other situation where sixteen wells were used to analyze an area of over a million acres?

A. Well, sixteen wells were not used; forty-one wells were used.

Q. Well, let me ask you this, then. The data you've showed us here on certain exhibits, anyway, are

based on sixteen wells, is that true, the core -- core data?

In other words, on Exhibit Seven, only sixteen wells are shown there. Oh, you excluded the other twenty-five because of the shotgun pattern.

A. On these two -- top two porosity plots I did, yes.

MR. BUELL: Mr. May, explain once more, you only verified,your uppermost cross plots, you only used that to verify the cross plots you'd previously obtained using all the data from all forty-one wells, one more time.

A. That's correct.

What I did, what I did is I cross plotted all forty-one wells; drew a line through there, and saw a relationship, and eliminated the wells that had a shotgun type pattern and just used the ones that had -- what I felt was the best relationship, excluded the ones that had a shotgun pattern, and cross plotted those to verify this particular line.

I did not rely on this line up here. This is a check of this cross plot down here.

Q. Let me ask you then, would a forty-one well program be sufficient as a matter of general recognized practice to cover a million acres? Do you know of any other situation where it's been done?

A. No, I haven't.

Q. I just have two more questions.

One is, based on your study do you believe that the entire unit consists of one continuous formation?

A. Just one formation.

MR. BUELL: Did you say yes?

A. Yes.

MR. BUELL: He said yes.

Q. Just one continuous source of supply?

A. From my study I haven't determined that. It's extremely possible that there are several different sources of supply.

Q. But are you aware of any faulting within the boundary of the unit?

A. Yes, I've exhibited that on all my cross sections, where I have faults.

On my cross section D-D' I've indicated a fault right here between the Amoco No. 5 Heimann and No. 6 Heimann.

Q. If I could follow up on that, the fault line is drawn straight up and down and yet it shows a continuous orange area between the two wells. Could you explain how that would occur?

A. Yes. The cross section is hung strati-

graphically, not structurally.

Q. But there wouldn't necessarily be communication between the pay zones, even though you've shown them on your exhibit as continuous?

A. That is true, but with so much permeability within the section it's extremely possible that -- that permeable sections of greater than one millidarcy could be with faulting in juxtaposition.

MR. HEALY: I have no further questions.

MR. RAMEY: Any other questions? Mr. Nutter.

QUESTIONS BY MR. NUTTER:

Q. On all of these exhibits the orange color represents the permeability that's one millidarcy or more, is that correct?

A. That's correct.

Q. So we can't make a qualitative analysis of permeability and determine that there's equal permeability and equal communication between the wells on the cross sections by looking at the orange color.

A. No, that is correct that they are not the same permeability. What, the only thing the orange represents is the permeability greater than or equal to one

millidarcy.

Q Now, what did you base your statement, Mr. May, on that a study of these exhibits leads you to believe that one well will drain a wide area?

A Well, one millidarcy, in my experience, that one millidarcy will drain a large area. Gas can flow through one millidarcy and I used that as a cutoff and that's my basis for concluding that it could drain a wide area, based on my correlation.

Q But you haven't made any analysis as to any time limits that gas would flow across one mile through one millidarcy of permeability, or anything like that.

A No, I have not.

Q Only that given sufficient time gas would flow through one millidarcy of formation.

A Yes, that's correct.

Q So this is permeability but not necessarily effective permeability.

A That is correct, permeability. I did not determine effective permeability in any fashion.

Q Okay, thank you.

MR. RAMEY: Mr. Arnold.

CROSS EXAMINATION

BY MR. ARNOLD:

Q Mr. May, what was the highest permeability you measured in any core?

A We had several cores that were over a millidarcy, slightly over a millidarcy.

Q Thank you.

A Excuse me, not over a millidarcy, 1000, 1000 millidarcies. I'm sorry.

Q Did you have large sections of those, or a foot here or a foot there, or how?

A It's not that -- that -- greater than one Darcy is not prevalent throughout the whole area, that's correct. It's not a -- it's localized in some of our cores. It's not a -- fieldwide.

Q You didn't come up with any kind of an average across your orange section, or anything like this? This is strictly a lower limit?

A That's correct. Average porosity and permeability that we've seen from core analysis has shown us that it's been about 20 percent porosity at 42 millidarcies permeability. That's the only average I have and that's only through core analysis.

Q That's 42 millidarcies?

A. 42 millidarcies.

Q. Thank you.

MR. RAMEY: Any other questions? Mr. Stamets.

QUESTIONS BY MR. STAMETS:

Q. Mr. May, all these cross sections are very interesting. Amoco has obviously done some excellent work.

Isn't the final proof of this particular pudding in the drilling and production of wells scattered over a large portions of the unit?

A. To my knowledge that's the final proof of the pudding. What I'm showing here is the probability, based on one millidarcy, that a well could drain a large area.

Q. And if Amoco drills the same number of wells on 640-acre spacing as it might drill on 160, wouldn't that prove up more of the area geographically?

A. Can you repeat that question, please?

Q. If Amoco's got enough money to drill 200 wells in a certain period of time, those wells are drilled on 640-acre spacing rather than 160, wouldn't that result in a larger percentage of this vast area in the unit being -- have more data on it?

A. That's correct.

Q. So that you can then prove or disprove what you tend to show here?

A. That's correct.

Q. And also would serve to define, perhaps, more quickly areas where there is no --

A. That's correct.

Q. That's all.

MR. RAMEY: Mr. Ulvog.

QUESTIONS BY MR. ULVOG:

Q. Mr. May, have you made any attempt to correlate your potential production, from this estimate, made any attempt to correlate that with either the net footage of permeability or with the quality of the permeability? In other words, you might have 100 feet of one millidarcy permeability, you might have ten feet of ten millidarcy permeability, and so on, have you tried to make any correlation between that, or between the pressures that you have?

A. No, I haven't.

MR. RAMEY: Any other questions? Mr. Padilla.

CROSS EXAMINATION

BY MR. PADILLA:

Q. Mr. May, I believe you testified that there was pressure communication between the first two wells on your EX-EX' cross section?

A. That's correct.

Q. And as I understand the remainder of your testimony, you did not testify as to any other pressure communication between any other wells on the cross sections.

A. No, I did not because I believe the next witness may talk about the pressure communication between wells.

We did have interference tests done on No. 1 "FD". We also had it done in a couple of the Heimann wells as part of the pressure interference test and they showed communication, based on what the engineering told us.

MR. BUELL: May it please the Commission, I was going to have our next witness, Mr. Padilla, go through not only the interference wells that are on cross section EX-EX', but on all the other interference wells that appear on the cross sections.

MR. PADILLA: Your next witness will then be prepared to answer any questions with regard to pressures?

MR. BUELL: Yes, sir.

MR. PADILLA: No more questions.

MR. RAMEY: Any other questions of Mr. May? He may be excused.

MR. BUELL: May it please the Commission, I would like to formally offer into the record Amoco's Exhibits Seven through Fifteen, inclusive.

MR. RAMEY: Amoco Exhibits Seven through Fifteen will be admitted.

MR. RAMEY: Let's break for lunch now and be back at 1:00 o'clock.

(Thereupon the noon recess was taken.)

MR. RAMEY: The hearing will come to order.

You may proceed with your next witness.

MR. BUELL: As the last witness in our direct presentation, we will call Mr. Sanders.

L. J. SANDERS, JR.

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

DIRECT EXAMINATION

BY MR. BUELL:

Q. Mr. Sanders, would you state your complete name, by whom you're employed, and in what capacity, and in what location please?

A. My name is L. J. Sanders Junior. I'm employed as Staff Petroleum Engineer and Associate by Amoco Production Company in Houston, Texas.

Q. Mr. Sanders, in this hearing here today we're recommending temporary operating rules for the Bravo Dome Unit area. In connection with that temporary rule request we're making, have you made any study to enable you to make a recommendation to this Commission as to the temporary period that we might possibly need?

A. Yes, I have, and I would recommend that we have a period of three years after first production into a pipeline.

Q. From the unit?

A. From the unit.

Q. All right, sir, in connection with your recommendation, will you direct your attention now to what has been identified as Amoco Exhibit Sixteen and state for the record what Exhibit Sixteen reflects?

A. Exhibit Sixteen is a timing calculation for an initial 25 psi reservoir pressure decrease using the Heimann No. 1 and State "FI" No. 1 area characteristics. This is the area where we had run our -- was two of the sites where we ran pressure interference tests.

Q. Would you point out the Heimann area generally on Exhibit One and just say that it appears to be about in the south central -- central south central area?

A. Well, it's in the -- might be called the east central. The Heimann 1 was our producing well. It's located in Township 19, 33 North, and then in the east central at the State "FI" site, this one -- this is a lease that's in Township 20, Range 34.

Q. All right, just what did you do in making your study to prepare yourself to make your recommendation to this Commission?

A. I looked at time here as the time that it would take to produce enough gas from an area to cause 25 psi decrease. I picked an area five miles by five miles that was developed on 640-acres. I picked this large of an area because in the center of it is going to be a pressure observation well and I wanted to minimize as much as I could the interference from outside, just this five mile area that would facilitate evaluation of the tests.

And in this five mile tract there's 10240 acres. The net wells inside the test site, there's fifteen producers and one pressure observation well.

Millions of cubic feet of CO_2 were removed from this area to lower the initial pressure, which was 375 psig, 25 psi, is 15.2 BCF, and the time to remove this 15.2 BCF, using a million a day, million cubic feet per day producing rate for the producing wells, which I believe will be reasonable, that calculates then to be 2.78 years, the time required to remove enough gas to cause a 25 psi pressure decrease, and this is about a 7 percent pressure depletion from the initial pressure point.

Q. So your 25 psi drawdown in your observation well doesn't look like much when you're just saying 25 psi, but percentagewise the original pressure that would be in your observation well is a significant percent?

A. Yes, it is.

Q. Now if your prediction on the original gas in place in the area that you studied is wrong in that there is less original gas in place, we should see the pressure interference in the observation well sooner than three years?

A. We'll see it sooner and we'll see a larger decrease.

Q. And by the same token, if you have understated the original gas in place, and hopefully, I'm going to say I hope that's the case, it will take a little longer than your predicted three years to see the same incremental decrease in pressure in your observation well?

A. Yes, sir, that's -- that's correct.

Q. All right, sir. I want you to turn now to your Exhibit Seventeen more or less a summary of the plans that Amoco intends to initiate in this three year period that we're asking for after the first unit production into a pipeline, to show the Commission the type of program we will have to gather data that we think we'll need to show definitive 640-acre spacing is correct?

A. Yes, it is.

Q. Why don't you, since Exhibit Seventeen is self-explanatory, why don't you just kind of summarize each of the four numbers, paragraphs, on the exhibit?

A. Okay. Our plans at this time is there will be a central gathering system installed ultimately in approximately each quarter -- quadrant of the productive area of the unit.

Drilling that will be done in the next three to four years will be concentrated 640-acre development for initial production, with the exception of scattered

locations which will be on a less dense spacing for the purpose of obtaining additional reservoir data.

A pressure observation well will be located in the center of a minimum of a twenty-five well block of 640-acre development in each quadrant to furnish information on CO_2 in place and areal drainage on 640-acre spacing.

A highly accurate measuring device will be run periodically in the observation well to monitor the pressure, and a well defined initial pressure will be obtained prior to any production in each test site.

When a twenty-five psi pressure change is obtained in the observation well in any test site, or when three years of unit production to a pipeline has occurred, spacing rules for the unit will be, in my opinion, should be reviewed as appropriate with the Oil Conservation Division.

Q. All right, Mr. Sanders, you've already stated for the record the location of the test site area from which you made your study. Would you just generally indicate for the record and the benefit of the Commission where the other three will be located?

A. Let's look at the southeast quadrant and, as you can see, in this Hutcherson area we have already drilled quite a few wells on 640, and so it won't take a

whole lot of drilling to develop a pretty good area there on 640-acre spacing.

And so in this area we'll pick out a minimum of a five mile by five mile solid block of 640-acre development. And the center well in that block will be left shut-in as a pressure observation well, and then we'll produce the surrounding wells and we'll watch the pressure from that observation well.

It's a -- it's a good, straightforward way of production and pressure and the relating of those two.

Q. All right, sir. Now, Mr. Sanders, -- we're going to need some more lights on.

Maybe you can see well enough, Mr. Sanders. On some of Mr. May's cross section exhibits we had included wells that were part of the previous pressure interference test. I wish you'd come over here, start over here.

A. Okay.

Q. Are there any wells that were involved in the pressure interference test on any of the exhibits that we have over on the west wall?

A. Cross section B-B' has the State "FD" test site, which the State "FD" No. 1 was the producing well, the State "FD" No. 2 was a pressure observation well, located 660 feet apart.

Q And that B-B' is Amoco Exhibit Number Ten.

All right, I believe some attention has been pointed to these two wells before. Why don't you comment, please, on the pay continuity, and by pay I mean anything with one millidarcy permeability or greater, between the two wells that were involved in the pressure interference test, and the development of zones of one millidarcy permeability or greater away from the two test wells.

First, did we observe pressure interference in the short term pressure interference test on the wells that you mentioned, the State "FD" No. 1 and the State "FD" No. 2?

A. Yes, we did. On the three sites, this was the only one that we couldn't quantify. The producing rate here was questioned because of scale buildup on our orifice, well test data, and so this was one site that we couldn't quantify the results of.

We did see pressure interference between the producing well and the observation well, pressure observation well.

A point that's been interesting to me, and Mr. May has made it, is that when you look at the continuity between these two wells located 660 feet apart, so much

has been made about the fact that they're only 660 apart and only thirty-one acres, but what's interesting is the continuity of anything is better with distance in many cases. Here it's better for sure --

Q. By "here" you mean to the right or to the south of the two State wells you've been talking about.

A. Yes, but I believe what we'll see on all of these is that the close spaced wells will show the pressure interference, they don't show any more continuity than if you had wide spaced wells offsetting. Over here, 4.75 miles there's plenty of continuity there, and then the 3.8 miles, it looks like there might be a little less but there's still plenty of continuity.

Q. So here we know we have two wells located rather close together where we've observed pressure interference.

A. Yes.

Q. And you see nothing on this exhibit that would indicate there there is any break in continuity of this one millidarcy pay zone between wells to the south and wells to the north?

A. No, I do not.

Q. Would that indicate to you as a reservoir engineer that wells in this reservoir could certainly

drain as large a spacing unit as 640 acres?

A Yes, it does. The first thing we've got to have for drainage is we've got to have continuity. This looks like we have the continuity and therefor we should have drainage.

Q All right, sir Are there any more wells that were used in previous interference tests on the exhibits on the west wall?

A Yes, there are. Cross section C-C'.

Q Exhibit Number Eleven, now, you're referring to?

A Yes, sir. This cross section contains our State "FI" No. 1, our State "FI" No. 2, and we're going to talk about this one some more later on.

Q Are those the same two wells that are on our Exhibit Eight?

A Yes.

Q Cross section EX-EX'?

A Yes. We might just mention without getting into comparisons, that this cross section, I believe, has -- no, it would be better to wait and make my statement later on.

Q All right, sir, let's go over now to the exhibits on the east wall. Are my compass directions

right?

MR. RAMEY: North.

Q All right. On the wall to the left of the Commissioners.

A On cross section D-D' --

Q Which is Exhibit -- Amoco Exhibit Number Twelve.

A We have the logs on the Heimann No. 2 and the Heimann No. 5. Both of these were pressure observation wells. Both of them showed about the same amount of pressure decline in the producing wells. There should be some correlation there. If each of these responded to the producing well about the same, then you would think that they would respond to one another to some extent, and you can see that -- you can see the continuity that we have here between these two wells, between the Heimann No. 2 and Heimann No. 5.

And again as we go 4.25 miles -- 4.5 miles to the south the continuity doesn't look much poorer than -- than it does between the 6 -- between the 937 foot wells, and if you go north, it appears we have a mile distance here, you can see that the continuity is about the same, and then 5.6 miles going north, then it does begin to break up.

Q But you still have a continuity of zones containing one millidarcy of permeability or greater.

A Yes, very definitely.

Q And actually, as you go to the south, and I believe you said you go to the south, the continuity is poorer but wouldn't you say it's as good a quality as we find in the Heimann wells until you go on further south?

A Yes, I believe that would be closer to the truth.

Q But we do see continuity.

A Yes.

Q Between wells that we observed a pressure -- pressure interference and wells adjacent to them to the north and south?

A Yes.

Q Continuity.

A Yes.

Q All right. Let's go now t Amoco's Exhibit Number Eight, cross section EX-EX'. Would you comment on it, please?

A Yes. This cross section contains the producing well, the State "FI" test -- pressure interference test site. "FI" No. 1 was the producing well and "FI" No. 2 was one of the pressure observation wells located 660 feet

apart, and then this third well that's on the cross section is the Heimann No. 1, which is located approximately 2.4 miles on to the south.

And as Mr. May pointed out, here again you see good continuity on the 660-foot distance between wells, but you also see the same good continuity at 2.4 miles.

So what we're seeing is what we saw on the closer spaced interference wells, we're seeing on the wells now that we've drilled on 640-acre spacing, which is detailed on our Exhibits Twelve, Thirteen, and Fourteen, plus we're seeing a lot of continuity over long distances, up to three or four miles.

Q Do these data indicate to you as a reservoir engineer that these wells in this area, I'm talking about the area of Exhibit Eight, would certainly drain a 640-acre spacing unit?

A Yes, very definitely.

Q Now while it is true we have not conducted any formal interference tests subsequent to the March, 1980, spacing hearing, previous hearing, by venting CO_2 to the atmosphere or injecting it, we have acquired significant additional data that shows that 640-acre spacing units are a proper pattern for development in the Bravo Dome Unit area?

A Yes, that's true. As you mentioned

earlier, or Mr. May mentioned, we're bettar than 100 percent increased in the number of wells than we had the time of the previous hearing, and a lot of these wells have been drilled on a 640-acre spacing unit. The continuity looks good on these wells.

Q. Do you have anything else you'd care to add at this time to your testimony?

A. No, I do not.

MR. BUELL: May it please the Commission, that's all we have by way of direct of Mr. Sanders, and I would like to formally offer at this time Amoco Exhibits Sixteen and Seventeen.

MR. RAMEY: Amoco Exhibits Sixteen and Seventeen will be admitted.

MR. BUELL: I tender Mr. Sanders for cross examination.

MR. RAMEY: Are there any questions of Mr. Sanders? Mr. Healy.

CROSS EXAMINATION

BY MR. HEALY:

Q. Mr. Sanders, based on your studies, do you believe there's a common source of the CO_2 supply in the entire unit?

A. No, I do not.

Q. Describe in your judgment what you would believe to be a description of the -- a proper description of the formation?

A. In what repsect?

Q. The reservoirs.

A. Would you help me a little bit?

Q. Are there, do you believe there are separate reservoirs in the unit area?

A. Well, Mr. Healy, as you pointed out earlier, we only have -- not a whole lot of wells in a large area, so a person's got to be real careful about when he starts scoping here, and from what I've seen, there may be four or five separate reservoirs would be my guess right now. But that's got to be taken as scoping. We need a lot more data.

Q. Would that be based on faulting or some other base?

A. It's mainly based on the pressure gradient that we see from the west side of the field to the east.

Q. Yeah, I wanted to ask you about that. What would be the high pressure that you've encountered in your studies?

A. We had one well that was 1068 pounds on

the west side, and we've had a well on the north side of about 340 pounds.

Q. Okay, so that there would indicate that there's not a common source of supply.

A. That's right.

Q. I wanted to ask why there weren't any interference tests run since the last hearing. Is there any particular reason for that?

A. Well, as you know from the previous hearing, it takes a long time for interference even on 660 feet, which it seemed that your position was that that was awfully close. The further away you go, the more time it takes, and it looks like the best thing for us to do , we're looking at probably several hundred wells in the next four years, is to do what is an old time oilfield interference test, and that is put an area on production, put a pressure observation well, and we'll find out what kind of interference, if any, we have.

Q. Have you had any sustained production from any of the wells that you've studied?

A. No, I believe about five months is the longest we've had; the Heimann 1 flowed for about five months on that one interference test.

Q. What were the results on that, how many

Mcf a day and what sort of pressure did you --

A Well, it started at a million a day and through just mechanical problems the rate dropped off to about 700 Mcf per day, and at that time the test was terminated.

Q When we say mechanical problems, would that indicate poor drainage or something else?

A No, it's just a matter of keeping the well open. As the rate went down, the tubing pressure went up.

But we do want to do some more of this long term testing, as Mr. Allen was speaking about.

Q We haven't really -- or I guess you haven't addressed this directly, but certainly indirectly in the exhibits, I think the basic -- a basic issue here is prevention of waste and recovery of maximum amount of CO_2 out of the field, and would you explain how you arrived at the conclusion that 640-acre spacing results in that as opposed to smaller spacing?

A The first thing you've got to have to drain any kind of area, you've got to have pay continuity, and we see that here. It looks like pretty widespread pay continuity.

And then, as far as the efficiency with

which you drain, the theoretical calculations are available, but what we're proposing here is that we find out through performance what the efficiency of this drainage is, and then from there we'll move to closer spacing if such is needed.

Q Do you believe, to turn it around, that drilling on 160-acre spacing would result in lower recovery of CO_2?

A I don't believe it would produce lower recovery but it might well be wasteful, might be too many wells.

Q Certainly costly?

A Yes.

Q I think that's all I have. Thank you.

MR. RAMEY: Any other questions of Mr. Sanders? Mr. Stamets?

QUESTIONS BY MR. STAMETS:

Q Mr. Sanders, how many of these 25 well blocks would be necessary to demonstrate 640-acre spacing throughout the unit?

A We're thinking that we'd have one in each quadrant of the unit. You know, we'd have like a site here, a site in this area, a site in the northwest -- I should say the north/northwest, and then in the south/southwest part.

Q It looks like some of those sites would be rather distant from the unit boundary. Of course, I realize it's early and it's kind of hard for you to project what data you might find there.

Is it conceivable that more sites might be necessary?

A Well, it could be, yeah. You've got to start some place and we're going to be drilling several hundred wells it looks like in the next four years, and that in itself brings a lot of log information and we'll have the potential testing, and should have time to do some bottom hole buildup from kh, and it's one of those things. I believe you know, if you start out thinking of one for each quadrant, that certainly seems like a good start and it's something, you know, might need to be enlarged.

Q It's possible, though, to put one in each quadrant and still have them all located right smack dab in the center of the unit.

A Well, no, we will not do that. We're interested as much as you are in finding out what we've got here, and we'll -- we'll make sure that we get something that is representative.

I know just looking, this seems -- would seem to be a good area here. We already have a lot of wells,

we're going to go ahead and drill some more in this very north part, and maybe over here. This is pretty wide open into here. We could drill here, depending on the -- the open windows, you know, that's one thing that's going to make -- may press a little bit, is picking a site there with those open windows, and it's in through here, is where we have that, the pressure benches come a little more often than they do over in this area, so we'll have to match here to meet the windows, as well as pressure benches, to make sure, but once we start production, then, see, we're back in where we can shut in wells and take bottom hole pressure buildup, and if we -- if we wind up here with five or six hundred wells, you know, we start blocking up some acreage then where we can go in and take pressures, as well as having this pressure observation well.

MR. BUELL: Mr. Sanders, please try to remember when you're referring to Exhibit One, be a little more specific than "here". We can't get your pointing in the record.

Let the record reflect that his last answer, that he was moving away from the Heimann area in the southeast portion of the unit, working up to a quadrant in the northeast portion, then over to the northwest, and down to the southwest.

MR. STAMETS: The only trouble I have with that, Mr. Buell, is it looks to me like the Heimann is right about in the center as opposed to the southeast, but that's neither here nor there.

Q What other data do you expect to develop which would help demonstrate that 640-acre spacing is the most efficient and economical?

A Well, as you know, there's theoretical calculations. It would just be more positive if we could go in and, you know, really cause some depletion.

But I should tell you that -- that we're looking at some more testing in the unit. We want to produce and inject the CO_2, as I mentioned to you earlier. We want to do that for surface equipment, but we also want to observe the deliverability characteristics of these wells. We'll see how some of these frac treatments hold up with time, and I'm like Mr. Allen, I'm not sure how long these have run, but I've been thinking more like a year or two years on some of these production tests, just testing and injecting, and on those if we get a chance to tie in with some injection and interference tests on those, we'll be able to do that. And did I mention the pressure pulsing? We'll take another look at pressure pulse testing. As you know, pressure pulse testing is rather than produce the well

for 150 days you can produce it for a few days and then try to follow that pulse through to an observation well with highly accurate measuring, and it -- it takes that pulse a long to travel, just like it does a continuous transient (sic) and I'm not too hopeful that we'll find pressures that we can pressure pulse on wide spacing, but we're going to take another look at pressure pulsing.

MR. RAMEY: Any other questions of Mr. Sanders? Mr. Padilla.

CROSS EXAMINATION

BY MR. PADILLA:

Q Mr. Sanders, I'm a little confused as to what you mean by continuity in the cross section. As I understand the way you use continuity, it just means that there's a permeability of greater than one millidarcy, is that correct?

A Yes, sir, that's the basis for his orange colorings.

I think it might be worth -- Ernest, it might help you, let's take a look at this -- at this permeability level here.

MR. BUELL: Where are you now, Mr. Sanders?

A. Sorry. Exhibit Eight. Let me take one minute on this Exhibit Eight, EX EX, and you'll have a chance to look at these. These are permeability values, core permeability values. See, we're talking about, I think this is like fifty millidarcies. There are some little fifty millidarcy streaks in through here, and these are high, high streaks of permeability. And we're talking about that -- that a pressure wave or disturbance can move it, move through continuously through that interval, and that's what it takes to get drainage.

Q. But you're not saying that the entire Tubb formation is homogeneous throughout the --

A. No.

Q. -- unit.

A. No, and we'll drain some portions of the pay better than others, of course, but it will be to the point of you have to drain -- there's some trade-off between wells, closer spacing and efficiency that you get.

Q. Well, looking at your exhibits, or your cross sections E-E', F-F', and G-G', it seems as though those are the ones that have the wells spaced closer together. How does the pay section, the amount of the pay section, compare to the initial potentials of those wells listed on those exhibits, or cross sections?

A The -- Ernest, that's primarily the Hutcherson area, and those wells have been potentialing for about 1.2 million a day after just acid, with about 150 psi, which is just about what we expected of that area, so we're seeing the same kind of potential on close spaced wells as --

Q How did the pressures differ in these wells?

A I believe in this particular area, the Hutcherson, that that -- we have a 375 pound area that covers quite -- quite an area, and I believe all these wells in here will be 375 pounds. We have quite a bit of pressure information right in here.

You see, Ernest, this is some of the new data that -- that have been developed. This 131 well drilling program we started in October of 1980, then we're ready to come in with these new wells on 640-acre spacing, so you're getting to see for the first time what -- what the pay looks like on 1-mile spacing.

Q So what you're saying is in this area, the Hutcherson area, you generally have the same amount of pay section, the same pressures, and pretty much identical potentials.

A Yes, right in the Hutcherson area, right.

Q Now, do those -- well, I think somebody

has already testified that those wells do not look like the other wells in the, say, in the west side of the -- of the unit area, is that correct?

A. Well, Ernest, I think what they were talking about, they generally thin some to the west/northwest. Just the gross section thins and so as you move to the north/northwest, then you can just see, you see less orange, partly because it's less gross section.

Q. Do you have lower pressures there also?

A. No, we have higher pressures on the west side and that's something that's helped the thinner pay. Fortunately you have higher pressure, so that's tended to equalize it with the eastern side, both with gas in place and with deliverability standpoint.

Q. Still, based on that, you would still advocate 640-acre spacing for both areas, or both characteristics?

A. Yes, sir, yes, I would. If the continuity is there, we're going to drain. The question is how efficient we'll be. We'll make some calculations that tell us what's fifty millidarcies and over. When you start getting down lower than that, then you can argue about how good it's going to do it, but if we prove the production, then we'll start assessing, and it seems like three years or so is not

too much to pay for starting wide and coming in, if we have to.

Q. Couldn't you get the same information by developing 160 acres versus 640 acres for three years to determine the production into the pipeline?

A. Yes, we could. It would just be whether or not, you know, we drilled unnecessary wells to do that.

Q. You don't have a covenant of further development in the unit, do you, from a standpoint of having to drill on 160 acre spacing?

A. No, there's --

Q. Do you?

A. I can't answer that, Ernest. Mr. Buell would have to.

Q. Well, let me put it this way. You're not precluded from drilling only one well to 640 acres, are you?

A. No, I don't believe so.

MR. PADILLA: I have no further questions.

MR. RAMEY: Any other questions of Mr. Sanders? Mr. Arnold?

CROSS EXAMINATION

BY MR. ARNOLD:

Q I'll ask one. Have you developed any theories at all as to why there is such pressure difference across there?

A Mr. Arnold, there really -- we're really just not there yet. We know we've got some difference. We have some ideas, but until we get some more wells I'd just be wasting your time to -- with reasons. We're just -- we're just not there.

MR. RAMEY: You may be excused.

MR. SANDERS: Thank you.

MR. RAMEY: Anything further, Mr. Buell?

MR. BUELL: May it please the Commission, that's all we have by way of direct presentation, and we rest our case.

MR. RAMEY: Mr. Healy, do you have a witness, or Mr. Coffield?

MR. COFFIELD: Just one moment.

Mr. Beeler, would you please take the witness chair there?

PHILIP BEELER

being called as a witness and being duly sworn upon his oath,

testified as follows, to-wit:

DIRECT EXAMINATION

BY MR. COFFIELD:

A. My name is Philip Beeler. I'm a consulting petroleum engineer from Norman, Oklahoma.

Q. Mr. Beeler, what is your relationship with the protestant companies, AmeriGas and Schwartz Carbonic?

A. For fifteen years I was an employee of Carbonic Chemicals and then later SCC Corporation, which in turn has been merged into AmeriGas.

Q. And for purposes of this hearing are you a consultant for AmeriGas and Schwartz Carbonic, as well as an expert by way of background in this particular area?

A. Yes, yes.

Q. Have you testified before the Commission previously and had your credentials made a matter of record as an engineer?

A. Yes.

Q. And accepted by the Commission?

A. Yes, they were.

Q. RElative to this particular case, are you familiar with this area?

A. Yes, I am.

Q And the subject matter of Amoco's application?

A Yes.

MR. COFFIELD: Does the Commission have any further questions of Mr. Beeler?

MR. RAMEY: No, Mr. Beeler is considered qualified.

Q Mr. Beeler, what period of time have you personally had occasion to observe this area of development and your professional opinions about the carbon dioxide production and characteristics of the reservoir?

A Since 1962 to date.

Q What aspect of Amoco's application is it that you find objection to?

A The 640-acre spacing requirement.

Q Okay, Mr. Beeler, would you please review for the Commission your knowledge of the history and experiences of AmeriGas and Schwartz Carbonic, particularly relative to the question of spacing allocated to the wells in the area?

A In 1940 Carbonic Chemicals first started production of CO_2 from what we call the Mitchell Field in Harding County. Production has been continuous from that time to date. A considerable amount of data is available

from that long period of production, and we feel that we are, and have been for a number of years, able to give valid information as to drainage and productivity of wells of this -- in this area.

Q. Just a moment, Mr. Beeler. With reference to Amoco's Exhibit One, precisely what areas are you talking about?

A. In Township 19 North, 30 East, along the west boundary of the township.

Q. And does this -- does the area with which you're familiar both -- with both inside the unit boundary as well as outside the unit boundary?

A. Yes, sir, this, as you can see, the unit boundary moves in and out amongst these wells.

In addition to that, there is a window in the unit for what is called the Bueyeros Field, which is operated by Schwartz Carbonic, that is a separate reservoir containing four wells at the present time that I will be able to -- I will give you more information on.

Q. All right, go ahead with your discussion.

A. I think we ought to handle one area at a time so we don't get confused, and the first area I would like to continue to discuss is the so-called Mitchell Field in 19 North, 30 East.

This field had initial bottom hole shut-in pressure over compressibility factor, P/Z, of about 1000. At this present time it has a P/Z of about 600, so this field has gone through approximately half of its reservoir life. There is a steady decline in pressure, indicating that we have one reservoir, one common source of supply, of a limited extent.

In this particular area we think the extent of drainage is approximately 3000 acres.

To this date nineteen wells have been drilled in and around what we call the Abo reservoir, which is the same as what Amoco refers to as the Tubb reservoir. Some of these wells were not completed as producers because of poor permeability in the Abo zone, which would not allow for economic production. Other wells were drilled and encountered extraneous water production, which would not allow for economic production of the wells. This is different from a bottom water contact, which was also encountered by later drilling.

So we have up-dip water coming in from the west to the east in this particular field.

So we have had several wells that were drilled that would not avail us any ability to provide production.

With the history we've encountered here we feel that approximately one well per 320 acres is adequately draining this reservoir without a doubt.

Now I'd like to discuss briefly the Bueyeros Field, which is located in Township 20 North, 31 East, Sections 30 and 31.

From the records of the State's records, we conclude that a well was drilled in 1919 in this pool; that according to the records blew out. Now, how long it blew out or how much and to what extent and how much gas was left, we have no idea, but another company began a CO_2 dry ice operation in the area about 1947, and their records were very incomplete. The company went bankrupt and it was not until about the mid-fifties that Schwartz Carbonic took over this operation, and from that point forward we have fairly good information, but we can't give as complete an analysis of this area because of the early blowout, from our knowledge, must have resulted in a loss of a tremendous amount of CO_2 to the air.

This particular field has four productive wells, and it is at a further stage of depletion than the Mitchell Field. In fact, it is very near its economic limit. Our most recent tests show the P/Z of about 350; however, in one of the wells in this field we've found that there is

another reservoir besides the Abo that is productive of CO_2. We term it the Glorieta zone and it appears to be a small reservoir with gas in place of only about 125,000 tons of CO_2, and we've already taken this reservoir down to a P/Z approaching 200.

So we have fairly good information from this reservoir dating back to 1968, and we can extrapolate good decline curve information.

The reservoir in this area is about 600 acres in extent in the Abo zone. Four wells are producing. One well is a blown -- the well that blew out depleted the pressure somewhat but would not have depleted this reservoir completely, from our engineering calculations.

Here again we think probably 320-acre drainage could be effective; however, in effect we have about one well per every 150 acres of reservoir.

So briefly, that is our experience with the area.

Referring to the maps that Amoco has presented, you will notice that they show thinning of so-called pay sand towards the west, towards this western edge of the unit boundary. This is very true, and we know that there are discontinuous sand bodies as you taper out to no sand at all further west, and as we have already observed

with the westernmost production, there is an extraneous water drive coming in up-dip and all across, no matter whether it's up-dip or down-dip, all across the western side of the reservoir. This we don't know how to explain, but wells put on production may be pure gas for a period of time and then start getting more and more water and eventually just get completely watered out.

Amoco has drilled one well that I have information on that has experience almost the same thing as we did with our nearby No. 4 Well, a high amount of salt water production from an up-dip gas well. Where that water comes from, we don't know.

So we boil it down to this. Maybe on the east side of the reservoir, or this Bravo Dome area, you've got such a massive body of sands that are interlocked, possibly, that maybe 640-acre drainage can be effective in that area. We have what we've termed earlier proof of the pudding in our long time history of production. We don't need test units. We've already, in effect, talking about a 25-well test area, we have the 20-well Mitchell Field that's been in production for forty years. We've affected the testing of that area. We know it's a limited reservoir. We have seen the earlier recommendation or standard that the Commission put forth, 160-acre spacing as being adequate, meeting

the needs of the operators in this area. Maybe some adjustment could be made to where as of now you can apply for smaller units, even 120-acre, 80-acre, 40-acre. Maybe the same thing can be applied, that the base spacing unit would be 160 acres and if somebody sees that -- or has information that shows that 640-acres could be drained, that there would be some means of allowing them to utilize one per 640 acres.

In our area where we've produced the wells, in effect we're on 160-acre spacing but we aren't on each and every 160-acre tract. So just because you have 160-acre spacing doesn't necessarily mean that you're going to drill one well on each and every 160-acre tract.

Now I would like to comment on specific data concerning this continuing -- the sand body in our particular portion of this area, the western portion. We earlier saw on Exhibit Ten, cross section B-B, the two wells 660 feet apart in Section 23, 30 North, 21 East.

AmeriGas drilled two wells within approximately a mile and a quarter of those two wells that are 660 feet apart. One well, an excellent producer, very similar to the two wells Amoco drilled.

Approximately 3/4 of a mile away and just about a little over a half mile away from the Amoco wells, a well with very similar characteristics on the log

as to sand development, wouldn't even flow 100,000 cubic feet a day.

So we have experienced that instead of finding forty and fifty millidarcy permeability here or there, and even greater, it is very, very seldom on the west side that you encounter those, what we consider high permeability. A good many wells over there will only find a few feet of one to five or six millidarcy permeability.

And if you were to insist on 640-acre spacing, you would not actually drain these little discontinuous sand bodies underlying each and every section in the western part of the field.

One other thing we'd like to point out is, where would somebody cut off, or what is the economic limit of production, for wells in this area? Well, it's one thing to one party and another thing to another party.

SEC, or pardon me, AmeriGas nowadays, has just in 1980 drilled two wells at approximately half the cost that Amoco has shown as their cost for drilling in the area. That makes a great difference for a company like AmeriGas. They can put two wells in for the same cost that Amoco can do it. So cutting the spacing in half, we come out with the same costs, and we all know no matter where it is or how good a reservoir, that more wells result in a more

efficient drainage of the reservoir. We've seen that from the Four Corners area to the east Texas fields, where at one time they said gas wells five acres apart was a waste of money, but we see nowadays that that was an efficient means of getting the maximum recovery from an excellent permeability reservoir.

Another thing is concerning economic limit and who's going to produce for how long, AmeriGas has a different situation for recovery of CO_2. This is converted in the field to liquid, and in certain cases to dry ice, and is sold all over the western part of the United States. An entirely different situation than is conceived for the pipelining of CO_2 for secondary or tertiary recovery by Amoco.

Another part of this problem is if we restrict to 640-acre spacing and indeed we find ten years down the line that this isn't doing the trick, will it be economic to go and infill drill in -- particularly in this isolated western part that's not going to drain as effectively, when maybe halfway through the life of these additional wells the pipeline will be at a point where it's uneconomic to operate and there'll be no market, and here you'll be sitting with wells that can't sell anything before they're -- because the great vast bulk of the area has declined to the economic limit of the pipeline.

Therefor, we conclude that the present spacing has been adequate and is adequate for the situation in a large, known area of the Bravo Dome Gas -- CO_2 Gas deposit, and that this spacing should remain intact the way it is and if the Commission sees that some expansion of provisions are allowed for someone to allot, say, as much as 640 acres, fine, but to continue to the spacing as it has been effective.

Q In conclusion, then, Mr. Beeler, would it be your professional opinion that at least with respect to the western portion of the Bravo Dome Unit area, about which you've --

A. Right.

Q -- directed your attention, at least with respect to that area, the granting of 640-acre spacing would probably cause waste and a violation of correlative rights?

A. Yes, it would.

MR. COFFIELD: I have no further questions of Mr. Beeler on direct.

MR. RAMEY: Any questions of Mr. Beeler? Mr. Buell?

MR. BUELL: I have some, Mr. RAmey, but I'd appreciate a brief recess. Mr. Beeler's, again, testimony

was very generalized, and I think with a recess I can certainly shorten the cross examination.

MR. RAMEY: Fifteen minutes?

MR. BUELL: That's plenty.

(Thereupon a recess was taken.)

MR. RAMEY: The hearing will come to order.

Do you have some questions now, Mr. Buell?

MR. BUELL: Yes, Mr. Ramey.

CROSS EXAMINATION

BY MR. BUELL:

Q Mr. Beeler, I believe you've testified previously that based on data that have been made available to you, the rock quality of the Tubb outside your western area that you've spoken of today, and on over in the Bravo Dome Unit, appeared to be of much higher and better quality.

A In other words, from west to east the permeability and sand sand thickness increases.

Q All right, sir, and certainly the cross

section exhibits that we've introduced here today, certainly confirm your belief in that respect, do they not?

A. Yes, it does.

Q. All right, sir, I believe you mentioned two areas that you were concerned about, one you referred to as the Mitchell Field?

A. Yes.

Q. I believe it was your testimony that while one well in the Mitchell Field would drain 320, you were happy with 160. Am I getting the right connotation on your testimony?

A. That the spacing pattern as previously adopted by the Commission, and which is still in force, fits the drilling of wells adequately to meet the needs of Ameri-Gas to effectively prevent waste of reservoir gases, economic waste.

Q. Well, did I misunderstand you when you said that a well in the Mitchell Field area would drain 320 acres?

A. No, you did not.

Q. So is my summary of your testimony right, the well will drain 320, but for other reasons your client is happy with the 160 pattern?

A. The way it is written presently, the

form it is written based on 160-acre spacing, doesn't necessarily require you to drill each and every 160, but it does allow you to drill on a 160-acre tract, and also provides for even smaller drilling units.

Q. If for reasons other than drainage of the spacing unit you want to drill down to a denser pattern than 320, you can?

A. That's correct.

Q. All right, sir, I believe you also told me that the source of supply that the Mitchell Field wells were producing out of has been defined.

A. Yes.

Q. And by that, I take it that your testimony was that you know the horizontal limits of a common source of supply from which the Mitchell Field wells are producing?

A. We know by material balance calculations that approximately 3000 acres is being drained by the present wells.

Q. All right, you're --

A. I don't -- I don't say that that means that along this fenceline, that the field ends, but the present wells are adequately draining 3000 acres by material balance calculations.

Q And you're convinced that 3000 acres constitutes a common source of supply?

A Yes.

Q All right, sir, and you heard our recommendations today. We recommended that our temporary rules, including a 640-acre spacing unit, would not apply to anything west of the western boundary of the Bravo Dome Unit.

A Yes, I heard that.

Q So the Mitchell Field and its wells would be excluded from the purview of the rules by our recommendation, assuming the Commission adopted the manner that we're recommended.

A It's a little confusing the way the line is drawn around the northernmost well, the Mitchell No. 6. It doesn't seem to be excluded from the unit.

Q Well, if it isn't excluded from the unit, it should be, and I hope our boundary is accurate, but our recommendation pertained to an accurate boundary description of Exhibit One, and if it isn't accurate, we'll change and make it accurate.

Under that assumption that it is accurate or will be made accurate, that would exclude every well in the Mitchell Field, would it not?

A Well, if you intend for it to and you

write it properly, I'm sure you can exclude them all.

Q. All right, sir. Now the problem you mentioned, and I'm coming inside the outer boundaries of the Bravo Dome Unit, was the Bueyeros Field.

A. Bueyeros. Yes.

Q. Bueyeros Field. I believe you also said that that was a 600-acre common source of supply, did you not?

A. Yes.

Q. That by your studies you had defined?

A. Yes.

Q. That 600-acre reservoir. Again, as in the case of the Mitchell Field, as I recall your testimony and correct me if I'm wrong, you said one well in the Bueyeros Field would drain 320 but for the same reasons for the Mitchell, you would prefer 160 for that field.

A. Yes, the basic spacing pattern as now written.

Q. And that field is clearly within the outer boundary of the Bravo Dome Unit and our temporary rule recommendation would apply to that area, is --

A. Yes.

Q. -- that correct?

I believe you heard testimony of Mr.

Allen that it was contemplated that if any separate common source of supply was defined within the outer boundary of the Bravo Dome Unit, that by proper application to the Commission, in this case probably the Oil Conservation Division, that could be excluded from the purview of the rules and the Oil Conservation Division could adopt any rules that the evidence showed were proper. Do you recall that testimony?

A. Yes.

Q. Would that not be a solution to your Bueyeros Field concern?

A. Would it not be the other side of the coin be just as well that we leave the rules as they are, and as you show various areas that 640-acre drainage will be affected, that you seek permission to exclude this area from the basic 160-acre spacing and qualify it as 640-acre spaced area?

Q. I believe you have heard testimony that the thrust of our recommendation here is to recommend temporary 640-acre spacing units to serve conservation through uniform and orderly development while data are being obtained definitive data to show the optimum spacing pattern for this Commission to adopt. You've heard that testimony?

A. Yes, sir.

Q. Don't you think the adoption of tempo-

rary rules will serve that purpose?

A. It probably would for a large portion of the unit. You don't need to include all forty-two townships, I don't think, particularly in the face of contrary evidance of 640-acre drainage.

Q. All right, sir, you mentioned the Mitchell Field is a concern. We've eliminated it have we not, in that all the wells in that field are outside the area to which we wanted our temporary rules to apply?

A. We don't say that - that maybe at one end or the other there still are potential drilling sites that will expand the area of drainage, so therefor, we don't say that this particular field is completely developed.

However, the development that has occurred is draining 3000 acres. Maybe five or six more wells will make it 4000 acres. We can't conclude that.

Q. All right, sir, and with regard to the Bueyeros Field, I have described a solution that may not be acceptable to you, or to UGI, but it would be a solution to the specifically defined Bueyeros Pool from the purview of our rules we've recommended.

A. We say that the Bueyeros Field is 600 acres. We have approximately 10,000 acres of so-called Libby Ranch oil and gas leases. Since last year, the hearing last

year, we have drilled two wells approximately four miles away from the plant I discussed earlier, that found -- encountered an entirely separate pool or field from the Bueyeros Field, and we feel that it, as earlier discussed, is in the same pool or field as the wells shown as three and four on Exhibit Ten are in.

So we have a lot of undeveloped acreage in the so-called window that we need to -- not throw into limbo, but we feel to protect in the same manner as they have been protected in the past by the present spacing procedure.

Q You're not testifying that it is the intention of UGI to drill unnecessary wells on this area, the Libby acreage outside of the Bueyeros Field, are you?

A It's not the intent to drill unnecessary wells. The intent is to be able to study and make engineering calculations and reasonable deduction of what the conditions are in each individual area, and proceed on what density drilling fits the particular case.

Q Wouldn't the adoption of temporary 640-acre spacing serve to give UGI the time to make that decision on their currently undeveloped Libby Ranch area?

A I don't think it would.

Q Why wouldn't it?

A We have different ownerships and differ-

ent types of oil and gas leases, very radically different forms of oil and gas leases. The requirements, in effect, AmeriGas has two basic leases, one with the Mitchell Ranch and one with the Libby Ranch. These are very different from the ordinary oil and gas leases and very different from the leases that Amoco has with, for instance, Mr. Libby, of the Libby Ranch.

Q Doesn't each of these leases that you're describing contain a provision that this private contract is subject to every valid rule and regulation of the New Mexico Oil Conservation Division?

A I can't recall the terminology is just like that.

Q You've read part of the leases but you haven't read that part.

A Well, I've read them, but I don't have one with me and I can't recall exactly what --

Q Do you believe the New Mexico Oil Conservation Commission should consider problems in a private contract between private individuals in adopting their conservation rules and regulations?

MR. HEALY: I object to that question. The issue is really not what our leases contain but whether the spacing rule should be changed, and I think the question

is whether the 640 acre spacing rule would provide for economic recovery of CO_2 and prevention of waste.

What our leases require isn't really germane to this hearing. I think it's irrelevant.

MR. BUELL: For the first time since I have known Mr. Healy, I'm in agreement with him. These provisions of their private contracts are of no concern to this Commission or this hearing, but their witness interjected it, I didn't.

MR. HEALY: I disagree with that. I think you brought up what would be suitable for our development and lead into the questioninf of our leases.

MR. BUELL: Now that we have Mr. Healy's legal position, I'm going to repeat a question I asked Mr. Beeler, and I'm sure in view of his counsel's position, he will answer it differently.

MR. HEALY: Restate the question.

MR. BUELL: I will not bring up your private contracts again, because I --

MR. HEALY: Well, I think what our leases are,are really irrelevant to the whole hearing.

Q Mr. Beeler, you've testified that UGI does not want to drill any unnecessary wells.

A That is correct.

Q And then I asked you this question. Would not the adoption of our recommendation of 640-acre spacing units on a temporary basis for the Libby Ranch area outside the Bueyeros Field give UGI the time necessary to determine whether or not they would want to drill on a more dense pattern than 640 acres?

A As you know, the production from Ameri-Gas' wells is all processed on the, you know, in the field, and various conditions change as to demand on production. Additions have been made to the liquification facilities out there. Two wells were drilled this year because of a differing need for CO_2 production. Due to the enhanced recovery projects being discussed and put into operation, we don't know how soon more wells will be needed. We can only evaluate things one well at a time, I think, in our particular area because we have found that, indeed, 640-acre spacing would not result in the best economical recovery from the areas --

Q Are you talking about --

A Okay.

Q I didn't mean to interrupt you, Mr. Beeler.

A That's okay.

Q I thought you were through.

Are you talking about the area that can

be effectively and efficiently drained by one well or are you talking about the number of wells you would need to satisfy a demand completely aside from effective and efficient drainage of an area?

A. Well, we have the basic problem of supplying the demand that presents itself. We're in an era of increased demand for liquid CO_2.

Q. All right, sir, we're still on the Libby Ranch area outside the Bueyeros Field. How will our temporary 640-acre spacing recommendation prevent UGI from drilling whatever wells are necessary to satisfy any demand that they might have?

A. Well, as I understand it, you would want to restrict the drilling to one well per 640 acres. Therefor, if we encountered a situation, as we have already done in the two 1980 wells, where one well will not recover anything from a particular drilling site, we had to conclude therefor that certainly we are not going to be able to drain 640 acres with a well similar to that.

So therefor we have to look at each well as we drill it to see what kind of well we get. Will it be able to drill -- obtain the drainage from 160, from 320, as we look into every new field.

Q. Mr. Beeler, are you telling this Com-

mission that you can look at one well and determine its effective and efficient drainage area?

A. Yes, as production history goes on and as we have information from one or two wells in the general vicinity, yes, each well will provide valuable information.

Q. But you cannot instantaneously look at any one well and by any method known to you or to reservoir engineering science or geological science, just look at that one well instantaneously and arrive at its effective and efficient drainage area.

A. We could if there were no sand in it. We could conclude that you can't drain anything from it.

Q. I understand --

A. So, yes, we can get instantaneous information, just as you've indicated you're getting -- each well you drill, more information.

Now we're not getting, you know, on a --

Q. Other than that one example of a dry hole --

A. Yes, but we might get a --

Q. -- you couldn't make an instantaneous judgment.

A. A dry hole or a very -- as we have seen in other cases, a well that would only produce a small amount

of gas that would be uneconomic or marginal.

Q. Mr. Beeler, how many acres in the Libby Ranch lease of UGI are outside the 600-acre Bueyeros Field?

A. About 10,000 acres.

Q. Would you divide 640 into 10,000 and tell me the number of wells that UGI could drill on a 640-acre temporary spacing basis?

A. I believe that to be approximately 15, wouldn't it?

Q. Do you anticipate the local demand of UGI is going to in the immediate future require them to drill more than 15 wells?

A. It's quite possible. We've had some inquiries as to very large pilot projects anticipated by major oil companies, and they are inquiring as to our ability to provide this material.

Q. Has UGI management approved the drilling of one additional well on the Libby acreage, to your knowledge?

A. Well, they approved two in 1980. I haven't heard any of the exact plans for 1981.

Q. If they're going to drill any wells on that acreage in 1981, you're not aware of it.

A. Well, I haven't heard one way or the other.

Q All right, sir. Now going back to your Mitchell Field area and Bueyeros Field area, and with the poor quality of pay you have there, if this Commission set the spacing that you're recommending for this localized area, to the entire Bravo Dome Unit, that's 160-acre current --

A They, let's say, they already have. That's what we have right now.

Q Yes. Wouldn't that be like the tail wagging the dog?

A Well, I think what you're recommending can be termed the same thing, the tail wagging the dog. Here we've already established something and you're wanting to wag the dail; you want to change it.

I think the burden of proof is on you to show that it should be changed. You have no production to show; no production history to show that your change is called for.

We have so-called proof of the pudding.

Q All right, sir, now let's take your testimony that in this area of admittedly poorer quality reservoir rock, and I'm speaking of your 600-acre Bueyaros Field, as you call it, even this area of poor quality rock, you have testified that one well has pressure depleted the entire 600-acre reservoir.

A. I did not say that, sir.

What I said, that one well blew out, it affected the pressure in the whole 600 acres. It drew down the pressure. Of course, near the wellsite the pressure drawdown was greater than out near the edge of the 600 acres.

Q. I thought that's the way I had phrased your previous testimony, but I'll certainly accept the way you phrased it now.

So you noted pressure interference over your 600 acre reservoir in an area of admitted poor reservoir rock quality, and you've admitted the rock quality east of your 600-acre Bueyeros reservoir is of a much higher quality, am I right --

A. Yes.

Q. -- so far? And still you object to this Commission adopting on only temporary basis 640-acre spacing for the Bravo Dome Unit area.

A. Yes, sir, because in the Bueyeros Pool, 600-acre reservoir, it certainly would have taken more than one well to efficiently drain and prevent economic waste of the gas in place.

Q. Excuse me. How can you make that statement to the Commission when you admitted that you did not know the volume of gas that was vented to the air, onto the

air, from this one well?

A. Because we have four producing wells that were, at least one of them would have been necessary to complete the whole reservoir as we are doing now. We actually have four in 600 acres, remember, and we're drawing it down, steadily, slow but sure, and it's been an economical operation throughout its history, except for the first bankruptcy, but I mean after Schwartz Carbonic took over.

Q. One more question, Mr. Beeler, and I'm through.

In the latter part of your direct testimony I didn't object to it, but weren't you more or less speculating or philosophizing when you were talking of down the road the pipeline outlet quantity might reach the economic limit and it might be impossible to drill a well that could be necessary, weren't you -- weren't you engaging in the pure realm of speculation?

A. No, sir, I'm a trained engineer and I've evaluated economic limits on production through pipelines, through plants. There's got to be an economic limit somewhere, where well production will get to the point that it's -- you'll have to cease operations of your whole system.

Q. What hard data, or what hard evidence, even a shred of evidence, do you have to present to this

Commission at this hearing that this will occur in the Bravo Dome Unit area?

Just a shred of evidence, Mr. Beeler?

A Well, I've already presented it, that we have 320-acre drainage, approximately; if we only had one well per 640 acres, we wouldn't properly drain those areas. Maybe we would -- let's take a hypothetical case. Maybe we would get 50 or 60 percent of the gas that we could get with the present type of spacing. Okay, if we wait till later on to put the second well in on each section, at some point the pipeline is going to say, well, we don't have enough gas to keep the whole system going, so that's the end of it. Here these wells started much later and just didn't have the opportunity to effectively drain the reservoir.

It's as simple as that.

Q Mr. Beeler, I take it from your testimony that you're under the impression that our recommendation would limit one well to a 640-acre spacing unit, if an operator wanted to drill more. Is that your understanding, that we would fervently limit one well to 640 acres?

A I under -- I don't get the complete story, but from the way the Commission operates, you would have to come to the Commission to get an exception from the spacing that was established to drill a, in other words, to

prove the need to drill a second well.

Q Let me just clear this up right now for you, Mr. Beeler, and --

A Okay.

Q -- it's already clear in the record. Under our recommendation an operator, if he wanted to and thought it was necessary, could drill four wells on a 640-acre spacing unit that we're recommending.

A Okay.

Q Has all of your testimony been given with this misconception?

A No.

Q About --

A That was my understanding, the way I saw the spacing order, but no, I'm saying, have said from the beginning, the present spacing pattern fits the need of the western part of the Bravo Dome CO_2 gas area.

Q And has it been your understanding, or has it not been your understanding, that in our recommendation an operator could simply apply for a permit to drill a well administratively for a second well as he did for the first well, and do the same thing with the third and fourth? There would be no exception hearing. What is your understanding in that regard?

A. Well, now that you've -- I've never heard during this hearing the specifics of the mechanics of drilling other wells on the 640-acre spacing unit that you recommend.

Q. So, actually, under our recommendation UGI, although they have no wells to your knowledge planned to be drilled in 1981, could drill four wells on the 640-acre spacing unit that we're recommending, could they not?

A. According to your latest information, yes.

MR. BUELL: May it please the Commission, I believe that's all.

Thank you very much, Mr. Beeler.

MR. RAMEY: Any other questions of Mr. Beeler?

REDIRECT EXAMINATION

BY MR. COFFIELD:

Q. Well, one point on this matter that Mr. Buell is bringing out here in the latter part of his cross examination, with respect to the location of four wells, for example, on a 640-acre spacing area while 640 acres is the proper spacing, is it your understanding, Mr. Beeler, that as generally applied by the Commission, drilling more than

one well on a 640-acre spacing -- just generally as far as your answer --

A. Right.

Q. -- drilling one well, more than one well on a single proration spacing area, does normally involve some kind of penalty?

A. That's my experience in most cases.

MR. COFFIELD: No further questions.

RECROSS EXAMINATION

BY MR. BUELL:

Q. Well, is your misconception cleared up now, Mr. Beeler?

A. Well, I'm glad you have cleared it up.

Q. Thank you, sir.

A. Because I didn't see it that way until you explained it that way.

Q. I was having a hard time understanding your testimony on cross, and I'm glad that we finally got to the root source of our trouble, Mr. Beeler, and again I thank you very much.

A. Well, you did introduce earlier a sheet or an exhibit indicating where a well would be permitted to drill. It was a shaded area. I don't have that --

Q. Exhibit Six, Mr. Beeler.

A. Exhibit Six, okay. It was -- it showed shaded areas inside each 640-acre tract where the drilling of a well would be permitted. In total, this was 40 acres for the whole 640-acre tract. And my understanding, the way you presented that, those 40 acres were the only place, there were four 10-acre spots, were the only place you could drill within the 640-acre tract. Am I correct?

Q. If you're asking me a question, Mr. Beeler, the answer is yes, sir, Mr. Beeler.

A. Certainly it would severely limit the actual area in a 640-acre section of land. It would pin you down to 1/16th of the total area of the section, whereas, the present rule allows you to put a well inside each quarter section within 660 feet of the boundary of the governmental quarter quarter section. Quarter section. Which allows you for each section of land 1/4 of the whole section.

I think that would be greatly restrictive compared to the present situation.

Q. Mr. Beeler, if you would rather recommend a more flexible well spacing pattern for the 640 acre temporary spacing unit, I'm sure the Commission would be glad to consider that flexible spacing and so would Amoco.

And again I thank you, Mr. Beeler.

MR. RAMEY: Any other questions of Mr. Beeler? He may be excused.

MR. BEELER: Thank you.

MR. RAMEY: Anything further, Mr. Coffield?

MR. COFFIELD: No, sir.

MR. RAMEY: Mr. Kellahin, do you have a witness that you wish to --

MR. KELLAHIN: No, sir, we do not.

MR. RAMEY: Anything further? Any statements at this time?

MR. BUELL: May it please the Commission we have no evidence to be submitted in rebuttal.

I don't know whether the Commission at this time is ready for closing statements, and if they are, I would like the right, since I as applicant have the burden, to close last.

MR. RAMEY: Right.

MR. STAMETS: Mr. Ramey, in light of the last bit of questioning between Mr. Buell and Mr. Beeler, perhaps those parties here subsequent to the hearing, might like to recommend some minimum distance between wells in this reservoir, 1980 feet between wells, something like that, which would permit the additional wells that might be drilled

on 640 to provide for better spacing and better drainage.

MR. BUELL: May it please the Commission, we would certainly be happy to consider Mr. Stamets' recommendation. Right off the top I think it has a lot of merit. I would like to say if anyone other than Amoco would like to take advantage of this recommendation, that we set a time limit so it wouldn't delay a decision on our application here today.

MR. RAMEY: I would think that perhaps seven days, if there's any suggestion, that one could be submitted by this time next week; at the end of the work day on the 25th of March? Leave the record open for technical proposals.

MR. BUELL: I think that's certainly ample time, Mr. Ramey.

MR. RAMEY: We will so do.

MR. KELLAHIN: Mr. Ramey, on behalf of Amerada Hess Corporation and Cities Service Company, we'd like to voice our support of Amoco in the application today.

We believe that the establishment of temporary 640-acre spacing for this area within the Bravo Dome Unit, the outer boundaries of the Bravo Dome Unit, is the only logical and reasonable way to at this time preserve orderly development of this carbon dioxide reservoir.

We have a unique opportunity at this point to effectively and efficiently control for purposes of conservation and prevention of waste, as well as avoiding the drilling of unnecessary wells, the establishment of wide spacing. To develop otherwise compounds the minimal problem that AmeriGas has presented today. If we fail to act now, then wells will be drilled on 160-acre spacing and we'll set upon a course of action that could not in the future be reversed.

By establishing 640-acre spacing now on a temporary basis, we have reserved to the Commission the maximum amount of flexibility in coming up with a system of spacing that will eventually and ultimately result in the greatest production of carbon dioxide from this reservoir.

MR. RAMEY: Thank you, Mr. Kellahin. Do you have a statement, Mr. Healy?

MR. HEALY: I have a short statement.

You'll all heard the testimony and seen the exhibits today. It's very complex subject matter, and I don't pretend to understand it fully or even adequately, but I think the Commission and its staff will have the time and the obligation to look at things very carefully and decide what they think is the best course of action.

I think that all I can say is that based

on our producing history that we don't believe that the change in spacing as proposed for the western portion of the field where we have acreage is proper.

I think the evidence, testimony that you've heard today supports that, and I'd like to move that if the Commission grants Amoco's application on the spacing, that acreage in the western part of the unit be excluded from that. I don't see any pressing need to change the spacing pattern in that area where there is production history and where the evidence supports continuing the present spacing pattern.

I'm not speaking to the rest of the unit which is a very large area, and I think Amoco's done a fine job on collecting the data that's available to them now. I think perhaps they ought to be on larger spacing than the rest of the field.

That's all I have.

MR. RAMEY: Mr. Healy, along that line, I think if you have an area which you feel has a separate common source of supply, that you would like excluded from this, I think it might be well to let us know what that is.

MR. HEALY: Submit that, okay. Is that okay, Mr. Buell, I'll put that in writing.

MR. BUELL: I'm sorry, Mr. Ramey, I was

thinking about what I was going to say to answer Mr. Healy, and I didn't hear your remarks.

MR. RAMEY: Well, basically I was proposing perhaps that the Bueyeros Field might be excluded, it being a separate common source of supply, as they have indicated that, that it might be excluded from the 640-acre requirement, if it were granted; that he would submit an area.

MR. BUELL: I would say, based on Mr. Beeler's testimony there is ample evidence in this record to be excluded, and I would stipulate that Amoco Production Company as applicant has no objection to the Commission excluding the wells in what we've been calling here the Bueyeros Field.

That's better than writing, isn't it, a stipulation on the record?

MR. HEALY: Yes, but the problem we have is our wells are very close to the other acreage we have and we would apply what we've learned from our wells to the acreage positioned within the unit boundary, so we'd want to exclude all of that acreage. Now that's not a very big area and I think, as I say, our production history is as easily extrapolated to the acreage that we haven't developed yet as Amoco's data is to the rest of the unit. I think it's

more powerful proof than perhaps some of the other proof we've had today.

I would propose that we exclude all of the acreage which we have with the Libby and Mitchell Ranches based on our production history.

MR. RAMEY: You may make the request, Mr. Healy, submit what you think should be taken out, and with that adequate reason, it probably will be done.

MR. HEALY: Fine, thank you.

MR. RAMEY: You may proceed, Mr. Buell.

MR. BUELL: Is that everyone?

MR. RAMEY: I think that's everyone.

MR. BUELL: In the interest of time, I predicted that we'd be through and you could start your next hearing by 3:00 o'clock, let me adopt Mr. Kellahin's closing statement for Amerada Hess and Cities Service, as to the conservation thrust of our application, and I'll limit my remarks to just one or two things outside that overall conservation thrust that are, I think, important for the Commission to consider.

Looking at Exhibit One, there are many windows in the Bravo Dome Unit that are not held by UGI under their Libby Ranch lease, which is mainly over here north of the Bueyeros Field area, which we've defined in the record.

There are many individual windows in this unit. Under most of them are people that don't desire to lease; some are people that can't be located. The only way their interest can be protected in these small window units is to be included in a well drilled on a larger unit.

Under our proposed 640-acre spacing units, we will be able to prove these small window tracts, which are scattered throughout the length and breadth of the Bravo Dome Unit into a unit and thus protect the correlative rights of those owners of interest.

So again I urge the Commission in order to protect the correlative rights of all the interest owners, in addition to the conservation benefits that Mr. Kellahin has so articulated in his closing statement, that you adopt our recommendation for the temporary operating rules, including 640-acre spacing units for the Bravo Dome Unit area.

Thank you.

MR. RAMEY: Thank you, Mr. Buell.

Does anyone have anything further to add in this hearing?

If not, we'll take the case 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 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, C.S.R.
Rt. 1 Box 193-B
Santa Fe, New Mexico 87501
Phone (505) 471-7409

UGI CORPORATION

BOX 858 VALLEY FORGE, PA. 19482 ■ 215-337-1004

MANUS McHUGH III
Vice President

RECEIVED
MAR 3 1981
J. R. BARNETT

BEFORE ... CONSERVATION ... Exhibit No. 7198 ... Buell ... A ... Hearing Date 3-18-81

February 27, 1981

Mr. J. R. Barnett
Manager, Enhanced Oil Recovery
Amoco Production Company
500 Jefferson Building
Post Office Box 3092
Houston, Texas 77001

Dear Mr. Barnett:

Please find enclosed a signed copy of your letter, dated February 20, 1981 as requested. ——Sent to WJW

Reference Richard E. Ogden's letter of February 6, 1981 to Joe Ramey. In Paragrah (3) I would like to have a further definition of "outer boundary" as it pertains to AmeriGas' holdings within the Bravo Dome unit.

Thank you very much for your help in this matter.

Very truly yours,

Manus McHugh, III
Vice President

MMcH/bts

Enclosure

ANSWER REQUIRED BY_____
REGISTERED BY: MSE
POSTED IN CORRESPONDENCE REGISTER
PAGE 2 LINE 18

AMOCO

Amoco Production Company
Houston Region
501 Jefferson Building
Post Office Box 3092
Houston, Texas 77001

Richard E. Ogden
Regional Engineering
Manager

February 6, 1981

File: JCA-986.51NM-439

Re: Request for Hearing for Approval
of Temporary Special Pool Rules
Bravo Dome CO_2 Gas Unit
Union, Harding, and Quay Counties, New Mexico

State of New Mexico
Energy and Minerals Department
Oil Conservation Division
Post Office Box 2088
Santa Fe, New Mexico 87501

Attention: Mr. Joe D. Ramey

Gentlemen:

Amoco Production Company respectfully requests a hearing be scheduled before the Commissioners of the Oil Conservation Division for Approval of Temporary Special Pool Rules for the Bravo Dome CO_2 Gas Unit, Union, Harding, and Quay Counties, New Mexico. The following temporary special pool rules will be requested:

(1) Casing and Cementing

(a) Sufficient surface casing will be run to protect all fresh water zones with cement circulated behind casing to surface.

(b) Depth from surface to top of cement behind the production string will be furnished the Division on form C-103 based on temperature survey or other alternative methods approved by the District Director when cement is not circulated to surface.

(c) An affidavit specifying type and volumes of cement used in cementing all casing strings will be furnished the Oil Conservation Division on a form suitable to the Division.

(2) Injection of CO_2

The Division Director may grant administrative approval to inject CO_2 for the purpose of testing wells and surface production facilities only.

(3) Spacing

640 surface contiguous acres, more or less. Wells shall be located not closer than 1980' to any outer boundary of such tract, nor closer than 330' to any quarter-quarter section line. This rule will not prevent the drilling of more than one well on any 640 acre spacing unit.

Attached for your information is a plat of the Bravo Dome CO_2 Gas Unit. Any questions concerning the hearing can be directed to Mr. Jim Allen (713) 642-5497.

Very truly yours,

ORIGINAL SIGNED
R. E. OGDEN
BY

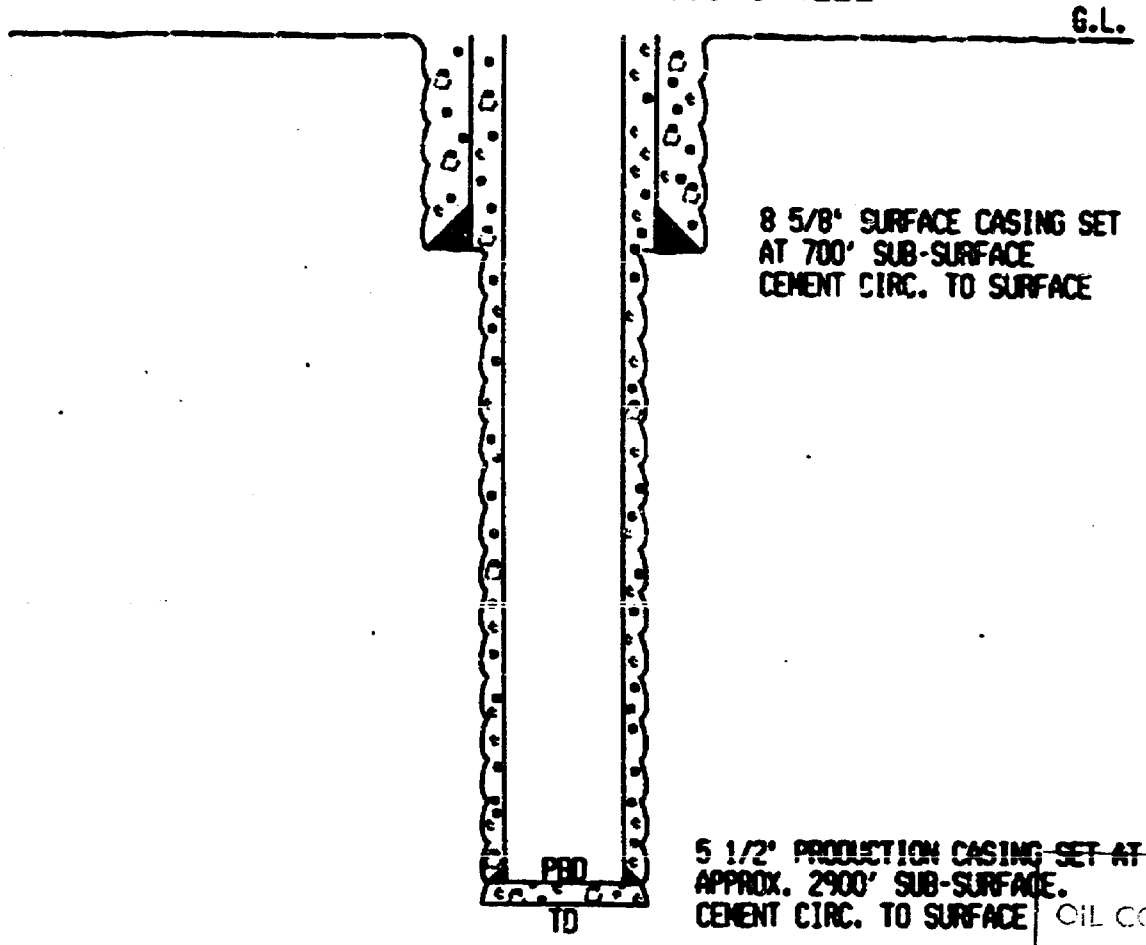
JCA

JCA/lg
497/V

Attachment

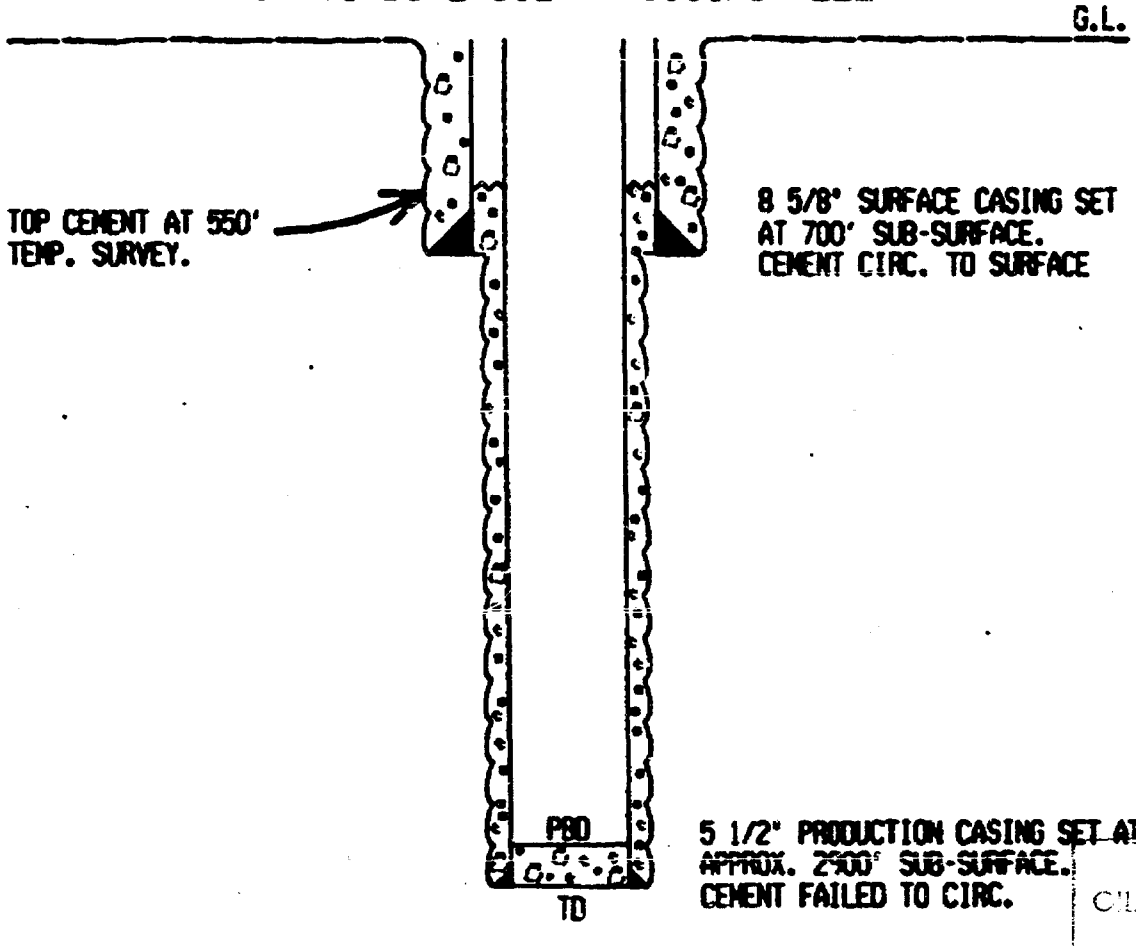
bcc: S. J. Okerson - Hobbs
J. H. Posey - 1822-C
C. A. Mote - 1604
B. A. Landis - 724
D. R. Currens - 1702-G
J. R. Barnett - 1730-G
B. I. May - 1425
L. J. Sanders - 1730
Ernest Sneed - 1822-B

TYPICAL CASING AND CEMENTING PROGRAM
BRAVO DOME CO2 PRODUCING WELL



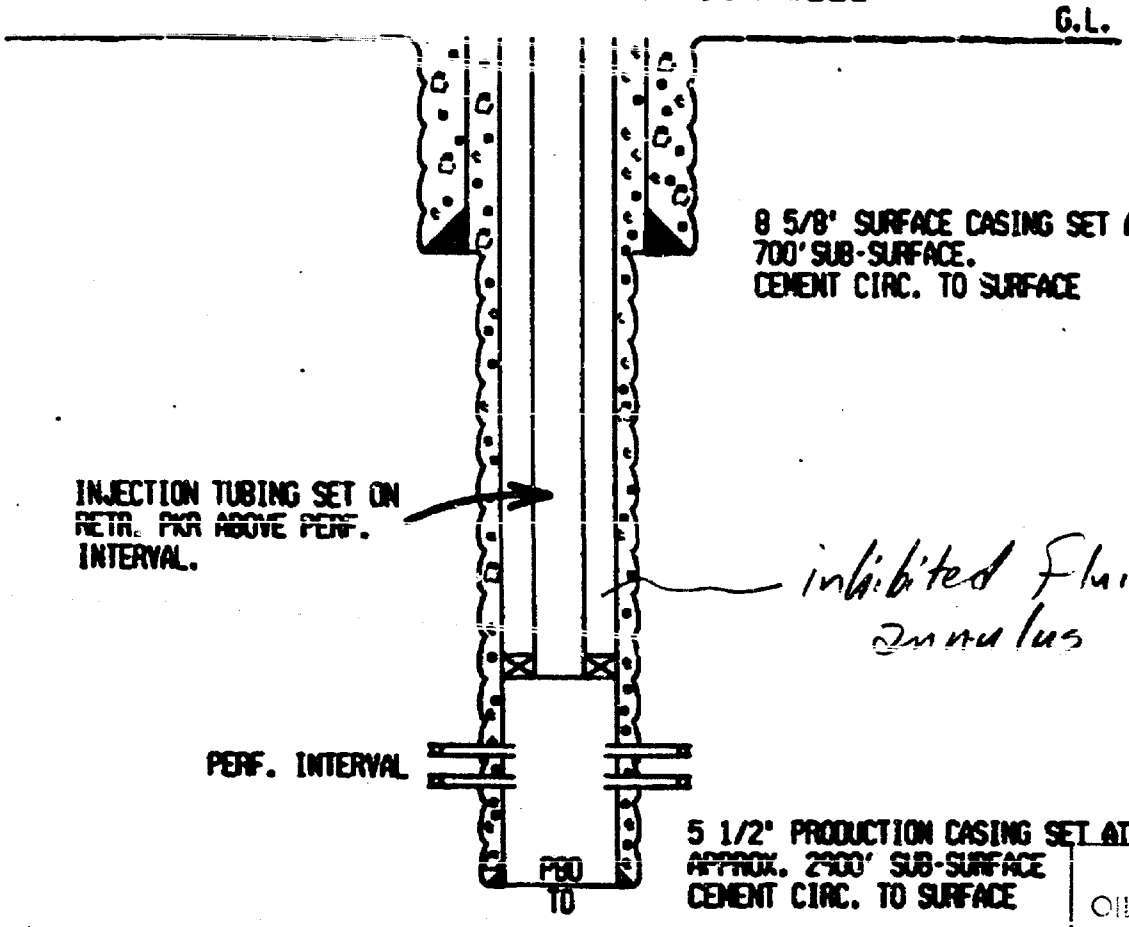
BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
Case No. 7198 Exhibit No. 2
Submitted by Amoco
Hearing Date 3-18-81

TYPICAL CASING AND CEMENTING PROGRAM
BRAVO DOME CO2 PRODUCING WELL



BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
Case No. 7198 Exhibit No. 3
Submitted by Amoco
Hearing Date 3-18-81

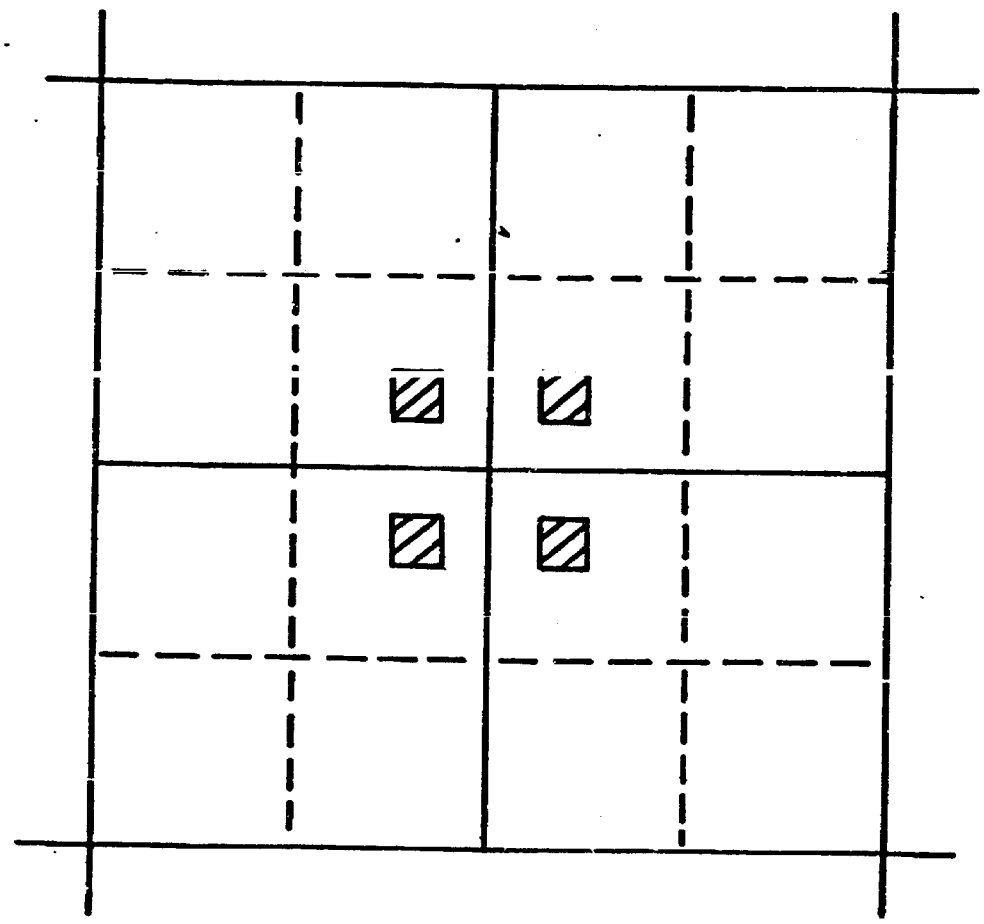
TYPICAL WELL BORE SKETCH
BRAVO DOME CO2 INJECTION WELL



BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
Case No. 7198 Exhibit No. 4
Submitted by Amoco
Hearing Date 3-18-81

Bravo Dome CO_2 Gas Unit

640 Ac. Spacing
Well Locations: 1980'/330'



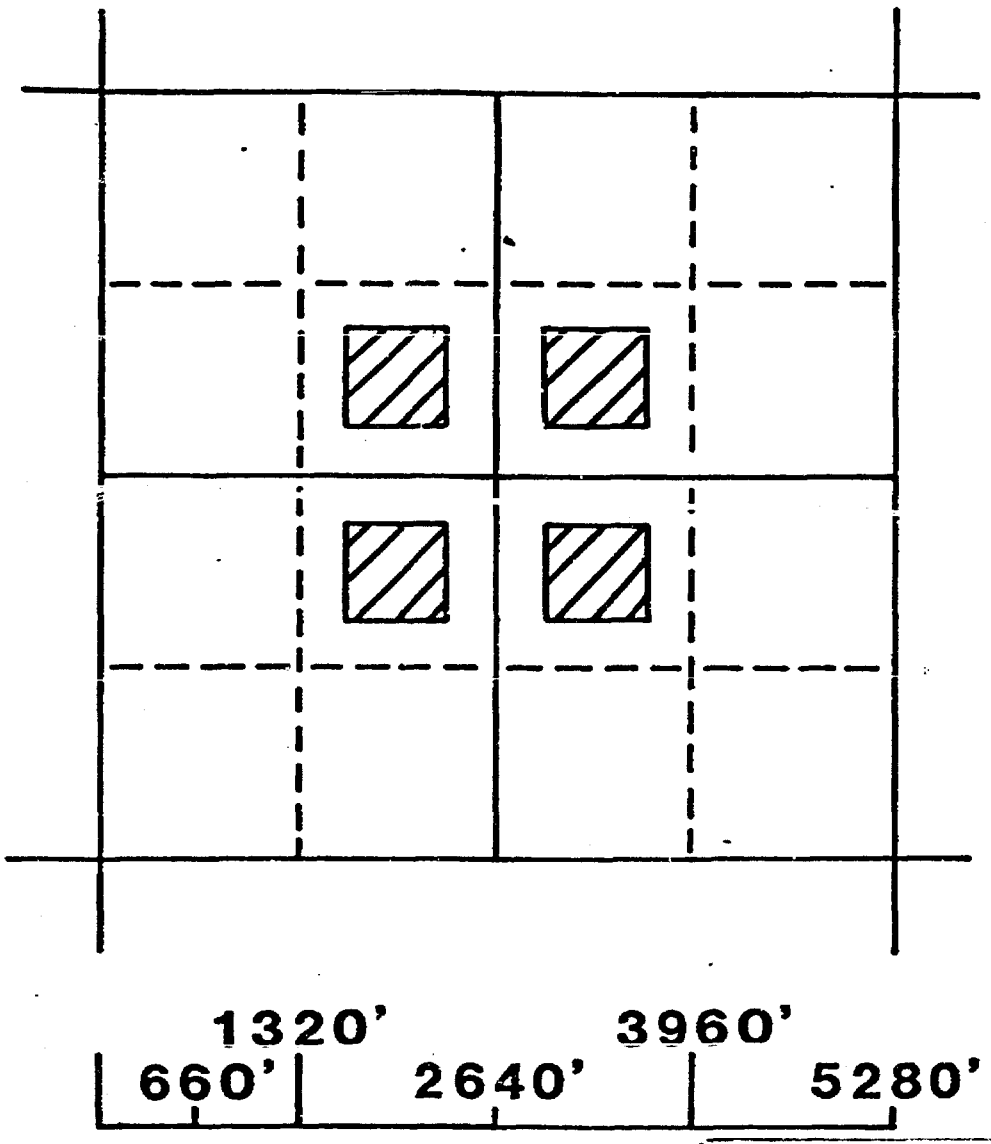
1320'
660' 2640' 3960' 5280'

Scale

BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
Case No. 7198 Exhibit No. 5
Submitted by Amoco
Hearing Date 3-18-81

Bravo Dome CO_2 Gas Unit

640 Ac. Spacing With Conventional Well Locations: 1650'/330'



Scale

BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
Case No. 7198 Exhibit No. 6
Submitted by Amoco
Hearing Date 3-18-81

TIMING CALCULATION FOR AN INITIAL 25 PSI RESERVOIR PRESSURE DECREASE HEIMANN NO. 1 AND STATE FI NO. 1 AREA BRAVO DOME CARBON DIOXIDE GAS UNIT

Description of Test Site:	5 miles x 5 miles
Total Acres In Test Site:	10240
Development Density:	640 acres
Net Wells Inside Test Site:	15 producers 1 pressure observation
MMCF of CO_2 To Remove To Lower Initial Reservoir Pressure 25 psi:	15,200
Time To Remove 15200 MMCF At 1000 MCFPD per Producing Well:	2.78 years

BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
Case No. 7198 Exhibit No. 16
Submitted by Amoco
Hearing Date 3-18-81

INITIAL DEVELOPMENT PLAN
BRAVO DOME CARBON DIOXIDE GAS UNIT

1. A central gathering system will be installed ultimately in approximately each quadrant of the productive area of the unit.

2. Drilling will be concentrated 640-acre development for initial production with the exception of scattered locations which will be on a less dense spacing for the purpose of obtaining additional reservoir data.

3. A pressure observation well will be located in the center of a minimum of a twenty-five well block of 640-acre development in each quadrant to furnish information on CO_2-in-place and areal drainage on 640-acre spacing. A highly accurate pressure measuring device will be run periodically in the observation well to monitor the pressure. A well defined initial pressure will be obtained prior to any production in each test site.

4. When a twenty-five psi pressure change is obtained in the observation well in any test site or when three years of unit production to a pipeline has occurred, spacing rules for the unit will be reviewed as appropriate with the Oil Conservation Division.

BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
Case No. 7198 Exhibit No. 17
Submitted by Amoco
Hearing Date 3-18-81

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION
STATE LAND OFFICE BLDG.
SANTA FE, NEW MEXICO
18 March 1981

COMMISSION HEARING

IN THE MATTER OF:

Application of Amoco Production Company for temporary special pool rules, Union, Harding, and Quay Counties, New Mexico.

CASE 7198

BEFORE: Commissioner Ramey
Commissioner Arnold

TRANSCRIPT OF HEARING

A P P E A R A N C E S

For the Oil Conservation Division:

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Legal Counsel to the Division
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and
Clyde A. Mote, Esq.
Amoco Production Company

A P P E A R A N C E S

For Amerigas, Inc., and Schwartz Carbonic, Inc.:

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Conrad Coffield, Esq.
HINKLE, COX, EATON, COFFIELD, & HENSLEY
P. O. Box 3580
Midland, Texas 79701

For Cities Service and Amerada Hess:

W. Thomas Kellahin, Esq.
KELLAHIN & KELLAHIN
500 Don Gaspar
Santa Fe, New Mexico 87501

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MR. RAMEY: The hearing will come to order.

Call Case 7198.

MR. PADILLA: Application of Amoco Production Company for temporary special rules, Union, Harding, and Quay Counties, New Mexico.

MR. RAMEY: Ask for appearances at this time.

MR. CARR: May it please the Commission, my name is William F. Carr, of the law firm Campbell, Byrd, and Black, P. A., in Santa Fe, New Mexico, appearing on behalf of Amoco Production Company.

I am appearing in association with Guy Buell, of the law firm Scott, Douglass, & Keeton, Austin, Texas, and Mr. Clyde Mote, with Amoco Production Company in Houston.

MR. COFFIELD: Conrad Coffield, with the Hinkle Law Firm of Midland, Texas, appearing on behalf of protestants, Amerigas and Schwartz Carbonic.

Appearing with me will be Mr. Walter Healy, General Counsel for the two corporations mentioned.

MR. KELLAHIN: I'm Tom Kellahin of Santa Fe, New Mexico, appearing on behalf of Cities Service Company and Amerada Hess in support of the application.

MR. RAMEY: Any other appearances?

I would ask that all witnesses stand at this time and be sworn.

(Witnesses sworn.)

MR. RAMEY: Mr. Buell, Mr. Carr, you may proceed.

MR. BUELL: May it please the Commission, I'd like to call as Amoco's first witness, Mr. Jim Allen.

MR. HEALY: I wonder if I could make a brief motion at the outset before the witness begins?

MR. RAMEY: Mr. Healy.

MR. HEALY: Amerigas learned last Friday the 13th that the spacing rules being considered today would probably affect the acreage position that they -- they have.

We have a witness who can testify today but we really haven't had sufficient time to adequately prepare testimony or bring along any exhibits.

I'd like to enter my objection for the record to the lack of notice sufficient to allow Amerigas to prepare testimony and exhibits complete enough to protect our interests, and I'd like to also make a motion to postpone the hearing, or in the alternative to permit a contin-

uance of the hearing until a later date to allow for additional testimony or exhibits, should that be in order to protect our interests.

MR. BUELL: May I respond rather briefly?

MR. RAMEY: You may respond, Mr. Buell.

MR. BUELL: Thank you. I'd like to have identified as Amoco's Exhibit A a letter from UGI.

(The reporter marked Amoco Exhibit A for identification.)

MR. BUELL: This letter will speak for itself, may it please the Commission, but it is in response to a letter from Richard Ogden, who is with Amoco. He transmitted a copy of our letter dated February the 6th requesting this hearing before the Commission, and this letter from Mr. Manus McHugh, III, Vice President of UGI, referred to our letter of application which was transmitted to them February the 20th.

So I think they've had ample notice, both legal and constructive, to certainly prepare for this hearing.

We resist any postponement, any continuance, or any recess.

MR. HEALY: If I could respond to that exhibit and statement.

The letter that was sent to UGI refers to special pool rules that would be applied to the Bravo Dome CO Gas Unit, Union, Harding, and Quay Counties.

Now, when we first say that wording we thought it meant that it applied only to the property that was included in the unit. We have not joined the unit so that we assumed, of course, that it didn't affect our properties.

Now, Mr. McHugh's letter was an attempt to clarify that, and even today I'm not completely clear what the area to be covered by this spacing rule changes today covers and I'd like to ask Mr. Buell if he would clarify that for the record.

MR. BUELL: May it please the Commission, a careful reading of Mr. McHugh's letter will clearly indicate that he was talking about the outer boundary of a 640-acre spacing unit.

MR. HEALY: I don't believe that answers my question, though, as to what area exactly it covers; whether it's the acreage that's included in the unit, that's committed to the unit, or whether it's acreage that's bounded by the outer boundary of the unit, including acreage that hasn't been committed. That's the first question.

And the other question we have is whether the application, due to the publication that was given

to it by the Commission, covers the entire three county area. I think, if you'll refer to the docket, it says to the Bravo Dome Carbon Dioxide Gas Area without identifying the acreage. And that could presumably include the entire Bravo Dome Field.

MR. BUELL: Are you through?

MR. HEALY: Yes.

MR. BUELL: May it please the Commissioners, our Exhibit A simply shows that they knew at an early, early date that a hearing had been requested.

The official docket notice was published within the prescribed statutory time for notice. So certainly, UGI had notice that the hearing had been requested. They had legal statutory notice of the way the Commission had docketed it, so I again urge that we continue this hearing, and no recess, no postponement, no continuance, that we start and finish it here today.

MR. RAMEY: Mr. Healy, it appears that you have had sufficient notice, both through the letter from Amoco and through the legal procedures of the Commission and Division. So your motion for continuance is denied.

MR. HEALY: Fine. I'd like to enter my objection to that point for the record -- in the record for appeal.

JAMES C. ALLEN

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

DIRECT EXAMINATION

BY MR. BUELL:

Q. Mr. Allen, would you state your complete name, by whom you're employed, in what capacity, and in what location, please?

A. Yes, sir. My name is James C. Allen. I'm a Senior Petroleum Engineering Supervisor with Amoco Production Company in Houston, Texas.

Q. Have you testified at prior hearings before this Commission and are your qualifications as a petroleum engineer a matter of public record?

A. Yes, sir.

MR. BUELL: Does the Commission consider Mr. Allen qualified?

MR. RAMEY: Yes, sir.

Q. Mr. Allen, in connection with your testimony here today I direct your attention to what has been identified as Amoco's Exhibit Number One.

A. Amoco's Exhibit Number One is a map of the Bravo Dome Carbon Dioxide Gas Unit area.

MR. BUELL: Off the record, please, Mrs. Boyd.

(Thereupon a discussion was had off the record.)

Q. Mr. Allen, how have you identified the outer boundary of the Brave Dome Unit?

A. The outer boundary is identified by a heavy black line.

Q. All right, sir. We're going to recommend certain operating rules here today on a temporary basis. What is your recommendation to this Commission as to the area which will be guided and governed by these temporary rules that we're recommending?

A. My recommendation is that these rules apply to all the area within the outer boundary of the Bravo Dome Carbon Dioxide Unit.

Q. That would include all the windows within the unit, acreage that is not committed to the unit, that is clearly reflected by Exhibit Number One?

A. Yes, sir.

Q. All right, sir, let's go now to the operating rules that you're recommending. Do you have a

recommendation as to surface casing?

A. Yes, sir, I do. The recommendation on surface casing is identical, really, to the statewide rule, in that we will set sufficient surface casing to protect all fresh water zones and cement will be circulated to the surface.

Q. All right sir, in that connection now I wish you'ld direct your attention to what has been identified as Amoco's Exhibit Number Two. What is Exhibit Number Two?

A. Exhibit Number Two is a typical and cementing program for an Amoco well in the Bravo Dome Carbon Dioxide Unit.

If you'll notice, in this example we show surface casing at 700 feet. We're not requesting a depth per se, but this is the program which Amoco is using at this time.

Q. Mr. Allen, do you have an extra copy of your Exhibit Number Two? I've misplaced mine.

A. I think they're in my briefcase.

Q. Thank you, Mr. Allen, I now have a copy of Exhibit Two.

I believe you made it clear that while this schematic diagram reflected on Exhibit Two shows 700

feet of surface casing, we're not recommending that that be incorporated in any kind of a surface casing rule?

A. No, sir.

Q. Has Amoco, based on a rather area-wide study concentrated in our areas of development, determined that 700 feet will in all probability protect all fresh subsurface water in areas where we're actively drilling?

A. Yes, sir, we have.

Q. And that's the reason that you show that 700 feet of surface on Exhibit Two?

A. Yes, sir, and also this is what we submit on our forms for application to drill.

Q. All right, sir, and you're recommending that this operating rule for surface casing have cement circulated to the surface?

A. Yes, sir.

Q. Do you have a recommendation to make about production string?

A. Yes, sir, I do. And again, this is reflected in our application for permit to drill, is that the production casing will be set through the Tubb formation in almost all cases and cement will be circulated back to at least the surface casing, or back into the surface casing.

Q. All right, sir, do you have any other comments on Exhibit Two?

A. Well, I could point out that this exhibit does show that cement on the production casing is circulated back to surface. In most of the wells which we have drilled on our current program, to my knowledge, essentially all the wells except maybe one or two have circulated back to surface.

Q. All right, turn your attention now to what has been identified as Exhibit Three. Is that a schematic diagram similar to Exhibit Two that simply shows that in this case it was impossible to obtain circulation of cement to the surface?

A. Yes, sir, that is correct.

Q. What do you recommend as an operating rule in the event an operator is unable to obtain circulation on his production string back to the surface of the earth?

A. I recommend that the top of the cement behind the production string be determined by either a temperature survey or some other suitable tool. We would recommend a temperature survey, and that it be furnished the conservation board.

Q. So the Conservation Commission, or Division, as the case may be, will also have -- always have in its files the top of the cement behind the production

string.

A. Yes, sir.

Q. All right, sir, do you have a recommendation to make, kind of an optional recommendation, that on the Form C-103 of the Commission that, if the Commission so desires, the cementing company that does the cementing can sign the form C-103 rather than a company or operator representative?

A. Yes, sir. The current procedure in filing the 103 shows the cementing and casing program. At the present time the producing company signs the Form C-103. If the Commission so desires, we would suggest that this be modified that when a 103 is submitted for the casing and cementing program, that it be signed by the cementing company.

Q. All right, sir, do you have any other operating rule that you're recommending to be incorporated into our temporary order?

A. Not regards casing and cementing, no, sir.

Q. So we're through with casing.

What about -- do you have any recommendation to make with regard to administrative approval to the injection of CO_2?

A. Yes sir I do. Amoco intends to run -- or anticipates running several long term flow tests within the Bravo Dome Unit between this time and prior to sales from the Brave Dome Unit to pipeline. We would like to have incorporated into these rules authority for the Division to grant administrative approval to inject carbon dioxide for test purposes only.

Q. The primary purpose will be to test the different surface facilities, and that's the reason we'll conduct these injection programs. Is it possible to conduct an interference test in conjunction with the injection of CO_2, the primary purpose would be to test surface facilities, and will we also incorporated that if it is possible?

A. Yes, sir, we will. It will also give us the opportunity to evaluate long term well deliverability, stimulation techniques, and this sort of thing.

Q. All right, sir, in conjunction with the injection of CO_2, will you turn your attention now to what has been marked and identified as our -- Amoco's Exhibit Number Four? What is that exhibit?

A. Exhibit Number Four is a schematic wellbore diagram. If you'll notice, it's essentially the same as Exhibit Number Two, except I have incorporated the production tubing which will be set on a packer immediately

above the perforated interval.

Q. All right, sir is there any reason why a well that has been used as an injection well for CO_2 for the testing purposes you mentioned could not be converted and the flow reversed and it become a producing well?

A. No, sir, in fact we'd probably do that.

Q. Although Exhibit Four is labeled a schematic diagram of the mechanical equipment in an injection well, is that also Amoco's plan for completing our producing wells?

A. Yes, sir, it is.

Q. Will you describe that? We'll set a packer immediately above the perforations, as I see this exhibit, and produce CO_2 through the tubing?

A. Yes, sir. In addition, we will load the back side of the tubing with inhibited fluid and that will be monitored for any possible casing or tubing leaks.

Q. So while this is labeled a typical wellbore sketch of an injection well, it's also typical of the way we will complete our producing wells.

A. Yes, sir.

Q. Do you have any more comments on Exhibit Four?

A. No, sir.

Q. All right, sir, I believe this case as docketed, it's going to be our recommendation that spacing units of 640 acres be adopted by the Commission for the area within the outer boundaries of the Bravo Dome Unit.

A. That is correct.

Q. Let me direct your attention to what has been identified as Amoco's Exhibit Five. What is Exhibit Five?

A. Exhibit Number Five shows the orthodox well locations which would be permitted under a location pattern of 1980 feet from the outer boundary and 330 feet from any quarter quarter section.

Q. Is that a rather rigid well spacing pattern in your opinion, Mr. Allen?

A. Yes, sir, it is rather rigid.

Q. The areas, as reflected by this exhibit, all tend to be almost in the center of a 640-acre spacing unit. Is my observation correct?

A. They'll be located essentially in the center 160 acres of the 640, yes, sir.

Q. All right, sir, turn your attention now to what has been dentified as Amoco's Exhibit Six. What is that exhibit?

A. This is the same type of exhibit, showing

the orthodox locations for wells with well locations being 1650 feet from the outer boundary, 330 feet from the quarter quarter sections, and these are rules which I believe are now applicable in the Indian Basin Field.

Q. This is the more recent well spacing pattern for a 640-acre spacing unit that has been adopted by this Commission, is that correct?

A. On 640, yes, sir.

Q. Yes. Yes. Is some of the terrain within the outer boundaries of the Bravo Dome Unit rather rough terrain, so to speak?

A. Yes, sir

Q. Which one of these spacing patterns, well spacing patterns, as reflected by Exhibit Five and Six, do you recommend be adopted by the Commission?

A. I'd recommend number -- Exhibit Number Six. It allows more flexibility in locating the wells. It would probably also allow us to utilize existing roads somewhat better than more rigid, and I think it would also reduce the number of unorthodox locations due to topo reasons.

Q. Is it Amoco's policy in the areas of the Bravo Dome Unit which we're developing to utilize the existing roads to the maximum possible extent?

A. Yes, sir.

Q. And the spacing pattern, well spacing pattern represented by Exhibit Six would give us more opportunity to utilize existing roads?

A. Yes, sir, it would.

Q. Mr. Allen, do you have anything to add to your testimony; any questions that I have overlooked asking you?

A. No, sir.

MR. BUELL: May it please the Commission, that concludes my direct of Mr. Allen. I tender him for cross examination at this time.

MR. RAMEY: Thank you, Mr. Buell. Any questions of Mr. Allen?

MR. HEALY: Yes.

MR. RAMEY: Mr. Healy.

CROSS EXAMINATION

BY MR. HEALY:

Q. On the question of casing and cementing, is a temperature survey required in all cases?

A. I don't believe it is required, no, sir. We routinely run when we cement a well and cement does not circulate to surface.

Q. Then a temperature survey wouldn't be

required if cement circulated to the surface.

A. That's correct it would not be required.

Q. Then on the question of injection well conversion, is a packer required in all cases?

A. I believe the rule for injection wells normally does require a packer. I could be mistaken in that, but we do plan to run a packer.

Q. Does that imply that packers would be required in all producing wells?

A. In this case, Mr. Healy, I did not specify including a packer rule in our application. All I was showing the Commission was the manner in which we would equip our injection wells.

Q. And on the question of spacing, I just wanted to be clear, you've commented on the recommended pattern for the spacing of wells in 640-acre spacing, if adopted, is that correct?

A. Yes, sir, the last two exhibits.

Q. But you haven't commented on whether 640-acre spacing is warrented by any evidence as better than 1640-acre spacing.

A. Mr. Healy, I did recommend 640-acre spacing, the reason being that it will provide for a more uniform and orderly development within the Bravo Dome Unit

area.

Q. I'm sorry, I didn't hear that recommendation in your direct testimony.

Could you amplify the reasons for recommending the 640-acre spacing?

A. Yes, sir. The primary reason is to provide for an orderly and uniform development within the area. 640-acres would certainly do that. In addition, I think it would add incentive to more -- to accelerate wider drilling within that area.

Q. Do you think it would prevent waste and permit recovery of the maximum amount of CO_2 out of the field?

A. Yes, sir, I do. By utilizing a 640-acre spacing initially I think we can assure that unnecessary wells will not be drilled.

Q. Can you explain or expand on your data that led you to those conclusions?

A. Primarily the geological data which has been presented at previous hearings. It showed the probability that we can drain 640 is there.

Q. I'd like to clarify for the record whether we're incorporating material in previous hearings. I was under the impression that we were going to treat this as a fresh consideration of the whole subject and look at --

consider documentary testimony -- evidence by way of exhibits, as well as complete testimony for the record as to whether or not spacing is proper or not.

MR. RAMEY: Mr. Healy, there has been no request for incorporation of any testimony from any previous hearings today.

MR. HEALY: Thank you.

MR. RAMEY: I personally think you're asking Mr. Allen questions that he hadn't testified to.

MR. HEALY: I don't believe he testified to that on direct. I was just trying to establish that --

MR. RAMEY: Perhaps he shouldn't answer or perhaps his counsel should make some kind of a statement. Mr. Buell?

MR. BUELL: May it please the Commission, the Commission can consider anything in this record from the previous hearings with regard to this hearing without any specific motion for incorporation being made. I have no objection to incorporating any record that Amoco has made relating to Bravo Dome specifically into this case.

MR. HEALY: I have no objection either. I'd like to repeat my earlier comments on that testimony, that I believe it's insufficient to establish 640-acre spacing as proper, particularly with regard to prevention of waste.

MR. BUELL: May it please the Commission, frankly I don't understand Mr. Healy's area of concern. Could you elaborate, Mr. Healy? Maybe I'm just having difficulty understanding.

MR. HEALY: Well, the basic question on this spacing issue is whether 640-acre spacing per well is the best method of recovering the maximum amounts of CO_2 out of the Bravo Field economically.

Our position is that it is not; that 160-acre spacing, based on our own experience in our corner of the field, is the most that we should consider by way of spacing, and if we go to 640-acre spacing, there's a possibility and even stronger, likelihood, that we will not recover all the CO_2 that's in the field when we go back and infill drill later on, and we have -- we have a witness here who will expand on that point. I don't want to testify myself, but I think Mr. Buell knows my position from the last hearing, and up to this point I haven't heard anything to change our position, and that's why I was trying to have the witness explain his recommendation, which, as I say, I don't think there's any record by direct testimony.

MR. RAMEY: I don't think Mr. Buell asked him to make any recommendation as to 640-acre spacing. I think he was just covering the rules.

And I assume, Mr. Buell, you will have more witnesses to go into the merits of 640-acre spacing.

MR. BUELL: Yes, sir, I certainly will, Mr. Ramey, and I would suggest if Mr. Healy has evidence that one well would only effectively and efficiently drain 160 acres, that he should present it in opposition to our case for 640-acre spacing.

MR. HEALY: Absolutely. My original question to the witness was to make it clear that he hadn't recommended anything about the merits of 640-acre spacing.

MR. RAMEY: Well, I think your -- I think your questions to Mr. Allen are a little premature on -- or on a subject that he hasn't covered in his testimony. And I think this will probably be covered by the next two witnesses, perhaps.

MR. HEALY: Fine. What I have established is that he hasn't commented on the merits of the change, just the spacing matter.

MR. RAMEY: Any other questions of Mr. Allen? Mr. Nutter?

QUESTIONS BY MR. NUTTER:

Q. Mr. Allen, now you propose that these rules would be applicable to the Bravo Dome Unit area. Now

there are lands within that unit area, as outlined on your Exhibit A, there, that are not committed to the unit, are there not?

A. Yes, sir, I believe that I actually testified that we wanted these rules to apply to all area within the outer boundary of the unit, so those windows --

Q. Whether they were committed or not?

A. Yes, sir.

Q. Okay. Now there are wells within that unit area that have been drilled on lands, that have lands dedicated to them, of less than 640 acres, are there not?

A. Yes, sir, there are.

Q. Now, the statutes of the State of New Mexico provide that carbon dioxide production would be treated in the same manner by this Commission and Division as natural gas, or hydrocarbon gas production. I presume that would include rateable take.

Now, what provision have you made in your proposed rules for rateable take on those wells that had less than 640 acres dedicated to them?

MR. BUELL: May it please the Commission, that's not an engineering question. I'll answer it if it's a legal question.

There's no provision that the rules we

are recommending are for ratable take, that are in the statutes of New Mexico and the New Mexico Oil Conservation Commission or Division rules.

MR. NUTTER: Well, I'm wondering what provision your rules are making, Mr. Buell, whether they're making any provision for rateable take and the protection of correlative rights, or if you're just going to overlook that question in the proposed rules.

MR. BUELL: May it please the Commission, we have not overlooked that question. That question arises automatically out of the existing statutes and the Division and New Mexico conservation rules.

There are many gas pools and gas areas in New Mexico that are not prorated. Rateable take comes into the picture after a pool or an area is prorated.

The recommended rules we're making here today will not affect the existing wells, topside or bottom, from a standpoint of their production, from the standpoint of the acreage that is currently assigned to them, whether it's 40 acres or 160 acres.

MR. NUTTER: I beg to differ with you, Mr. Buell, because rateable take has nothing to do with proration. Rateable take is rateable take. Prorationing is limiting production to market demand.

MR. BUELL: Prorationing is also the mechanism that this Commission uses to enforce rateable take.

MR. NUTTER: Again I beg to differ with you, Mr. Buell, because the Commission on numerous occasions in the past has issued rateable take orders in the absence of proration orders.

MR. BUELL: All right, I'll say this, Mr. Nutter, to shorten this, if any operator within the outer boundaries of the Bravo Dome Unit feels that he is being subjected to unrateable take, then I would suggest that he come in, the example that you mentioned, Mr. Nutter, and apply for rateable take order.

MR. NUTTER: But presumably an operator who has a 40-acre tract dedicated to a well within the unit boundary would be limited to 1/16th of the production of a well on a 640-acre unit if rateable take were enforced, is that correct?

MR. BUELL: No, Mr. Nutter, that is not correct.

MR. NUTTER: What would he be limited to?

MR. BUELL: He'll be limited to the amount of CO_2 that he can deliver and sell, just like a natural gas well.

MR. NUTTER: And under rateable take that would be on an acreage basis per unit, wouldn't it?

MR. BUELL: If the Commission would decide that it took an acreage basis for rateable take, yes.

MR. NUTTER: Okay, we'll leave this for a minute.

Q. Now, Mr. Allen, there have been no defined limits to any gas pool in the Bravo Dome Unit area or in the adjoining gas production areas, have there?

A. Not to my knowledge.

Q. Now is there any reason to believe that any pool is -- the productive limits of any pool are going to stop at the outer boundary of the unit area, although some of those pools probably extend into the unit area and outside the unit area?

A. Mr. Nutter, I don't think that the productive limits have been completely rigidly defined in this area. This is one of the reasons for a temporary request rather than permanent rules.

Q. As a matter of fact, the known productive area, particularly on the southwest side of the Bravo Dome Unit area, extends beyond the unit boundary, is that correct?

A. Yes, sir, there are some wells over there outside the unit area.

Q. So assuming that that would be one commos source of supply within the unit area and outside the unit area, you're proposing two different spacing patterns for the same pool, is that correct?

A. The wells outside the outer boundary would be a different rule than we're requesting for the inner boundary. That is correct. However, rights would be protected by the unit drilling whatever wells necessary to protect those correlative rights in those areas.

Q. Do you know of any cases where the Commission has established two separate spacing patterns for a given pool?

A. Mr. Nutter, I know of some field that butt up against each other where spacing is 320 in one section and 160 on another. I can think of at least one field where the interior is on 160's and the wells around it are on 320's, yes, sir.

Q. But do you know of any cases where the Commission has two separate spacing patterns for any given pool?

A. For a given pool, no, sir.

Q. So we would have under your proposal there, we would have 640 acres in the unit portion of a pool and 160 acres for the non-unitized portion of a pool, is

that correct? Under your proposed rules.

A. The 640-acre, which we propose in our rules, apply to the Bravo Dome Unit Gas Area. We may find that there may be more than one common source of supply within it as we develop it, in which case special field rules, such as could be adopted for the interior wells now existing, could be applied for a hearing, and notice of said hearing.

Q. I'm not talking about the pools inside the unit area. I'm talking about the pools that cross the unit boundary. You'd have 160-acre spacing on the outside and 640-acre spacing on the inside of the unit, is that correct?

A. Initially that would be the case; however again I mention that along, particularly, the west line, that wells necessary to protect correlative rights would be drilled.

And again I point out that our rules do not tie us to only one well in 640 acres.

Q. Mr. Allen, I grant you that your application was for 640-acre spacing rules in the Bravo Dome Unit area, and I prepared the legal notice for this case and made it apply to the Bravo Dome gas producing area, because of that very fact that there are pools that are going to cross the unit boundary, and that would be in

violation of past Commission policy to create pool rules of one spacing size for one pool and another spacing size for the other part, and knowing full well that some of those pools are going to cross the unit boundary is the reason that that advertisement of this case was prepared in the manner that it was.

MR. NUTTER: I believe that's all the questions I have of Mr. Allen.

MR. RAMEY: Any other questions of Mr. Allen? Mr. Stamets.

QUESTIONS BY MR. STAMETS:

Q. Mr. Allen, did I understand you correctly to say that the surface casing rules are essentially identical to the statewide rules?

A. Mr. Stamets, as I recall Rule, I think it's 107, I think it's required to circulate cement back on the surface casing, and that casing be set to sufficient depth to protect fresh water. Our intent is to see that surface casing is set to a sufficient depth to protect all known fresh water sands and that the cement be circulated to the surface.

Q. So the Commission wouldn't have to rewrite that rule --

A. No, sir, they would not.

Q. You also suggested that the cementing company could sign the 103. If the Commission decided not to do that, would you have any objection to a separate form being designed for the cementing company to sign relative to their operations, which would be submitted with the 103?

A. I would have no objection at all, Mr. Stamets. The reason for utilizing the 103 was in an attempt to just not add another sheet of paper for the Commission to handle.

Q. Then you discussed injection of CO_2 for test purposes. Under those conditions, would that CO_2 be a dry stream? Would there be any liquids associated with it or would you only inject dry CO_2 gas?

A. Injection which we plan to do, the injection here would be dry CO_2, after dehydration.

Q. And what time period are you looking at for the length of this type of test?

A. We haven't really specified any time period. In fact, at this moment I don't know whether we've actually picked a site where we want to run an injection -- or a long term flow test.

I would assume, though, that in the case we'd be looking at a period in excess of six months.

Q. And --

A. It could be as long as a year.

Q. Six to twelve months, then? Mr. Allen, are you familiar with the -- what's called the Southeast Chaves-Queen Gas Area?

A. I am familiar that there is one there, Mr. Stamets. I have not familiarized myself in detail with it.

Q. Is that an area with special pool rules that doesn't bear a pool definition in itself?

A. I don't recall that -- that it does. It may.

Q. Well, let me suggest to the Commission that they may want to review that. I believe that that's what the record will shows there.

How about the Basin Dakota pool rules? Are you familiar with those?

A. No, sir, I'm not.

Q. I would suggest that perhaps that's another area the Commission might want to look at to see a situation where one set of rules could exist, and if something is discovered that's different later, different rules could be applied within the same horizontal boundaries.

Do you have any idea at this time how

many wells exist within the boundaries of the -- of the unit, which wells are not Amoco wells, and which wells are on 160-acre spacing?

A. Mr. Stamets, I don't know whether all the wells -- to the best of my knowledge this map shows all the wells that exist, and I believe within the Libby area there's -- we showed seven wells. Whether they have dedicated 160 acres to each one, or not, I assume that they have.

Also --

Q. The Libby area, could you define that somehow?

A. Yes, sir, the area I'm speaking of is located in Township 20 North, Range 31 East, southwest portion of that township.

Q. The wells in there have names like Schwartz 1-X, DeBaca 1, DeBaca 2, and so on?

A. Yes, sir.

Q. Okay.

A. The number of wells within the unit area, I believe we have approximately about 111 at this -- at this time.

Q. Those are all under Amoco's authority and dedicating 640 would be no problem, is that correct?

A. That is -- that is correct. I think

that number does include the wells which were drilled for our interference testing, and which, of course, were 660 feet apart, so we would have some problems there.

Q Now, in response to Mr. Nutter's questioning, I thought I heard you say this, and if you didn't, would you please let me know.

I think I heard you say that this would be an area with special rules, but if there were pools clearly defined within this area, there would be no -- and perhaps even crossing the line -- you would see no reason why pool rules could not be adopted for those individual pools which would be different from the Bravo Dome rules?

A I see no reason at all. In fact, that was the way I foresee this, that if areas do develop where the 640 is not applicable, after notice and hearing, special rules could be adopted for that specific area.

MR. STAMETS: That's all.

MR. RAMEY: Mr. Ulvog?

QUESTIONS BY MR. ULVOG:

Q Mr. Allen, I realize that you're talking here about just temporary pool rules, but quite often temporary pool rules become permanent, so I think it's pertinent to find out a couple of things.

For instance, what would your disposition be of produced water?

A. Mr. Ulvog, to my knowledge at this time, I guess we'd have to haul it or use an evaporation pit. When we have sufficient water that has to be disposed of, I would recommend that we would probably try to drill a disposal well and would comply with what the rules are of the Commission for that purpose.

Q. Would this apply to the entire unit area, then? Would this be -- would this be part of your recommendation for pool rules, that this be incorporated in there and that it apply to all of the producing area that you intend to --

A. I'm not recommending that we specifically write it into it. I believe the statewide rules cover that pretty well.

Q. And now with respect to the -- some type of bond log, temperature survey, and so on, to determine where your top of cement is when it's not circulated, or you get a tieback on the production casing to the surface, does this also apply to all wells within the unit area?

A. I would recommend that, yes, sir.

MR. ULVOG: All right.

MR. RAMEY: Mr. Padilla.

QUESTIONS BY MR. PADILLA:

Q. Mr. Allen, has Amoco run any new flow tests or interference tests since the last 640-acre application?

A. Did you say flow tests or interference tests?

Q. Either.

A. I don't believe we have, other than just the completion testing for a few days, but not -- not any interference test, per se.

Q. In other words, since the last hearing on 640-acres for this area, 640-acre spacing for this area, you have not made any additional testing to -- as far as interference tests or flow tests?

A. Not interference tests, no, sir, flow tests.

Q. Have you done any other type of testing to determine drainage?

A. Mr. Padilla, I don't think that we can, as we said before, can actually determine the -- we feel that the opportunity, and the probability, that we can drain 640 does exist, which I think our subsequent witnesses will show, but to actually see interference on a 640-acre

basis would take production, which, of course, we have no outlet at this time.

So we do need to establish production for a significant length of time to actually see what I would think would be a meaningful interference test under 640-acre spacing.

Q. I think what you just told me was that you haven't done anything as far as drainage testing.

A. That was actually running tests, that is correct, to my knowledge.

MR. PADILLA: I have nothing else.

MR. RAMEY: Do you have a question, Mr. Buell?

MR. BUELL: I have one question on re-direct, Mr. Ramey.

REDIRECT EXAMINATION

BY MR. BUELL:

Q. Mr. Allen, I failed to ask you, I think you covered it in your cross examination, but for the record to be clear, you're not recommending that our order prohibit the drilling of more than one well to a 640-acre spacing?

A. No, sir, I'm not.

Q. And any well that could be located on

a 640-acre spacing unit within the purview of the well spacing pattern that this Commission adopts in their order, could be drilled by an operator simply by applying for a permit to drill a well and drilling it at a permitted, orthodox location?

A. Yes, sir.

MR. BUELL: That's all I have, may it please the Commission.

I would like to formally offer our exhibits, Exhibits One through Six, inclusive.

MR. RAMEY: And Exhibit A, also? Are you offering that?

MR. BUELL: Exhibit A also. I forgot Exhibit A.

MR. RAMEY: Okay, Amoco's Exhibits A, and Exhibits One through Six, will be admitted.

MR. HEALY: May I ask another question on recross in response to the redirect?

MR. RAMEY: Certainly.

RECROSS EXAMINATION

BY MR. HEALY:

Q. Is there any penalty that can flow from asking for a permit to drill an additional well that's not

permitted by the temporary spacing rule on a 640-acre basis?

A. We are speaking now about, say, a second or third well on a 640-acre spacing unit?

Q. Right.

A. At this time there would be none unless proration were established. There would be no penalty.

Q. Then it's possible that prorationing -- that there could be prorationing that would limit the production?

A. It's possible, that should the deliverability far exceed the market that could occur.

MR. RAMEY: Any other questions? Mr. Allen, you may be excused.

MR. RAMEY: Let's have a fifteen minute recess.

(Thereupon a recess was taken.)

MR. RAMEY: Are you ready to press upward and onward, Mr. Buell?

The hearing will come to order.

MR. BUELL: We'd like to call next, Mr. Commissioner, Mr. May.

BRUCE I. MAY

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

DIRECT EXAMINATION

BY MR. BUELL:

Q. Mr. May, would you state your complete name, by whom you're employed, in what capacity, and what location, please?

A. My name is Bruce I. May. I'm employed by Amoco Production Company as a petroleum geologist, Houston, Texas.

Q. Have you testified at prior Commission hearings and hare your qualifications as a petroleum geologist a matter of public record?

A. Yes, they are.

MR. BUELL: Are there any questions as to Mr. May's qualifications as a petroleum geologist?

MR. RAMEY: No questions, Mr. Buell. He is considered qualified.

Q. Mr. May, by way of background, when were you first given the geological assignment to work in the Bravo Dome CO_2 area?

A. August of 1979.

Q. Since that time have you continued to study and geologically work the Bravo Dome area?

A. Yes, I have.

Q. Approximately how much of your time have you spent since August of 1979 just working the Bravo Dome area?

A. 100 percent.

Q. 100 percent of your time. Do you recall when you were given the assignment in August of 1979 approximately how many wells, date from which you had to make a geological study?

A. Yes, approximately 42 wells.

Q. How many wells, approximately, do we have at this time?

A. I believe we have, let's see, 111, over 111.

Q. Over 100 percent increase from a standpoint of well data alone.

A. That's correct.

Q. All right, sir. In your continuing studies, were you given the assignment to undertake a study to improve Amoco's well completion techniques?

A. Yes, I was.

Q. Approximately what date did you undertake that study?

A. I undertook it approximately August of 1980.

Q. At the time that you undertook that study there was no contemplation that the work you were doing in that connection would ever be used for a spacing hearing like this one today?

A. No, it was not.

Q. Have a lot of the exhibits that you will present, your geological exhibits, they were prepared strictly in connection with that study and not specifically for this hearing today.

A. That's correct.

Q. And some of your geological exhibits were prepared specifically for this hearing, is that correct?

A. That's correct, also.

Q. All right, we'll try to point those out as we go along.

What was your study to improve our completion technique, what did it primarily consist of, just in a general fashion, Mr. May?

A. Well, the study was primarily looking at the core data that we had collected from approximately 42

wells, 41 wells, to be exact; core data, plus the density logs that we had from those wells; taking that data, cross-plotting that data to adjust it to a calibrated porosity, and then in turn using the core data and the permeability measured in the core data to generate gamma ray permeability depth plots.

Q. Would it be a fair summary to state that the objective of your study was to make sure that Amoco was exposing in their completion of CO_2 wells the maximum possible amount of pay?

A. Yes, that's true.

Q. Is there any way you geologists and engineers can factually determine permeability in a rock other than purported?

A. No, there is not.

Q. In the geological and engineering professions, primarily geological, is there a scientific technique available to you where you can relate not only porosity obtained from a core, but permeability obtained from a core to an electric log?

A. Yes, there is, using a cross-plotting technique of density porosity and the core porosity, and the core porosity versus the permeability, we can determine permeability from a density log.

Q. Would that be measured, technical, or scientific tool you were using in your study to assure that in our completion we were exposing all possible pay, CO_2 pay, to the wellbore?

A. Yes.

Q. All right, sir, in connection with that technique, let me direct your attention to what has been identified as Amoco's Exhibit Number Seven. I'm going to ask you to come over to where it's hanging on the wall, and since you're moving away from the reporter, I'm going to ask you to speak up distinctly and project. Also, unfortunately, you're going to have your back to both the reporter and the Commission, so you'll really have to project.

A. Okay.

Q. Is Exhibit Seven a graphical presentation, a pictorial presentation of the cross plotting techniques that you used in making your completion study?

A. Yes, it is.

Q. All right. It appears to be divided into two parts. The upper portion has a broad, general heading of Calibration Technique, and the bottom part of it has a series of graphs and plots and insert map.

Let's start first on the upper portion. What is the first item on the lefthand side of the upper

portion of Exhibit Number Seven?

A. This side is a density porosity log based on a limestone matrix that we received from Schlumberger when they -- after we drilled the well and they logged it.

Q. Is it customary on at least the initial set of logs, or suite of logs, as some people call them, to run a log with a tool calibrated on a limestone matrix, even though you know you're logging a sandstone?

A. Yes, traditionally that has been the case.

Q. Also, do you have a simple formula or equation by which you can convert the limestone matrix to a sandstone matrix?

A. Yes.

Q. Have you made that correction on the upper portion of your Exhibit One?

A. Yes, I have. The log indicated here --

Q. By "here" you're pointing to the center log of five logs on the upper portion of Exhibit Seven?

A. That's correct. Here I've used a 2.68 sandstone matrix for the porosity, and the dark line indicated here is that porosity on a 2.68 matrix.

Q. So it's corrected on the middle log on

the upper portion of Exhibit Seven?

A. That's right.

Q. All right, let's go now to the next log to the right of the density log, and let's see, that was on Amoco's State "FI" No. 3 Well, is that right?

A. That's correct.

Q. What is your next log on the upper portion of Exhibit Number Seven?

A. This is the actual core analysis that we received from CORE Laboratories. We cored the upper portion of the Amoco State "FI" No. 3, and this is the porosity mreasured from CORE Laboratories.

Q. Now you're pointing to the characteristics, or the wiggles, on the righthand side of the CORE log, is that correct?

A. Yes, that's correct.

Q. What is on the left?

A. On the left of the depth column we have permeability that they measured at CORE Laboratories.

Q. And what's on the extreme left?

A. The extreme left is a gamma ray, which is used to shift the core data to better match the density porosity log.

Q. All right, sir. Now we need to go to

the center log on the upper portion of Exhibit Seven that we've mentioned before, or do we need to go now down to the lower portion of Exhibit Seven?

A. I might just want to point out that this dark line under this third column here --

Q. And you're pointing to the log, the middle log, the third from the left?

A. That's correct.

The solid line is the density porosity in the sandstone matrix. Also plotted here is the -- in a dashed line -- is the core porosity that we received from CORE Laboratories, so you can have visual comparison of both of those.

Q. All right, sir, now let's go down to the lower portion of Exhibit Number Seven, and let's start with the graph in the lower lefthand corner. Were you working up on that graph a cross plot of porosity?

A. Yes, I was. What I did was, I took the density porosity and also the core porosity from all wells that we had cored within the field, 41 cores, and cross plotted them to see a relationship between density porosity and actual core porosity.

Q. So you had available to you in making your study the density logs of 41 wells and core data from 41

wells.

A. That's correct.

Q. And directing your attention back now to the upper portion of Exhibit Seven, did you go through this same procedure that we're showing on the upper portion of Exhibit Seven with respect to all 41 wells?

A. Yes, I did.

Q. All right, sir, now let's go back to the lower lefthand graph or plot on the bottom of Exhibit Seven. After you put all of these data points on from your density porosity and from your core porosity, what then did you do?

A. I drew a line through the massive area of points, indicating that there was a relationship between the core porosity and the density porosity. That line is indicated here in red.

Q. All right, sir, and the upper portion of this graph we're talking about in the lower lefthand corner of Exhibit Seven, I notice your red line, your cross plot or your median line, in the upper righthand corner goes through an area that appears to be predominantly white. Can you explain that?

A. Yes. When we Xeroxed this, this particular area is solid black. When we Xeroxed it, due to the reflections of black, it didn't come out totally dark, and

it came out a little white in that particular area, but that is a solid concentration of points.

Q. So you just had so many points in here, this area that we're talking about, that it was black and as a result of Xerox reproduction or however you produce it, instead of coming out black it came out white?

A. That's correct.

Q. All right, sir, now that was using data on 41 wells, the density logs, and the core data. It appears that you have a very wide scattering, or I might even call it a shotgun scattering, of your data points in which you had to draw your cross plot or median line. Did you do anything to confirm in your own mind that you had actually drawn your cross plot line in the proper place?

A. Yes. I took the wells with the least amount of scatter, a total of 16 wells, that seemed to have -- not have the shotgun pattern, and I cross plotted those up here in --

Q. Now you say "up here", we're moving now to the graph just above the graph in the lower lefthand corner of Exhibit Seven?

A. That's correct.

And I saw this same type of straight line relationship and I felt confident that the line I'd

drawn down here was the correct line for this relationship between density porosity and core porosity.

Q. And the sixteen wells you used on your confirmation curve are listed in the righthand portion of the graph?

A. That's correct.

Q. All right. Let's go to the insert map now in the upper righthand portion of the lower portion of Exhibit Seven, and it appears to be an inset map of the outline of the unit area and you have some wells colored with the various symbols. What's the significance of that?

A. The symbols indicated in here that are colored are wells that I used in the two top cross plots, indicating that -- where I took these wells over here to confirm my line down in the lower lefthand corner, they were actually geographically distributed throughout the field and were not concentrated within one particular area.

Q. All right, sir, and then you found that using the sixteen wells with fewer scatter points, that you would draw approximately the same cross plot line in that manner as you had using all the wells.

A. That's correct.

Q. All right, we now have a cross plot of porosity, density log porosity versus core porosity. What's

the next thing that you did?

A. The next thing that I did is I took the density porosity based on a sandstone matrix, using the computer I entered it into this relationship and generated what I call a calibrated porosity.

Q. You're now pointing to the upper portion of the exhibit, the fourth log from the left?

A. That's correct.

Q. And it says it's calibrated porosity.

A. That's right.

Q. What does that show?

A. This shows the actual core calibrated porosity, the dark line, and also, dashed is the actual core porosity that we got from CORE Labs.

Q. So ycu can actually make a comparison here to see that if your porosity cross plot, how it compares with the porosity from the density log alone on the Amoco State "FI" No. 3?

A. That's correct.

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

A. The next thing I did is I took those 41 cores and I cross plotted the core porosity and the permeability, and again I found the relationship between the core

porosity and permeability.

Q. And then you drew your cross plot line.

A. That's correct.

Q. Really, the ultimate goal of this technique is to be able to relate permeability to the log of a well.

A. That's correct.

Q. All right, sir, now on your permeability cross plot did you find you had the same kind of a shotgun scattering of points that you had on your porosity cross plot?

A. Yes, I did find quite a few points that were a shotgun pattern.

Q. Did you make a similar study of permeability on a fewer number of wells to confirm the accuracy of your cross plot using all wells?

A. Yes. What I did is I took 13 of the best -- 13 of the wells that lacked that shotgun pattern and cross plotted core porosity versus permeability.

Q. You're now pointing to the graph immediately above the permeability cross plot on the lower portion of Exhibit Seven.

A. That's correct.

Q. And what did you do after you plotted

those points?

A. I drew a line through those points indicating that relationship using these 13 wells. I went down and compared that to what I'd drawn for the total wells, and it was good agreement.

Q. All right, sir, and again, as was the case in porosity, the wells you used on your confirmation curve are indicated by the symbols on the insert map on Exhibit Seven?

A. That's correct.

Q. And do they, as was the case in the porosity, show that while you had selected these wells for a specific purpose, the fewer most scatter points, that we do have good geographical distribution throughout the entire Bravo Dome Unit area?

A. Yes, we do.

Q. All right, sir. Now, once you have your cross plot of permeability, how do you get it to an ordinary density log or electric log?

A. Okay, what -- what I did is I took the calibrated porosity here, the second -- in the second depth plot second to the right, and entered it into this relationship here.

Q. Now "here", you're pointing down to the

cross plot of permeability?

A. That's correct. And generated a permeability. We did this with the computer and as a result we generated a depth plot of the permeability in that particular well. This appears to be --

Q. Now you're now directing your attention to the last log on the right of the upper portion of Exhibit Seven.

A. Yes, that's correct.

Q. What do we depict by that log?

A. We depict the calculated permeability, which is the solid line on this depth plot on the righthand side. We also have the actual core analysis for the "FI" No. 3 that we got here from CORE Laboratories, and we plotted those on this depth column so one can visually see how this calculated permeability compares with the actual permeability from core analysis.

Q. All right, sir, now is this technique a technique that is accepted and customarily used in the industry?

A. Yes, it is.

Q. Is it a 100 percent accurate?

A. Technique? No, it is not a 100 percent accurate technique.

Q. Is it accurate enough that companies expend capital in reliance on its accuracy?

A. Yes.

Q. Is it your understanding that Amoco is going to use the work you have done to improve their completion techniques in not only future drilled wells but go back in in wells that are already completed and conform with what your geological study recommended?

A. Yes.

Q. All right, sir, do you have any other comments on Exhibit Seven?

A. No, I do not.

Q. Let's go to Exhibit Eight, which is cross section EX-EX'. Is this an exhibit that you prepared, using your completion technique study, that you prepared this exhibit specifically for this hearing?

A. That's correct. This was prepared just for this hearing.

Q. Now you'll have a subsequent number of cross section exhibits. Do they use the same format as you are using on Exhibit Eight, cross section EX-EX'?

A. Yes, they use the same format.

Q. All right, let's go through the format. Let's start with the upper portion and then work our way down

into the body of the cross section.

What format did you use on Exhibit Eight?

A. What I did is I have depth plots of calculated permeability for the three wells. Above each well I have a number which corresponds to the number of an index map on the righthand side of this cross section, indicating the distance between wells on this map. Also the distance between wells is indicated up here in between the numbers at the top of the cross section.

Q. So you have a key well number, starting with number one, and two, and three of this exhibit. In other exhibits it will be four going from left to right.

In addition to identifying the well from which the log was taken, is the normal log heading.

A. That's correct.

Q. All right, sir, now what wells did you use in this particular section?

A. I used the Amoco State No. 1 "FI"; the Amoco State No. 2 "FI"; and the Amoco No. 1 Anglin.

Q. All right, sir, looking at this exhibit I see that the two state wells are only 660 feet apart and the Anglin well is some 2-1/2 miles to the south.

A. That's correct.

Q. All right, sir, let's go back to Exhibit

Seven once more, and I'll ask you in doing your completion improvement study, what permeability cutoff did you use?

A. I used one millidarcy permeability cut-off. I felt that one millidarcy gas could flow through that permeability.

Q. So it's your geological recommendation to Amoco that any intervals that have at least permeability of one millidarcy be exposed to the well.

A. That's correct.

Q. Not only in completion but so that any stimulation techniques that follow, that interval will be subjected to stimulation?

A. That's correct.

Q. All right, sir. Now I think we're ready to go back into the body of your Exhibit Eight.

Why don't -- we followed the same format that you followed in presenting cross sections in previous Commission hearings, did we not? To bring our recollection up to date and refresh everyone's memory, what is the area across this section, left to right, directionally it would be north and south, that you've colored in blue?

A. What I've done is I've hung these cross sections on top of the Tubb, base of the Cimarron anhydrite. What you see colored in here in blue is the Cimarron anhydrite,

which is my stratigraphic marker.

Q. Is the Cimarron anhydrite the caprock that forms a trap for the CO_2 that we find in the Tubb?

A. Yes, sir, it is.

Q. All right, sir. Now, I'm going to skip down to the bottom on you, and go down to the lowest line that you have running from left to right across this section. What does that represent?

A. The line, the wavy line that is colored in brown at the base of the cross section, is the top of the Basement, labeled appropriately.

Q. All right, sir, now let's go back to the body of your section. Based on your cross plotting technique of permeability, what are you depicting on this exhibit between the Cimarron Anhydrite and the Basement rock?

A. What I'm depicting is the permeability in the section that we have perforated or above which we have a -- above a bridge plug.

So I have correlated here everything that's perforated or above which we have a bridge plug if that well had one.

Q. All right. What is the significance of the area on this exhibit below the top of the Cimarron Anhydrite that you have shaded in orange?

A. Everything that is shaded in orange has a permeability greater than one millidarcy.

Q. Now I notice there are not many on this particular exhibit but there are some intervening white streaks. What are they? Now I see that that's where you have permeability of less than one millidarcy?

A. Yes.

Q. All right, sir. As I recall, State "FI" No. 1, State "FI" No. 2, key number wells numbers one and two on this exhibit, were used in a previous short term interference test that was run. Is my memory correct?

A. Your memory is correct.

Q. The third well on your exhibit, the Anglin, it has not been involved in an interference test, is that correct?

A. No, it hasn't.

Q. What I wish you would do is compare the rock in wells one and two on this section that have in excess of one millidarcy permeability, one with the other. In other words, compare wells one and two, key wells one and two.

A. Looking at the wells one and two, we can see a great deal of section that is greater than one millidarcy permeability that is in continuity with these two wells, the "FI" 1 and 2; a great deal of the section

has permeability greater than one millidarcy.

Q. So just looking at this exhibit and the rock colored orange, permeability of one millidarcy or greater, you have no difficulty in seeing the continuity between these two wells?

A. No, I don't.

Q. And as I recall, all the pressure draw-down, pressure interference, was experienced in those two wells.

A. Yes, it was.

Q. All right, now let's go over and examine the reservoir rock in the Anglin Well, some 2-1/4 miles to the south. What do you find there?

A. Again I find a great deal of permeability of greater than one millidarcy in the section that I can correlate to the Amoco State No. 2 "FI". A great deal of section has permeabilities greater than one millidarcy.

Q. Do these data indicate to you that there is a geological probability when we go from the known, I say known from the standpoint of pressure interference, to the unknown, now I'm referring to the Anglin Well, that you have continuity of reservoir rock of one millidarcy or greater, to the extent that it is a geological probability?

A. Yes, I believe it's a geological

probability that -- that the State "FI" No. 2 and the Anglin are in continuity, based on permeability.

Q. And is it clearly indicated that one well, at least in this particular area, would be able to drain a large area?

A. Yes.

Q. Let me ask you one general question before we leave Exhibit Eight.

When you were just working with logs that were available to you, density logs, on wells that were located on a linear distance miles away from each other, did you have difficulty in correlating the perforated intervals in one well to the perforated intervals in another well?

A. Yes, I did.

Q. Prior to the time that you did your cross plotting work did you have any idea that you would see the continuity of reservoir rock of one millidarcy or greater permeability as we see reflected on Exhibit Number Eight?

A. I never dreamed it would be this way.

Q. So at least on this section, and we'll get to the other sections later, you have no difficulty in correlating from one well to another well a continuing interval of one millidarcy or greater permeability?

A. That's true.

Q. Do you have any other questions you'd like to -- any other testimony you'd like to add to your Exhibit Eight?

A. Yes, I would like to point out that the Amoco State No. 1 "FI", what appears from the "FI" No. 1 to the "FI" No. 2, one can see a great deal of discontinuity in the log character, but again, these two wells were found to be in pressure communication.

Q. We do not see that in the similarity of log character when we are working with intervals of one millidarcy or greater permeability?

A. That's true.

Q. All right, sir, are you ready now to go to your Exhibit Nine?

A. Yes, sir.

Q. I believe it is over here on the far wall and I'm going to have to ask you to really speak up clearly.

Now we won't go into the format again. We've gone through that, I think, with enough clarity for the record.

Let me ask you first to go to the insert map on Exhibit Number Nine and speak to the surface trace of this cross section.

A. This particular cross section, the well number one, which is outside the unit, is towards the northwest, and we continue on eastward across the unit. This is essentially a west-to-east cross section through the northern portion of the unit. The unit boundary is outlined here, in yellow and green.

Q. And do you also have on this insert map on Exhibit Nine, not highlighted in red, but the surface traces of other sections that run through the length and breadth of the Bravo Dome Unit?

A. Yes.

Q. Are we at an exhibit now that you prepared in connection with your completion technique and not specifically for this hearing?

A. Yes.

Q. All right, speaking to the cue numbered well No. 1, the one that's outside the unit area, is this well on the northwest side of the pinchout line that is near the northwest outer boundary of the Bravo Dome Unit?

A. This particular well, the Amoco No. 1 State "FB" is fairly close to the pinchout line of the Tubb. It still has a little section left in that well but it's rapidly thinning, to the northwest.

A. All right, let's move along to the east,

key numbered well No. 2 is within the boundaries of the Bravo Dome Unit.

A. That's correct.

Q. And then moving on to the east, almost to the eastern boundary of the Bravo Dome Unit but still inside Bravo Dome Unit, is your key well No. 5, is that correct?

A. That's correct.

Q. All right, sir, would you briefly describe the continuity of zones of one millidarcy or greater permeability that we find up in the northwest corner of our unit as we approach the porosity pinchout line?

A. Looking at the Amoco No. 1 Poling, we can see that we still have quite a bit of section greater than one millidarcy permeability.

As we go towards the northwest, we lose that permeability, and by the time we come to the Amoco No. 1 State "FB" we don't have any section with permeability greater than one millidarcy.

Q. All right, let's go over to well key No. 3, do we see a thickening of the zones that have permeability of one millidarcy or greater?

A. Yes, we do. We see an increase going from the No. 1 Poling to the No. 1 State "FF", an increase in the section that contains permeability greater than one

millidarcy.

Q. All right, sir, although in well key No. 2 the zones that you colored orange are one millidarcy permeability or greater, are more scattered.

Let me ask you this: Do you have any difficulty in correlating from key numbered well 3 back to the west zones that are permeability of one millidarcy or greater?

A. No, I don't. There are a few zones or intervals of greater than one millidarcy that are gone by the Amoco No. 1 Poling, but there are intervals of greater than one millidarcy that one could correlate between the No. 1 Poling and the No. 1 State "FF".

Q. So while we're seeing a different rock characteristic, comparing the area of Exhibit Number Eight with Exhibit Number Nine, you still find that you can correlate and that we do have continuity of zones containing permeability of one millidarcy or greater?

A. That's correct.

Q. Do you have anything else you'd care to add about Exhibit Number Nine?

A. No, I don't.

Q. All right, let's move now to what has been identified as Amoco Exhibit Number Ten, a similar cross

section, identical in format and I'll ask you to go to the insert map and describe for the record the area through the unit that this section traverses.

A. This section traverses a southeast/northwest cross section going across the unit, starting with the Amoco No. 1 State "FB" to the northwest outside the unit.

Q. Is that the well that was the number one well on Exhibit Nine?

A. That's correct. Coming down towards the southeast is the CO_2-in-Action No. 1 Kutz, which is outside the unit.

Q. All right, sir, and again from the northwest to the southeast, as we saw to a degree on Exhibit Number Nine, we see in the northwest the zones are more scattered where you have permeability of one millidarcy or greater, and let me ask you this, looking at wells numbered key numbers two, three, and four, can you still correlate even in this area wells of -- zones of permeability of one millidarcy or greater?

A. Yes.

Q. And then we see as we move to the southeast a gradual thickening and growing closer together of the areas you've colored in orange.

A. That's correct.

Q. And we're seeing on the last wells, key numbers six, seven, and eight, a situation similar to that on your Exhibit Number Eight.

A. That's correct.

Q. Do you have anything -- any additional questions you'd like to add on that?

A. No.

Q. Not questions. Any comments?

A. No, I don't.

Q. All right, let's go now to Exhibit Eleven, cross section C-C', again same format.

A. That's correct.

Q. I direct your attention to the insert map on the righthand side and would ask you to explain for the record the surface path that this section follows.

A. This particular section goes from the north to the south along the east side of the unit, starting in the north with the Amoco No. 1 State "FT" and eventually ending with the CO_2-in-Action No. 1 Kutz. It compares the north/south ends of the section.

Q. All right, sir, again in the interest of time, I'll ask you if you can correlate through the length and breadth of this section, starting on the north and going all the way over into Texas, continuity of zones with perme-

ability of one millidarcy or greater?

A. Yes, we can.

Q. Now I haven't bothered to point out, Mr. May, but on our exhibits where the well has been perforated, you show the perforations, and it's obvious from some of the work that you have done that there is additional pay in the -- some of our wells that we've already completed that needs to be exposed to the wellbore, is that correct?

A. That's correct.

Q. And this section, as was Ten and Nine, were prpared in connection with your completion technique and not for this hearing.

A. Correct.

Q. All right, you've got to walk across the hall again.

We're to Exhibit Twelve now, which is cross section D-D'. I'll ask you to go to the insert map on the righthand side and state for the record the surface path that Exhibit Twelve traverses.

A. Exhibit Twelve traverses again a north to south pattern in the central portion of the unit, starting in the north with the Amoco No. 1 State "HM" and eventually ending in the south with the Amoco No. 1 State "GX".

Q. All right, sir, and in the interest of time, I'll ask you if on this section you can correlate zones of one permeability or greater as being continuous throughout the length and breadth of the area that this cross section traverses?

A. Yes, I can correlate zones of greater than one millidarcy across this section.

Q. All right, sir, let's go now to Exhibit Thirteen, cross section E-E'. Is this an exhibit that you prepared especially for this hearing?

A. Yes, it is.

Q. And what was the purpose of preparing this exhibit?

A. This exhibit was prepared to show wells that are approximately one mile apart, approximately 640-acre set spacing.

Q. All right, sir, now I'll ask you to go to the insert map on this section, and where is our surface area that we're traversing here?

A. Our surface area here is basically an east to west cross section, starting with the Hutcherson No. 1-B and traversing in an east/west manner all the way to the Hutcherson E-1.

Q. All right, sir, and on Exhibit Twelve

do you find many zones of one millidarcy or greater permeability that you can correlate from well to well even though the wells are a mile apart? And across the length and breadth of this cross section.

A. Yes, there are many zones that can correlate across this particular cross section.

Q. These zones that you're correlating are one millidarcy permeability or greater which will certainly flow gas?

A. That's correct.

Q. All right, sir, let's go now to Exhibit Fourteen, cross section F-F'. Was it prepared specifically for this hearing?

A. Yes, it was.

Q. And again, so that you can show continuity between wells located approximately a mile apart?

A. That's correct.

Q. Go to the insert map there and state for the record the surface area traversed by this cross section.

A. Again this cross section is an east/west cross section, starting with the Hutcherson E-7 and finally ending in the east with the Hutcherson "E" No. 1.

Q. All right, sir, and I'll ask you the

same question I asked on Exhibit Thirteen. Do you find many zones of one millidarcy permeability or greater that you can correlate from well to well, although the wells are nearly one mile apart, all the way across the area that this cross section traverses?

A. Yes. There are many zones we can correlate greater than one millidarcy across that particular cross section.

Q. All right, let's go now to Exhibit Fifteen, the last of your cross section exhibits, and this too was prepared specially for this hearing. I'll ask you to go to the insert map and detail the area that this section traverses.

A. This particular cross section is a north/south cross section. The northernmost well on this cross section is the Hutcherson B No. 15 and finally the southernmost well on this particular cross section is the Hutcherson B No. 13.

Q. Okay, and again do you find many zones one millidarcy or greater permeability that you can correlate from well to well, although the wells are generally about a mile apart, all the way across the area that this exhibit traverses?

A. That's correct.

Q. In your opinion, based on all of the geological work that you've done, and particularly on our last three exhibits, Thirteen, Fourteen, and Fifteen, do you see a geological probability that one well in this reservoir could drain an extremely large area?

A. Yes.

Q. I think you can go back to the witness chair now, Mr. May.

Or maybe for cross examination purposes you might want to stay down here. I'm sure that there will be some questions relating to these exhibits.

Do you have anything else that you'd care to add to your testimony, any question that I omitted to ask?

A. No, I can't think of anything.

MR. BUELL: That's all we have by way of direct for Mr. May at this time, and we tender him for cross examination.

MR. RAMEY: Any questions of Mr. May?

CROSS EXAMINATION

BY MR. HEALY:

Q. Mr. May, you've presented quite an array of complex data. Let me ask you some general questions to

put it in perspective.

How many total acres are there in the unit boundary?

A. I believe there are approximately one million acres.

Q. Do you know how many townships that covers?

A. Approximately, what, forty-two.

Q. Now, the wells that were included in this study, you said that there were forty-two wells, is that correct?

A. That's correct, forty-one wells.

Q. Forty-one wells?

A. Forty-one, that's correct.

Q. And those wells, had they already been drilled before the last hearing on this spacing issue?

A. No, not all of them had been drilled. Some of them were still --

Q. Can you identify how many were?

A. I can't, --

Q. Drilled after the date of that hearing?

A. I cannot at this time tell you a positive number.

Q. Do you have -- can you tell me generally

where the newer wells would be located in the total unit area?

A. The newer wells are -- most of them are located within the Hutcherson lease area, which is over here in Township 19 North, 33, 34 East.

We have drilled several other wells around the area, but most concentration is within this area.

Q. For the record, if I can -- well, maybe you can identify that as east or west or south. I just want to get in the record where exactly --

MR. BUELL: The area that Mr. May was referring to, and he identified it by township and range, is located in, I'd say, the east central portion of the unit.

Q. Now, just so I'm clear on this, so you have core data from wells that were drilled subsequent to the hearing that was held last year with this newer core data that's included in this study reflected in the exhibits?

A. Which particular hearing?

Q. The hearing last March at which you testified. I think the date was March 11, 1980.

A. There is new data, it's obvious.

Q. New core data.

A. New core data. The wells may have been drilled and completed but we may have -- there may have been

a two or three month lag in getting the actual core analysis to us. Once we core a well, we do not instantly get that core analysis. It has to be analyzed by CORE Laboratories, but there is a lag time.

Q. Now, I think you -- well, let me ask you this. In addition to the study of cores did you do any interference testing?

A. I'm not an engineer.

Q. I'll reserve the question.

MR. BUELL: The record is clear that no additional pressure interference tests have been run.

Q. Now, in a number of cases in describing your conclusions on your study of core data reflected in the exhibits, you said that there was a correlation between wells that you could demonstrate. I wonder if you could explain that more fully, as to how you established a correlation?

A. What I did is I used one millidarcy as a cutoff and correlated intervals of greater than one millidarcy between wells. I also correlated the intervals of less than one millidarcy. That was the criteria used for these correlations.

Q. Is there a way to relate particular zones, pay zones, from one well to another well so that you're clear that they're continuous throughout the area that you're

studying?

A. There are intervals of permeability in the same stratigraphic position that one can correlate from well to well of greater than one millidarcy ; that is what I saw.

Q. I wanted to ask, in your study whether any of the exhibits reflect the area in the southwest portion of the unit?

A. Core data was used from the Amoco State No. 1 "FN" and I believe the Amoco State No. 1 "HN" in my cross plot technique. That core data was honored, but I did not use any of my -- I did not have any cross sections that went through that area.

Q. I see. Let me focus your attention on Exhibit Ten, and particularly with cross section B-B, which I believe is located in the southwest portion of the area.

I believe Wells Numbers Three and Four, if you'd point those out on the exhibit.

A. Right here. I believe that cross section goes from northwest to southeast. This is the trace of that particular cross section. It does not go across the southwestern portion of the area.

Q. Are those the wells that would come closest to the southwest portion?

A. I believe there are several wells, other wells that are closer to that area, but I did not use them in my cross sections.

Q. Okay, how far apart were those Wells Three and Four?

A. Wells Three and Four were 660 feet apart.

Q. Okay, and what acreage coverage would that give you if you drew a circle?

A. I believe that's 50 acres. I'm not that sure.

Q. And would you describe or characterize the correlation between pay zones in those two wells as being good, or perhaps you can characterize them?

A. Between those two wells there were intervals that I could correlate that had greater than one millidarcy. There were also intervals that -- that were greater than one millidarcy that were found in the No. 2 State "FD" that I did not find in the No. 1 State "FD".

But the correlation is fairly well, I believe, between the -- between those two wells.

Q. Do you think that the data that you have on those two wells, other wells on the western side of the unit, allow you to extrapolate those findings to the entire unit?

A. Yes, I believe they do, based on the data that I have at this present time, and based on my cross plot technique and honoring all the data, even though it was on the western side of the unit, I believe I could make the established correlation.

Q. Let me ask you, looking at the unit as a whole, how would you characterize the porosity and permeability characteristics in the north as compared to the south and the east as compared to the west?

A. Generally toward the northwest, or when you go westward, you have an increase in the permeability less than one millidarcy. As one goes down towards the southeast we have an increase in the section of greater than one millidarcy.

Q. What would that lead you to conclude regarding the relative drainage of the areas, parts of the unit? Is the east better than the west and the north better than the south?

A. Well, certainly there was less section of greater than one millidarcy, but if one millidarcy has the ability to flow gas, I assume that -- that you have the ablility to drain a large area.

Q. On the data that you've studied did you find pressure differences from well to well?

A. I'm not an engineer. I do not study --

Q. Your study did not reflect the --

A. No, it did not.

Q. -- differences in pressure?

A. No, it did not.

Q. In the selection of wells, I think you said you excluded wells -- or you used wells that showed a lack of a shotgun pattern. I'm not clear what -- what that means, why it was picked as a standard for selecting wells.

Will you amplify that?

MR. BUELL: Mr. May, be sure you understand the question. If you don't understand it completely, ask Mr. Healy to restate it.

A. Perhaps that would be best.

Q. Well, let me restate it.

You said your study included forty-one wells as a start.

A. That's correct.

Q. But your exhibits today reflect data on sixteen wells, and I believe you said the sixteen wells selected had a lack of a shotgun pattern. In other words, you picked them as representative of the forty-one wells.

I'd like you to amplify that because I don't understand it.

MR. BUELL: I think he's now on Exhibit Seven, Mr. May, so --

MR. HEALY: Yes, what I want to --

MR. BUELL: -- go back over to Exhibit Seven and I believe you all can communicate a little better.

A. What I used, I drew the line through the total core data and then used the wells that -- that lacked a shotgun pattern to verify this line.

So this line is --

Q. What do you mean by shotgun pattern? Were there dots far above the line and also dots far below the line on the wells that you did not use?

A. For this particular upper cross plot, is that what you're talking about?

Q. Yes. I'd like to have that answered on all of the ones that show plotting based on the representative wells. In other words, was there a shotgun pattern encountered on each of the plots that you drew?

A. Well, there's a wide dispersal of points on either side of the line. I think that is, to me, somewhat of a shotgun pattern, yes.

The concentration of points was along this line.

MR. BUELL: Now, "along this line",

you're referring to the cross plot in the lower lefthand portion of Exhibit Number Seven.

A. That's correct.

Q. Let me ask you this. There were twenty-five wells that were not included in your plot, and are you saying that those represented such a wide swing from the norm that's plotted on your graph that you didn't feel they should be used?

A. No. The reason the shotgun pattern wells were not used in this particular plot is that they could have fit this curve and they could have fit, perhaps, due to their dispersal, a wide angle of -- a wide orientation of that particular line. So they -- because of the wide dispersal of points, what I wanted to do was better check the line that I had drawn down here for the total wells by using the wells that -- that showed the least amount of scatter.

Q. Let me ask, on wells -- do you recall on wells that were part of the forty-one that were included in the original scope of the study which were finally excluded because they showed the shotgun pattern, do you know how many were in the southwest portion of the forty-one?

A. I didn't exclude forty-one.

Q. No, I'm saying the forty-one you started

with. How many of those that were excluded from the plot here are in the southwest corner?

A. None of them. In fact, we used both the -- on the up end we used both the relationship between porosity permeability and the relationship between density and porosity core porosity.

Q. Did you have -- are there other wells that have been drilled in the southwest corner of the unit?

A. Do you mean outside our southwest boundary or --

Q. No, within the unit boundary but by anyone other than Amoco?

A. I believe CO_2-in-Action drilled the McCarty Well in that area. They are not part of our company. That's the only one I can think of offhand.

That particular well is located right here.

MR. BUELL: "Right here" is not getting in the record.

A. 18 North, 31 EAst, in that particular township.

Q. Okay, are there wells that have been drilled by AmeriGas or Schwartz Carbonic in that southwest part of the unit boundary?

A. Yes, there are. There are some wells in that area.

Q. Did you consider any data from those wells in making your study?

A. Yes, I would have used them, but they're all neutron logs and this particular calibration is based on density logs, which we believe best represents the porosity.

We tried neutron logs and they did not show a relationship, so we felt that the neutron logs were unreliable.

And all the logs that are within this area were all neutron logs. If they had been density logs we would have included them in the study.

Also, if there had been core data, we would have included it in the study.

Q. I'm not clear, can you characterize a little more precisely how much more reliable the density logs are than the neutron logs? Is it a much more accurate process or -- I'm not clear how much more weight the density log has compared to a neutron log.

A. Well, --

Q. In your own opinion, that is.

A. I believe in this particular area density logs best represent the porosity within the Tubb. I did not

exclude the neutron log for any reason. I cross plotted it against the core porosity and there was absolutely no relationship whatsoever.

The density log I believe best porosity tool that we have within the Bravo Dome area.

Q. In geological analysis, is production history another way to demonstrate porosity or permeability?

A. It certainly exhibits there's gas present but, no, I did not use production data as an indication of porosity/permeability, and that is an engineering question, I believe.

I'm strictly concerned with the rock.

Q. Right. All I'm asking is in studying the rock is production history a factor?

A. No, it is not.

Q. I think you testified that the technique that you used is generally recognized as a geological method. Can you tell me whether you know of any other situation where sixteen wells were used to analyze an area of over a million acres?

A. Well, sixteen wells were not used; forty-one wells were used.

Q. Well, let me ask you this, then. The data you've showed us here on certain exhibits, anyway, are

based on sixteen wells, is that true, the core -- core data?

In other words, on Exhibit Seven, only sixteen wells are shown there. Oh, you excluded the other twenty-five because of the shotgun pattern.

A. On these two -- top two porosity plots I did, yes.

MR. BUELL: Mr. May, explain once more, you only verified,your uppermost cross plots, you only used that to verify the cross plots you'd previously obtained using all the data from all forty-one wells, one more time.

A. That's correct.

What I did, what I did is I cross plotted all forty-one wells; drew a line through there, and saw a relationship, and eliminated the wells that had a shotgun type pattern and just used the ones that had -- what I felt was the best relationship, excluded the ones that had a shotgun pattern, and cross plotted those to verify this particular line.

I did not rely on this line up here. This is a check of this cross plot down here.

Q. Let me ask you then, would a forty-one well program be sufficient as a matter of general recognized practice to cover a million acres? Do you know of any other situation where it's been done?

A. No, I haven't.

Q. I just have two more questions.

One is, based on your study do you believe that the entire unit consists of one continuous formation?

A. Just one formation.

MR. BUELL: Did you say yes?

A. Yes.

MR. BUELL: He said yes.

Q. Just one continuous source of supply?

A. From my study I haven't determined that. It's extremely possible that there are several different sources of supply.

Q. But are you aware of any faulting within the boundary of the unit?

A. Yes, I've exhibited that on all my cross sections, where I have faults.

On my cross section D-D' I've indicated a fault right here between the Amoco No. 5 Heimann and No. 6 Heimann.

Q. If I could follow up on that, the fault line is drawn straight up and down and yet it shows a continuous orange area between the two wells. Could you explain how that would occur?

A. Yes. The cross section is hung strati-

graphically, not structurally.

Q. But there wouldn't necessarily be communication between the pay zones, even though you've shown them on your exhibit as continuous?

A. That is true, but with so much permeability within the section it's extremely possible that -- that permeable sections of greater than one millidarcy could be with faulting in juxtaposition.

MR. HEALY: I have no further questions.

MR. RAMEY: Any other questions? Mr. Nutter.

QUESTIONS BY MR. NUTTER:

Q. On all of these exhibits the orange color represents the permeability that's one millidarcy or more, is that correct?

A. That's correct.

Q. So we can't make a qualitative analysis of permeability and determine that there's equal permeability and equal communication between the wells on the cross sections by looking at the orange color.

A. No, that is correct that they are not the same permeability. What, the only thing the orange represents is the permeability greater than or equal to one

millidarcy.

Q. Now, what did you base your statement, Mr. May, on that a study of these exhibits leads you to believe that one well will drain a wide area?

A. Well, one millidarcy, in my experience, that one millidarcy will drain a large area. Gas can flow through one millidarcy and I used that as a cutoff and that's my basis for concluding that it could drain a wide area, based on my correlation.

Q. But you haven't made any analysis as to any time limits that gas would flow across one mile through one millidarcy of permeability, or anything like that.

A. No, I have not.

Q. Only that given sufficient time gas would flow through one millidarcy of formation.

A. Yes, that's correct.

Q. So this is permeability but not necessarily effective permeability.

A. That is correct, permeability. I did not determine effective permeability in any fashion.

Q. Okay, thank you.

MR. RAMEY: Mr. Arnold.

CROSS EXAMINATION

BY MR. ARNOLD:

Q. Mr. May, what was the highest permeability you measured in any core?

A. We had several cores that were over a millidarcy, slightly over a millidarcy.

Q. Thank you.

A. Excuse me, not over a millidarcy, 1000, 1000 millidarcies. I'm sorry.

Q. Did you have large sections of those, or a foot here or a foot there, or how?

A. It's not that -- that -- greater than one Darcy is not prevalent throughout the whole area, that's correct. It's not a -- it's localized in some of our cores. It's not a -- fieldwide.

Q. You didn't come up with any kind of an average across your orange section, or anything like this? This is strictly a lower limit?

A. That's correct. Average porosity and permeability that we've seen from core analysis has shown us that it's been about 20 percent porosity at 42 millidarcies permeability. That's the only average I have and that's only through core analysis.

Q. That's 42 millidarcies?

A. 42 millidarcies.

Q. Thank you.

MR. RAMEY: Any other questions? Mr. Stamets.

QUESTIONS BY MR. STAMETS:

Q. Mr. May, all these cross sections are very interesting. Amoco has obviously done some excellent work.

Isn't the final proof of this particular pudding in the drilling and production of wells scattered over a large portions of the unit?

A. To my knowledge that's the final proof of the pudding. What I'm showing here is the probability, based on one millidarcy, that a well could drain a large area.

Q. And if Amoco drills the same number of wells on 640-acre spacing as it might drill on 160, wouldn't that prove up more of the area geographically?

A. Can you repeat that question, please?

Q. If Amoco's got enough money to drill 200 wells in a certain period of time, those wells are drilled on 640-acre spacing rather than 160, wouldn't that result in a larger percentage of this vast area in the unit being -- have more data on it?

A. That's correct.

Q. So that you can then prove or disprove what you tend to show here?

A. That's correct.

Q. And also would serve to define, perhaps, more quickly areas where there is no --

A. That's correct.

Q. That's all.

MR. RAMEY: Mr. Ulvog.

QUESTIONS BY MR. ULVOG:

Q. Mr. May, have you made any attempt to correlate your potential production, from this estimate, made any attempt to correlate that with either the net footage of permeability or with the quality of the permeability? In other words, you might have 100 feet of one millidarcy permeability, you might have ten feet of ten millidarcy permeability, and so on, have you tried to make any correlation between that, or between the pressures that you have?

A. No, I haven't.

MR. RAMEY: Any other questions? Mr. Padilla.

CROSS EXAMINATION

BY MR. PADILLA:

Q. Mr. May, I believe you testified that there was pressure communication between the first two wells on your EX-EX' cross section?

A. That's correct.

Q. And as I understand the remainder of your testimony, you did not testify as to any other pressure communication between any other wells on the cross sections.

A. No, I did not because I believe the next witness may talk about the pressure communication between wells.

We did have interference tests done on No. 1 "FD". We also had it done in a couple of the Heimann wells as part of the pressure interference test and they showed communication, based on what the engineering told us.

MR. BUELL: May it please the Commission, I was going to have our next wtness, Mr. Padilla, go through not only the interference wells that are on cross section EX-EX', but on all the other interference wells that appear on the cross sections.

MR. PADILLA: Your next witness will then be prepared to answer any questions with regard to pressures?

MR. BUELL: Yes, sir.

MR. PADILLA: No more questions.

MR. RAMEY: Any other questions of Mr. May? He may be excused.

MR. BUELL: May it please the Commission, I would like to formally offer into the record Amoco's Exhibits Seven through Fifteen, inclusive.

MR. RAMEY: Amoco Exhibits Seven through Fifteen will be admitted.

MR. RAMEY: Let's break for lunch now and be back at 1:00 o'clock

(Thereupon the noon recess was taken.)

MR. RAMEY: The hearing will come to order.

You may proceed with your next witness.

MR. BUELL: As the last witness in our direct presentation, we will call Mr. Sanders.

L. J. SANDERS, JR.

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

DIRECT EXAMINATION

BY MR. BUELL:

Q. Mr. Sanders, would you state your complete name, by whom you're employed, and in what capacity, and in what location, please?

A. My name is L. J. Sanders, Junior. I'm employed as Staff Petroleum Engineer and Associate by Amoco Production Company in Houston, Texas.

Q. Mr. Sanders, in this hearing here today we're recommending temporary operating rules for the Bravo Dome Unit area. In connection with that temporary rule request we're making, have you made any study to enable you to make a recommendation to this Commission as to the temporary period that we might possibly need?

A. Yes, I have, and I would recommend that we have a period of three years after first production into a pipeline.

Q. From the unit?

A. From the unit.

Q. All right, sir, in connection with your recommendation, will you direct your attention now to what has been identified as Amoco Exhibit Sixteen and state for the record what Exhibit Sixteen reflects?

A. Exhibit Sixteen is a timing calculation for an initial 25 psi reservoir pressure decrease using the Heimann No. 1 and State "FI" No. 1 area characteristics. This is the area where we had run our -- was two of the sites where we ran pressure interference tests.

Q. Would you point out the Heimann area generally on Exhibit One and just say that it appears to be about in the south central -- central south central area?

A. Well, it's in the -- might be called the east central. The Heimann 1 was our producing well. It's located in Township 19, 33 North, and then in the east central at the State "FI" site, this one -- this is a lease that's in Township 20, Range 34.

Q. All right, just what did you do in making your study to prepare yourself to make your recommendation to this Commission?

A. I looked at time here as the time that it would take to produce enough gas from an area to cause 25 psi decrease. I picked an area five miles by five miles that was developed on 640-acres. I picked this large of an area because in the center of it is going to be a pressure observation well and I wanted to minimize as much as I could the interference from outside, just this five mile area that would facilitate evaluation of the tests.

And in this five mile tract there's 10240 acres. The net wells inside the test site, there's fifteen producers and one pressure observation well.

Millions of cubic feet of CO_2 were removed from this area to lower the initial pressure, which was 375 psig, 25 psi, is 15.2 BCF, and the time to remove this 15.2 BCF, using a million a day, million cubic feet per day producing rate for the producing wells, which I believe will be reasonable, that calculates then to be 2.78 years, the time required to remove enough gas to cause a 25 psi pressure decrease, and this is about a 7 percent pressure depletion from the initial pressure point.

Q. So your 25 psi drawdown in your observation well doesn't look like much when you're just saying 25 psi, but percentagewise the original pressure that would be in your observation well is a significant percent?

A. Yes, it is.

Q. Now if your prediction on the original gas in place in the area that you studied is wrong in that there is less original gas in place, we should see the pressure interference in the observation well sooner than three years?

A. We'll see it sooner and we'll see a larger decrease.

Q. And by the same token, if you have understated the original gas in place, and hopefully, I'm going to say I hope that's the case, it will take a little longer than your predicted three years to see the same incremental decrease in pressure in your observation well?

A. Yes, sir, that's -- that's correct.

Q. All right, sir. I want you to turn now to your Exhibit Seventeen more or less a summary of the plans that Amoco intends to initiate in this three year period that we're asking for after the first unit production into a pipeline, to show the Commission the type of program we will have to gather data that we think we'll need to show definitive 640-acre spacing is correct?

A. Yes, it is.

Q. Why don't you, since Exhibit Seventeen is self-explanatory, why don't you just kind of summarize each of the four numbers, paragraphs, on the exhibit?

A. Okay. Our plans at this time is there will be a central gathering system installed ultimately in approximately each quarter -- quadrant of the productive area of the unit.

Drilling that will be done in the next three to four years will be concentrated 640-acre development for initial production, with the exception of scattered

locations which will be on a less dense spacing for the purpose of obtaining additional reservoir data.

A pressure observation well will be located in the center of a minimum of a twenty-five well block of 640-acre development in each quadrant to furnish information on CO_2 in place and areal drainage on 640-acre spacing.

A highly accurate measuring device will be run periodically in the observation well to monitor the pressure, and a well defined initial pressure will be obtained prior to any production in each test site.

When a twenty-five psi pressure change is obtained in the observation well in any test site, or when three years of unit production to a pipeline has occurred, spacing rules for the unit will be, in my opinion, should be reviewed as appropriate with the Oil Conservation Division.

Q. All right, Mr. Sanders, you've already stated for the record the location of the test site area from which you made your study. Would you just generally indicate for the record and the benefit of the Commission where the other three will be located?

A. Let's look at the southeast quadrant and, as you can see, in this Hutcherson area we have already drilled quite a few wells on 640, and so it won't take a

whole lot of drilling to develop a pretty good area there on 640-acre spacing.

And so in this area we'll pick out a minimum of a five mile by five mile solid block of 640-acre development. And the center well in that block will be left shut-in as a pressure observation well, and then we'll produce the surrounding wells and we'll watch the pressure from that observation well.

It's a -- it's a good, straightforward way of production and pressure and the relating of those two.

Q. All right, sir. Now, Mr. Sanders, -- we're going to need some more lights on.

Maybe you can see well enough, Mr. Sanders. On some of Mr. May's cross section exhibits we had included wells that were part of the previous pressure interference test. I wish you'd come over here, start over here.

A. Okay.

Q. Are there any wells that were involved in the pressure interference test on any of the exhibits that we have over on the west wall?

A. Cross section B-B' has the State "FD" test site, which the State "FD" No. 1 was the producing well, the State "FD" No. 2 was a pressure observation well, located 660 feet apart.

Q. And that B-B' is Amoco Exhibit Number Ten.

All right, I believe some attention has been pointed to these two wells before. Why don't you comment, please, on the pay continuity, and by pay I mean anything with one millidarcy permeability or greater, between the two wells that were involved in the pressure interference test, and the development of zones of one millidarcy permeability or greater away from the two test wells.

First, did we observe pressure interference in the short term pressure interference test on the wells that you mentioned, the State "FD" No. 1 and the State "FD" No. 2?

A. Yes, we did. On the three sites, this was the only one that we couldn't quantify. The producing rate here was questioned because of scale buildup on our orifice, well test data, and so this was one site that we couldn't quantify the results of.

We did see pressure interference between the producing well and the observation well, pressure observation well.

A point that's been interesting to me, and Mr. May has made it, is that when you look at the continuity between these two wells located 660 feet apart, so much

has been made about the fact that they're only 660 apart and only thirty-one acres, but what's interesting is the continuity of anything is better with distance in many cases. Here it's better for sure --

Q. By "here" you mean to the right or to the south of the two State wells you've been talking about.

A. Yes, but I believe what we'll see on all of these is that the close spaced wells will show the pressure interference, they don't show any more continuity than if you had wide spaced wells offsetting. Over here, 4.75 miles there's plenty of continuity there, and then the 3.8 miles, it looks like there might be a little less but there's still plenty of continuity.

Q. So here we know we have two wells located rather close together where we've observed pressure interference.

A. Yes.

Q. And you see nothing on this exhibit that would indicate there there is any break in continuity of this one millidarcy pay zone between wells to the south and wells to the north?

A. No, I do not.

Q. Would that indicate to you as a reservoir engineer that wells in this reservoir could certainly

drain as large a spacing unit as 640 acres?

A. Yes, it does. The first thing we've got to have for drainage is we've got to have continuity. This looks like we have the continuity and therefor we should have drainage.

Q. All right, sir. Are there any more wells that were used in previous interference tests on the exhibits on the west wall?

A. Yes, there are. Cross section C-C'.

Q. Exhibit Number Eleven, now, you're referring to?

A. Yes, sir. This cross section contains our State "FI" No. 1, our State "FI" No. 2, and we're going to talk about this one some more later on.

Q. Are those the same two wells that are on our Exhibit Eight?

A. Yes.

Q. Cross section EX-EX'?

A. Yes. We might just mention without getting into comparisons, that this cross section, I believe, has -- no, it would be better to wait and make my statement later on.

Q. All right, sir, let's go over now to the exhibits on the east wall. Are my compass directions

right?

MR. RAMEY: North.

Q. All right. On the wall to the left of the Commissioners.

A. On cross section D-D' --

Q. Which is Exhibit -- Amoco Exhibit Number Twelve.

A. We have the logs on the Heimann No. 2 and the Heimann No. 5. Both of these were pressure observation wells. Both of them showed about the same amount of pressure decline in the producing wells. There should be some correlation there. If each of these responded to the producing well about the same, then you would think that they would respond to one another to some extent, and you can see that -- you can see the continuity that we have here between these two wells, between the Heimann No. 2 and Heimann No. 5.

And again as we go 4.25 miles -- 4.5 miles to the south the continuity doesn't look much poorer than -- than it does between the 6 -- between the 937 foot wells, and if you go north, it appears we have a mile distance here, you can see that the continuity is about the same, and then 5.6 miles going north, then it does begin to break up.

Q. But you still have a continuity of zones containing one millidarcy of permeability or greater.

A. Yes, very definitely.

Q. And actually, as you go to the south, and I believe you said you go to the south, the continuity is poorer but wouldn't you say it's as good a quality as we find in the Heimann wells until you go on further south?

A. Yes, I believe that would be closer to the truth.

Q. But we do see continuity.

A. Yes.

Q. Between wells that we observed a pressure -- pressure interference and wells adjacent to them to the north and south?

A. Yes.

Q. Continuity.

A. Yes.

Q. All right. Let's go now to Amoco's Exhibit Number Eight, cross section EX-EX'. Would you comment on it, please?

A. Yes. This cross section contains the producing well, the State "FI" test -- pressure interference test site. "FI" No. 1 was the producing well and "FI" No. 2 was one of the pressure observation wells located 660 feet

apart, and then this third well that's on the cross section is the Heimann No. 1, which is located approximately 2.4 miles on to the south.

And as Mr. May pointed out, here again you see good continuity on the 660-foot distance between wells, but you also see the same good continuity at 2.4 miles.

So what we're seeing is what we saw on the closer spaced interference wells, we're seeing on the wells now that we've drilled on 640-acre spacing, which is detailed on our Exhibits Twelve, Thirteen, and Fourteen, plus we're seeing a lot of continuity over long distances, up to three or four miles.

Q. Do these data indicate to you as a reservoir engineer that these wells in this area, I'm talking about the area of Exhibit Eight, would certainly drain a 640-acre spacing unit?

A. Yes, very definitely.

Q. Now while it is true we have not conducted any formal interference tests subsequent to the March, 1980, spacing hearing, previous hearing, by venting CO_2 to the atmosphere or injecting it, we have acquired significant additional data that shows that 640-acre spacing units are a proper pattern for development in the Bravo Dome Unit area?

A. Yes, that's true. As you mentioned

earlier, or Mr. May mentioned, we're better than 100 percent increased in the number of wells than we had the time of the previous hearing, and a lot of these wells have been drilled on a 640-acre spacing unit. The continuity looks good on these wells.

Q. Do you have anything else you'd care to add at this time to your testimony?

A. No, I do not.

MR. BUELL: May it please the Commission, that's all we have by way of direct of Mr. Sanders, and I would like to formally offer at this time Amoco Exhibits Sixteen and Seventeen.

MR. RAMEY: Amoco Exhibits Sixteen and Seventeen will be admitted.

MR. BUELL: I tender Mr. Sanders for cross examination.

MR. RAMEY: Are there any questions of Mr. Sanders? Mr. Healy.

CROSS EXAMINATION

BY MR. HEALY:

Q. Mr. Sanders, based on your studies, do you believe there's a common source of the CO_2 supply in the entire unit?

A. No, I do not.

Q. Describe in your judgment what you would believe to be a description of the -- a proper description of the formation?

A. In what repsect?

Q. The reservoirs.

A. Would you help me a little bit?

Q. Are there, do you believe there are separate reservoirs in the unit area?

A. Well, Mr. Healy, as you pointed out earlier, we only have -- not a whole lot of wells in a large area, so a person's got to be real careful about when he starts scoping here, and from what I've seen, there may be four or five separate reservoirs would be my guess right now. But that's got to be taken as scoping. We need a lot more data.

Q. Would that be based on faulting or some other base?

A. It's mainly based on the pressure gradient that we see from the west side of the field to the east.

Q. Yeah, I wanted to ask you about that. What would be the high pressure that you've encountered in your studies?

A. We had one well that was 1068 pounds on

the west side, and we've had a well on the north side of about 340 pounds.

Q. Okay, so that there would indicate that there's not a common source of supply.

A. That's right.

Q. I wanted to ask why there weren't any interference tests run since the last hearing. Is there any particular reason for that?

A. Well, as you know from the previous hearing, it takes a long time for interference even on 660 feet, which it seemed that your position was that that was awfully close. The further away you go, the more time it takes, and it looks like the best thing for us to do , we're looking at probably several hundred wells in the next four years, is to do what is an old time oilfield interference test, and that is put an area on production, put a pressure observation well, and we'll find out what kind of interference, if any, we have.

Q. Have you had any sustained production from any of the wells that you've studied?

A. No, I believe about five months is the longest we've had; the Heimann 1 flowed for about five months on that one interference test.

Q. What were the results on that, how many

Mcf a day and what sort of pressure did you --

A. Well, it started at a million a day and through just mechanical problems the rate dropped off to about 700 Mcf per day, and at that time the test was terminated.

Q. When we say mechanical problems, would that indicate poor drainage or something else?

A. No, it's just a metter of keeping the well open. As the rate went down, the tubing pressure went up.

But we do want to do some more of this long term testing, as Mr. Allen was speaking about.

Q. We haven't really -- or I guess you haven't addressed this directly, but certainly indirectly in the exhibits, I think the basic -- a basic issue here is prevention of waste and recovery of maximum amount of CO_2 out of the field, and would you explain how you arrived at the conclusion that 640-acre spacing results in that as opposed to smaller spacing?

A. The first thing you've got to have to drain any kind of area, you've got to have pay continuity, and we see that here. It looks like pretty widespread pay continuity.

And then, as far as the efficiency with

which you drain, the theoretical calculations are available, but what we're proposing here is that we find out through performance what the efficiency of this drainage is, and then from there we'll move to closer spacing if such is needed.

Q. Do you believe, to turn it around, that drilling on 160-acre spacing would result in lower recovery of CO_2?

A. I don't believe it would produce lower recovery but it might well be wasteful, might be too many wells.

Q. Certainly costly?

A. Yes.

Q. I think that's all I have. Thank you.

MR. RAMEY: Any other questions of Mr. Sanders? Mr. Stamets?

QUESTIONS BY MR. STAMETS:

Q. Mr. Sanders, how many of these 25 well blocks would be necessary to demonstrate 640-acre spacing throughout the unit?

A. We're thinking that we'd have one in each quadrant of the unit. You know, we'd have like a site here, a site in this area, a site in the northwest -- I should say the north/northwest, and then in the south/southwest part.

Q. It looks like some of those sites would be rather distant from the unit boundary. Of course, I realize it's early and it's kind of hard for you to project what data you might find there.

Is it conceivable that more sites might be necessary?

A. Well, it could be, yeah. You've got to start some place and we're going to be drilling several hundred wells it looks like in the next four years, and that in itself brings a lot of log information and we'll have the potential testing, and should have time to do some bottom hole buildup from kh, and it's one of those things, I believe, you know, if you start out thinking of one for each quadrant, that certainly seems like a good start and it's something, you know, might need to be enlarged.

Q. It's possible, though, to put one in each quadrant and still have them all located right smack dab in the center of the unit.

A. Well, no, we will not do that. We're interested as much as you are in finding out what we've got here, and we'll -- we'll make sure that we get something that is representative.

I know just looking, this seems -- would seem to be a good area here. We already have a lot of wells,

we're going to go ahead and drill some more in this very north part, and maybe over here. This is pretty wide open into here. We could drill here, depending on the -- the open windows, you know, that's one thing that's going to make -- may press a little bit, is picking a site there with those open windows, and it's in through here, is where we have that, the pressure benches come a little more often than they do over in this area, so we'll have to match here to meet the windows, as well as pressure benches, to make sure, but once we start production, then, see, we're back in where we can shut in wells and take bottom hole pressure buildup, and if we -- if we wind up here with five or six hundred wells, you know, we start blocking up some acreage then where we can go in and take pressures, as well as having this pressure observation well.

MR. BUELL: Mr. Sanders, please try to remember when you're referring to Exhibit One, be a little more specific than "here". We can't get your pointing in the record.

Let the record reflect that his last answer, that he was moving away from the Heimann area in the southeast portion of the unit, working up to a quadrant in the northeast portion, then over to the northwest, and down to the southwest.

MR. STAMETS: The only trouble I have with that, Mr. Buell, is it looks to me like the Heimann is right about in the center as opposed to the southeast, but that's neither here nor there.

Q. What other data do you expect to develop which would help demonstrate that 640-acre spacing is the most efficient and economical?

A. Well, as you know, there's theoretical calculations. It would just be more positive if we could go in and, you know, really cause some depletion.

But I should tell you that -- that we're looking at some more testing in the unit. We want to produce and inject the CO_2, as I mentioned to you earlier. We want to do that for surface equipment, but we also want to observe the deliverability characteristics of these wells. We'll see how some of these frac treatments hold up with time, and I'm like Mr. Allen, I'm not sure how long these have run, but I've been thinking more like a year or two years on some of these production tests, just testing and injecting, and on those if we get a chance to tie in with some injection and interference tests on those, we'll be able to do that. And did I mention the pressure pulsing? We'll take another look at pressure pulse testing. As you know, pressure pulse testing is rather than produce the well

for 150 days, you can produce it for a few days and then try to follow that pulse through to an observation well with highly accurate measuring, and it -- it takes that pulse a long to travel, just like it does a continuous transient (sic) and I'm not too hopeful that we'll find pressures that we can pressure pulse on wide spacing, but we're going to take another look at pressure pulsing.

MR. RAMEY: Any other questions of Mr. Sanders? Mr. Padilla.

CROSS EXAMINATION

BY MR. PADILLA:

Q. Mr. Sanders, I'm a little confused as to what you mean by continuity in the cross section. As I understand the way you use continuity, it just means that there's a permeability of greater than one millidarcy, is that correct?

A. Yes, sir, that's the basis for his orange colorings.

I think it might be worth -- Ernest, it might help you, let's take a look at this -- at this permeability level here.

MR. BUELL: Where are you now, Mr. Sanders?

A. Sorry. Exhibit Eight. Let me take one minute on this Exhibit Eight, EX-EX, and you'll have a chance to look at these. These are permeability values, core permeability values. See, we're talking about, I think this is like fifty millidarcies. There are some little fifty millidarcy streaks in through here, and these are high, high streaks of permeability. And we're talking about that -- that a pressure wave or disturbance can move it, move through continuously through that interval, and that's what it takes to get drainage.

Q. But you're not saying that the entire Tubb formation is homogeneous throughout the --

A. No.

Q. -- unit.

A. No, and we'll drain some portions of the pay better than others, of course, but it will be to the point of you have to drain -- there's some trade-off between wells, closer spacing and efficiency that you get.

Q. Well, looking at your exhibits, or your cross sections E-E', F-F', and G-G', it seems as though those are the ones that have the wells spaced closer together. How does the pay section, the amount of the pay section, compare to the initial potentials of those wells listed on those exhibits, or cross sections?

A. The -- Ernest, that's primarily the Hutcherson area, and those wells have been potentialing for about 1.2 million a day after just acid, with about 150 psi, which is just about what we expected of that area, so we're seeing the same kind of potential on close spaced wells as --

Q. How did the pressures differ in these wells?

A. I believe in this particular area, the Hutcherson, that that -- we have a 375 pound area that covers quite -- quite an area, and I believe all these wells in here will be 375 pounds. We have quite a bit of pressure information right in here.

You see, Ernest, this is some of the new data that -- that have been developed. This 131 well drilling program we started in October of 1980, then we're ready to come in with these new wells on 640-acre spacing, so you're getting to see for the first time what -- what the pay looks like on 1-mile spacing.

Q. So what you're saying is in this area, the Hutcherson area, you generally have the same amount of pay section, the same pressures, and pretty much identical potentials.

A. Yes, right in the Hutcherson area, right.

Q. Now, do those -- well, I think somebody

has already testified that those wells do not look like the other wells in the, say, in the west side of the -- of the unit area, is that correct?

A. Well, Ernest, I think what they were talking about, they generally thin some to the west/northwest. Just the gross section thins and so as you move to the north/northwest, then you can just see, you see less orange, partly because it's less gross section.

Q. Do you have lower pressures there also?

A. No, we have higher pressures on the west side and that's something that's helped the thinner pay. Fortunately you have higher pressure, so that's tended to equalize it with the eastern side, both with gas in place and with deliverability standpoint.

Q. Still, based on that, you would still advocate 640-acre spacing for both areas, or both characteristics?

A. Yes, sir, yes, I would. If the continuity is there, we're going to drain. The question is how efficient we'll be. We'll make some calculations that tell us what's fifty millidarcies and over. When you start getting down lower than that, then you can argue about how good it's going to do it, but if we prove the production, then we'll start assessing, and it seems like three years or so is not

too much to pay for starting wide and coming in, if we have to.

Q. Couldn't you get the same information by developing 160 acres versus 640 acres for three years to determine the production into the pipeline?

A. Yes, we could. It would just be whether or not, you know, we drilled unnecessary wells to do that.

Q. You don't have a covenant of further development in the unit, do you, from a standpoint of having to drill on 160 acre spacing?

A. No, there's --

Q. Do you?

A. I can't answer that, Ernest. Mr. Buell would have to.

Q. Well, let me put it this way. You're not precluded from drilling only one well to 640 acres, are you?

A. No, I don't believe so.

MR. PADILLA: I have no further questions.

MR. RAMEY: Any other questions of Mr. Sanders? Mr. Arnold?

CROSS EXAMINATION

BY MR. ARNOLD:

Q. I'll ask one. Have you developed any theories at all as to why there is such pressure difference across there?

A. Mr. Arnold, there really -- we're really just not there yet. We know we've got some difference. We have some ideas, but until we get some more wells I'd just be wasting your time to -- with reasons. We're just -- we're just not there.

MR. RAMEY: You may be excused.

MR. SANDERS: Thank you.

MR. RAMEY: Anything further, Mr. Buell?

MR. BUELL: May it please the Commission, that's all we have by way of direct presentation, and we rest our case.

MR. RAMEY: Mr. Healy, do you have a witness, or Mr. Coffield?

MR. COFFIELD: Just one moment.

Mr. Beeler, would you please take the witness chair there?

PHILIP BEELER

being called as a witness and being duly sworn upon his oath,

testified as follows, to-wit:

DIRECT EXAMINATION

BY MR. COFFIELD:

A. My name is Philip Beeler. I'm a consulting petroleum engineer from Norman, Oklahoma.

Q. Mr. Beeler, what is your relationship with the protestant companies, AmeriGas and Schwartz Carbonic?

A. For fifteen years I was an employee of Carbonic Chemicals and then later SCC Corporation, which in turn has been merged into AmeriGas.

Q. And for purposes of this hearing are you a consultant for AmeriGas and Schwartz Carbonic, as well as an expert by way of background in this particular area?

A. Yes, yes.

Q. Have you testified before the Commission previously and had your credentials made a matter of record as an engineer?

A. Yes.

Q. And accepted by the Commission?

A. Yes, they were.

Q. RElative to this particular case, are you familiar with this area?

A. Yes, I am.

Q. And the subject matter of Amoco's application?

A. Yes.

MR. COFFIELD: Does the Commission have any further questions of Mr. Beeler?

MR. RAMEY: No, Mr. Beeler is considered qualified.

Q. Mr. Beeler, what period of time have you personally had occasion to observe this area of development and your professional opinions about the carbon dioxide production and characteristics of the reservoir?

A. Since 1962 to date.

Q. What aspect of Amoco's application is it that you find objection to?

A. The 640-acre spacing requirement.

Q. Okay, Mr. Beeler, would you please review for the Commission your knowledge of the history and experiences of AmeriGas and Schwartz Carbonic, particularly relative to the question of spacing allocated to the wells in the area?

A. In 1940 Carbonic Chemicals first started production of CO_2 from what we call the Mitchell Field in Harding County. Production has been continuous from that time to date. A considerable amount of data is available

from that long period of production, and we feel that we are, and have been for a number of years, able to give valid information as to drainage and productivity of wells of this -- in this area.

Q. Just a moment, Mr. Beeler. With reference to Amoco's Exhibit One, precisely what areas are you talking about?

A. In Township 19 North, 30 East, along the west boundary of the township.

Q. And does this -- does the area with which you're familiar both -- with both inside the unit boundary as well as outside the unit boundary?

A. Yes, sir, this, as you can see, the unit boundary moves in and out amongst these wells.

In addition to that, there is a window in the unit for what is called the Bueyeros Field, which is operated by Schwartz Carbonic, that is a separate reservoir containing four wells at the present time that I will be able to -- I will give you more information on.

Q. All right, go ahead with your discussion.

A. I think we ought to handle one area at a time so we don't get confused, and the first area I would like to continue to discuss is the so-called Mitchell Field in 19 North, 30 East.

This field had initial bottom hole shut-in pressure over compressibility factor, P/Z, of about 1000. At this present time it has a P/Z of about 600, so this field has gone through approximately half of its reservoir life. There is a steady decline in pressure, indicating that we have one reservoir, one common source of supply, of a limited extent.

In this particular area we think the extent of drainage is approximately 3000 acres.

To this date nine teen wells have been drilled in and around what we call the Abo reservoir, which is the same as what Amoco refers to as the Tubb reservoir. Some of these wells were not completed as producers because of poor permeability in the Abo zone, which would not allow for economic production. Other wells were drilled and encountered extraneous water production, which would not allow for economic production of the wells. This is different from a bottom water contact, which was also encountered by later drilling.

So we have up-dip water coming in from the west to the east in this particular field.

So we have had several wells that were drilled that would not avail us any ability to provide production.

With the history we've encountered here we feel that approximately one well per 320 acres is adequately draining this reservoir without a doubt.

Now I'd like to discuss briefly the Bueyeros Field, which is located in Township 20 North, 31 East, Sections 30 and 31.

From the records of the State's records, we conclude that a well was drilled in 1919 in this pool; that according to the records blew out. Now, how long it blew out or how much and to what extent and how much gas was left, we have no idea, but another company began a CO_2 dry ice operation in the area about 1947, and their records were very incomplete. The company went bankrupt and it was not until about the mid-fifties that Schwartz Carbonic took over this operation, and from that point forward we have fairly good information, but we can't give as complete an analysis of this area because of the early blowout, from our knowledge must have resulted in a loss of a tremendous amount of CO_2 to the air.

This particular field has four productive wells, and it is at a further stage of depletion than the Mitchell Field. In fact, it is very near its economic limit. Our most recent tests show the P/Z of about 350; however, in one of the wells in this field we've found that there is

another reservoir besides the Abo that is productive of CO_2. We term it the Glorieta zone and it appears to be a small reservoir with gas in place of only about 125,000 tons of CO_2, and we've already taken this reservoir down to a P/Z approaching 200.

So we have fairly good information from this reservoir dating back to 1968, and we can extrapolate good decline curve information.

The reservoir in this area is about 600 acres in extent in the Abo zone. Four wells are producing. One well is a blown -- the well that blew out depleted the pressure somewhat but would not have depleted this reservoir completely, from our engineering calculations.

Here again we think probably 320-acre drainage could be effective; however, in effect we have about one well per every 150 acres of reservoir.

So briefly, that is our experience with the area.

Referring to the maps that Amoco has presented, you will notice that they show thinning of so-called pay sand towards the west, towards this western edge of the unit boundary. This is very true, and we know that there are discontinuous sand bodies as you taper out to no sand at all further west, and as we have already observed

with the westernmost production, there is an extraneous water drive coming in up-dip and all across, no matter whether it's up-dip or down-dip, all across the western side of the reservoir. This we don't know how to explain, but wells put on production may be pure gas for a period of time and then start getting more and more water and eventually just get completely watered out.

Amoco has drilled one well that I have information on that has experience almost the same thing as we did with our nearby No. 4 Well, a high amount of salt water production from an up-dip gas well. Where that water comes from, we don't know.

So we boil it down to this. Maybe on the east side of the reservoir, or this Bravo Dome area, you've got such a massive body of sands that are interlocked, possibly, that maybe 640-acre drainage can be effective in that area. We have what we've termed earlier proof of the pudding in our long time history of production. We don't need test units. We've already, in effect, talking about a 25-well test area, we have the 20-well Mitchell Field that's been in production for forty years. We've affected the testing of that area. We know it's a limited reservoir. We have seen the earlier recommendation or standard that the Commission put forth, 160-acre spacing as being adequate, meeting

the needs of the operators in this area. Maybe some adjustment could be made to where as of now you can apply for smaller units, even 120-acre, 80-acre, 40-acre. Maybe the same thing can be applied, that the base spacing unit would be 160 acres and if somebody sees that -- or has information that shows that 640-acres could be drained, that there would be some means of allowing them to utilize one per 640 acres.

In our area where we've produced the wells, in effect we're on 160-acre spacing but we aren't on each and every 160-acre tract. So just because you have 160-acre spacing doesn't necessarily mean that you're going to drill one well on each and every 160-acre tract.

Now I would like to comment on specific data concerning this continuing -- the sand body in our particular portion of this area, the western portion. We earlier saw on Exhibit Ten, cross section B-B, the two wells 660 feet apart in Section 23, 30 North, 21 East.

AmeriGas drilled two wells within approximately a mile and a quarter of those two wells that are 660 feet apart. One well, an excellent producer, very similar to the two wells Amoco drilled.

Approximately 3/4 of a mile away and just about a little over a half mile away from the Amoco wells, a well with very similar characteristics on the log

as to sand development, wouldn't even flow 100,000 cubic feet a day.

So we have experienced that instead of finding forty and fifty millidarcy permeability here or there, and even greater, it is very, very seldom on the west side that you encounter those, what we consider high permeability. A good many wells over there will only find a few feet of one to five or six millidarcy permeability.

And if you were to insist on 640-acre spacing, you would not actually drain these little discontinuous sand bodies underlying each and every section in the western part of the field.

One other thing we'd like to point out is, where would somebody cut off, or what is the economic limit of production, for wells in this area? Well, it's one thing to one party and another thing to another party.

SEC, or pardon me, AmeriGas nowadays, has just in 1980 drilled two wells at approximately half the cost that Amoco has shown as their cost for drilling in the area. That makes a great difference for a company like AmeriGas. They can put two wells in for the same cost that Amoco can do it. So cutting the spacing in half, we come out with the same costs, and we all know no matter where it is or how good a reservoir, that more wells result in a more

efficient drainage of the reservoir. We've seen that from the Four Corners area to the east Texas fields, where at one time they said gas wells five acres apart was a waste of money, but we see nowadays that that was an efficient means of getting the maximum recovery from an excellent permeability reservoir.

Another thing is concerning economic limit and who's going to produce for how long, AmeriGas has a different situation for recovery of CO_2. This is converted in the field to liquid, and in certain cases to dry ice, and is sold all over the western part of the United States. An entirely different situation than is conceived for the pipelining of CO_2 for secondary or tertiary recovery by Amoco.

Another part of this problem is if we restrict to 640-acre spacing and indeed we find ten years down the line that this isn't doing the trick, will it be economic to go and infill drill in -- particularly in this isolated western part that's not going to drain as effectively, when maybe halfway through the life of these additional wells the pipeline will be at a point where it's uneconomic to operate and there'll be no market, and here you'll be sitting with wells that can't sell anything before they're -- because the great vast bulk of the area has declined to the economic limit of the pipeline.

Therefor, we conclude that the present spacing has been adequate and is adequate for the situation in a large, known area of the Bravo Dome Gas -- CO_2 Gas deposit, and that this spacing should remain intact the way it is and if the Commission sees that some expansion of provisions are allowed for someone to allot, say, as much as 640 acres, fine, but to continue to the spacing as it has been effective.

Q. In conclusion, then, Mr. Beeler, would it be your professional opinion that at least with respect to the western portion of the Bravo Dome Unit area, about which you've --

A. Right.

Q. -- directed your attention, at least with respect to that area, the granting of 640-acre spacing would probably cause waste and a violation of correlative rights?

A. Yes, it would.

MR. COFFIELD: I have no further questions of Mr. Beeler on direct.

MR. RAMEY: Any questions of Mr. Beeler? Mr. Buell?

MR. BUELL: I have some, Mr. RAmey, but I'd appreciate a brief recess. Mr. Beeler's, again, testimony

was very generalized, and I think with a recess I can certainly shorten the cross examination.

MR. RAMEY: Fifteen minutes?

MR. BUELL: That's plenty.

(Thereupon a recess was taken.)

MR. RAMEY: The hearing will come to order.

Do you have some questions now, Mr. Buell?

MR. BUELL: Yes, Mr. Ramey.

CROSS EXAMINATION

BY MR. BUELL:

Q. Mr. Beeler, I believe you've testified previously that based on data that have been made available to you, the rock quality of the Tubb outside your western area that you've spoken of today, and on over in the Bravo Dome Unit, appeared to be of much higher and better quality.

A. In other words, from west to east the permeability and sand sand thickness increases.

Q. All right, sir, and certainly the cross

section exhibits that we've introduced here today, certainly confirm your belief in that respect, do they not?

A. Yes, it does.

Q. All right, sir, I believe you mentioned two areas that you were concerned about, one you referred to as the Mitchell Field?

A. Yes.

Q. I believe it was your testimony that while one well in the Mitchell Field would drain 320, you were happy with 160. Am I getting the right connotation on your testimony?

A. That the spacing pattern as previously adopted by the Commission, and which is still in force, fits the drilling of wells adequately to meet the needs of Ameri-Gas to effectively prevent waste of reservoir gases, economic waste.

Q. Well, did I misunderstand you when you said that a well in the Mitchell Field area would drain 320 acres?

A. No, you did not.

Q. So is my summary of your testimony right, the well will drain 320, but for other reasons your client is happy with the 160 pattern?

A. The way it is written presently, the

form it is written based on 160-acre spacing, doesn't necessarily require you to drill each and every 160, but it does allow you to drill on a 160-acre tract, and also provides for even smaller drilling units.

Q. If for reasons other than drainage of the spacing unit you want to drill down to a denser pattern than 320, you can?

A. That's correct.

Q. All right, sir, I believe you also told me that the source of supply that the Mitchell Field wells were producing out of has been defined.

A. Yes.

Q. And by that, I take it that your testimony was that you know the horizontal limits of a common source of supply from which the Mitchell Field wells are producing?

A. We know by material balance calculations that approximately 3000 acres is being drained by the present wells.

Q. All right, you're --

A. I don't -- I don't say that that means that along this fenceline, that the field ends, but the present wells are adequately draining 3000 acres by material balance calculations.

Q. And you're convinced that 3000 acres constitutes a common source of supply?

A. Yes.

Q. All right, sir, and you heard our recommendations today. We recommended that our temporary rules, including a 640-acre spacing unit, would not apply to anything west of the western boundary of the Bravo Dome Unit.

A. Yes, I heard that.

Q. So the Mitchell Field and its wells would be excluded from the purview of the rules by our recommendation, assuming the Commission adopted the manner that we're recommended.

A. It's a little confusing the way the line is drawn around the northernmost well, the Mitchell No. 6. It doesn't seem to be excluded from the unit.

Q. Well, if it isn't excluded from the unit, it should be, and I hope our boundary is accurate, but our recommendation pertained to an accurate boundary description of Exhibit One, and if it isn't accurate, we'll change and make it accurate.

Under that assumption that it is accurate or will be made accurate, that would exclude every well in the Mitchell Field, would it not?

A Well, if you intend for it to and you

write it properly, I'm sure you can exclude them all.

Q. All right, sir, now the problem you mentioned, and I'm coming inside the outer boundaries of the Bravo Dome Unit, was the Bueyeros Field.

A. Bueyeros, yes.

Q. Bueyeros Field. I believe you also said that that was a 600-acre common source of supply, did you not?

A. Yes.

Q. That by your studies you had defined?

A. Yes.

Q. That 600-acre reservoir. Again, as in the case of the Mitchell Field, as I recall your testimony and correct me if I'm wrong, you said one well in the Bueyeros Field would drain 320 but for the same reasons for the Mitchell, you would prefer 160 for that field.

A. Yes, the basic spacing pattern as now written.

Q. And that field is clearly within the outer boundary of the Bravo Dome Unit and our temporary rule recommendation would apply to that area, is --

A. Yes.

Q. -- that correct?

I believe you heard testimony of Mr.

Allen that it was contemplated that if any separate common source of supply was defined within the outer boundary of the Bravo Dome Unit, that by proper application to the Commission in this case probably the Oil Conservation Division, that could be excluded from the purview of the rules and the Oil Conservation Division could adopt any rules that the evidence showed were proper. Do you recall that testimony?

A. Yes.

Q. Would that not be a solution to your Bueyeros Field concern?

A. Would it not be the other side of the coin be just as well; that we leave the rules as they are, and as you show various areas that 640-acre drainage will be affected, that you seek permission to exclude this area from the basic 160-acre spacing and qualify it as 640-acre spaced area?

Q. I believe you have heard testimony that the thrust of our recommendation here is to recommend temporary 640-acre spacing units to serve conservation through uniform and orderly development while data are being obtained, definitive data to show the optimum spacing pattern for this Commission to adopt. You've heard that testimony?

A. Yes, sir.

Q. Don't you think the adoption of tempo-

rary rules will serve that purpose?

A. It probably would for a large portion of the unit. You don't need to include all forty-two townships, I don't think, parpticularly in the face of contrary evidence of 640-acre drainage.

Q. All right, sir, you mentioned the Mitchell Field is a concern. We've eliminated it, have we not, in that all the wells in that field are outside the area to which we wanted our temporary rules to apply?

A. We don't say that -- that maybe at one end or the other there still are potential drilling sites that will expand the area of drainage, so therefor, we don't say that this particular field is completely developed.

However, the development that has occurred is draining 3000 acres. Maybe five or six more wells will make it 4000 acres. We can't conclude that.

Q. All right, sir, and with regard to the Bueyeros Field, I have described a solution that may not be acceptable to you, or to UGI, but it would be a solution to the specifically defined Bueyeros Pool from the purview of our rules we've recommended.

A. We say that the Bueyeros Field is 600 acres. We have approximately 10,000 acres of so-called Libby Ranch oil and gas leases. Since last year, the hearing last

year, we have drilled two wells approximately four miles away from the plant I discussed earlier, that found -- encountered an entirely separate pool or field from the Bueyeros Field, and we feel that it, as earlier discussed, is in the same pool or field as the wells shown as three and four on Exhibit Ten are in.

So we have a lot of undeveloped acreage in the so-called window that we need to -- not throw into limbo, but we feel to protect in the same manner as they have been protected in the past by the present spacing procedure.

Q. You're not testifying that it is the intention of UGI to drill unnecessary wells on this area, the Libby acreage outside of the Bueyeros Field, are you?

A. It's not the intent to drill unnecessary wells. The intent is to be able to study and make engineering calculations and reasonable deduction of what the conditions are in each individual area, and proceed on what density drilling fits the particular case.

Q. Wouldn't the adoption of temporary 640-acre spacing serve to give UGI the time to make that decision on their currently undeveloped Libby Ranch area?

A. I don't think it would.

Q. Why wouldn't it?

A. We have different ownerships and differ-

ent types of oil and gas leases, very radically different forms of oil and gas leases. The requirements, in effect, AmeriGas has two basic leases, one with the Mitchell Ranch and one with the Libby Ranch. These are very different from the ordinary oil and gas leases and very different from the leases that Amoco has with, for instance, Mr. Libby, of the Libby Ranch.

Q. Doesn't each of these leases that you're describing contain a provision that this private contract is subject to every valid rule and regulation of the New Mexico Oil Conservation Division?

A. I can't recall the terminology is just like that.

Q. You've read part of the leases but you haven't read that part.

A. Well, I've read them, but I don't have one with me and I can't recall exactly what --

Q. Do you believe the New Mexico Oil Conservation Commission should consider problems in a private contract between private individuals in adopting their conservation rules and regulations?

MR. HEALY: I object to that question. The issue is really not what our leases contain but whether the spacing rule should be changed, and I think the question

is whether the 640-acre spacing rule would provide for economic recovery of CO_2 and prevention of waste.

What our leases require isn't really germane to this hearing. I think it's irrelevant.

MR. BUELL: For the first time since I have known Mr. Healy, I'm in agreement with him. These provisions of their private contracts are of no concern to this Commission or this hearing, but their witness interjected it, I didn't.

MR. HEALY: I disagree with that. I think you brought up what would be suitable for our development and lead into the questioninf of our leases.

MR. BUELL: Now that we have Mr. Healy's legal position, I'm going to repeat a question I asked Mr. Beeler, and I'm sure in view of his counsel's position, he will answer it differently.

MR. HEALY: Restate the question.

MR. BUELL: I will not bring up your private contracts again, because I --

MR. HEALY: Well, I think what our leases are,are really irrelevant to the whole hearing.

Q. Mr. Beeler, you've testified that UGI does not want to drill any unnecessary wells.

A. That is correct.

Q. And then I asked you this question. Would not the adoption of our recommendation of 640-acre spacing units on a temporary basis for the Libby Ranch area outside the Bueyeros Field give UGI the time necessary to determine whether or not they would want to drill on a more dense pattern than 640 acres?

A. As you know, the production from Ameri-Gas' wells is all processed on the, you know, in the field, and various conditions change as to demand on production. Additions have been made to the liquification facilities out there. Two wells were drilled this year because of a differing need for CO_2 production. Due to the enhanced recovery projects being discussed and put into operation, we don't know how soon more wells will be needed. We can only evaluate things one well at a time, I think, in our particular area, because we have found that, indeed, 640-acre spacing would not result in the best economical recovery from the areas --

Q. Are you talking about --

A. Okay.

Q. I didn't mean to interrupt you, Mr. Beeler.

A. That's okay.

Q. I thought you were through.

Are you talking about the area that can

be effectively and efficiently drained by one well or are you talking about the number of wells you would need to satisfy a demand completely aside from effective and efficient drainage of an area?

A. Well, we have the basic problem of supplying the demand that presents itself. We're in an era of increased demand for liquid CO_2.

Q. All right, sir, we're still on the Libby Ranch area outside the Rueyeros Field. How will our temporary 640-acre spacing recommendation prevent UGI from drilling whatever wells are necessary to satisfy any demand that they might have?

A. Well, as I understand it, you would want to restrict the drilling to one well per 640 acres. Therefor, if we encountered a situation, as we have already done in the two 1980 wells, where one well will not recover anything from a particular drilling site, we had to conclude therefor that certainly we are not going to be able to drain 640 acres with a well similar to that.

So therefor we have to look at each well as we drill it to see what kind of well we get. Will it be able to drill -- obtain the drainage from 160, from 320, as we look into every new field.

Q. Mr. Beeler, are you telling this Com-

mission that you can look at one well and determine its effective and efficient drainage area?

A. Yes, as production history goes on and as we have information from one or two wells in the general vicinity, yes, each well will provide valuable information.

Q. But you cannot instantaneously look at any one well and by any method known to you or to reservoir engineering science or geological science, just look at that one well instantaneously and arrive at its effective and efficient drainage area.

A. We could if there were no sand in it. We could conclude that you can't drain anything from it.

Q. I understand --

A. So, yes, we can get instantaneous information, just as you've indicated you're getting -- each well you drill, more information.

Now we're not getting, you know, on a --

Q. Other than that one example of a dry hole --

A. Yes, but we might get a --

Q. -- you couldn't make an instantaneous judgment.

A. A dry hole or a very -- as we have seen in other cases, a well that would only produce a small amount

of gas that would be uneconomic or marginal.

Q. Mr. Beeler, how many acres in the Libby Ranch lease of UGI are outside the 600-acre Bueyeros Field?

A. About 10,000 acres.

Q. Would you divide 640 into 10,000 and tell me the number of wells that UGI could drill on a 640-acre temporary spacing basis?

A. I believe that to be approximately 15, wouldn't it?

Q. Do you anticipate the local demand of UGI is going to in the immediate future require them to drill more than 15 wells?

A. It's quite possible. We've had some inquiries as to very large pilot projects anticipated by major oil companies, and they are inquiring as to our ability to provide this material.

Q. Has UGI management approved the drilling of one additional well on the Libby acreage, to your knowledge?

A. Well, they approved two in 1980. I haven't heard any of the exact plans for 1981.

Q. If they're going to drill any wells on that acreage in 1981, you're not aware of it.

A. Well, I haven't heard one way or the other.

Q. All right, sir. Now going back to your Mitchell Field area and Bueyeros Field area, and with the poor quality of pay you have there, if this Commission set the spacing that you're recommending for this localized area, to the entire Bravo Dome Unit, that's 160-acre current --

A. They, let's say, they already have. That's what we have right now.

Q. Yes. Wouldn't that be like the tail wagging the dog?

A. Well, I think what you're recommending can be termed the same thing, the tail wagging the dog. Here we've already established something and you're wanting to wag the dail; you want to change it.

I think the burden of proof is on you to show that it should be changed. You have no production to show; no production history to show that your change is called for.

We have so-called proof of the pudding.

Q. All right, sir, now let's take your testimony that in this area of admittedly poorer quality reservoir rock, and I'm speaking of your 600-acre Bueyeros Field, as you call it, even this area of poor quality rock, you have testified that one well has pressure depleted the entire 600-acre reservoir.

A. I did not say that, sir.

What I said, that one well blew out, it affected the pressure in the whole 600 acres. It drew down the pressure. Of course, near the wellsite the pressure drawdown was greater than out near the edge of the 600 acres.

Q. I thought that's the way I had phrased your previous testimony, but I'll certainly accept the way you phrased it now.

So you noted pressure interference over your 600 acre reservoir in an area of admitted poor reservoir rock quality, and you've admitted the rock quality east of your 600-acre Bueyeros reservoir is of a much higher quality, am I right --

A. Yes.

Q. -- so far? And still you object to this Commission adopting on only temporary basis 640-acre spacing for the Bravo Dome Unit area.

A. Yes, sir, because in the Bueyeros Pool, 600-acre reservoir, it certainly would have taken more than one well to efficiently drain and prevent economic waste of the gas in place.

Q. Excuse me. How can you make that statement to the Commission when you admitted that you did not know the volume of gas that was vented to the air, onto the

air, from this one well?

A. Because we have four producing wells that were, at least one of them would have been necessary to complete the whole reservoir as we are doing now. We actually have four in 600 acres, remember, and we're drawing it down, steadily, slow but sure, and it's been an economical operation throughout its history, except for the first bankruptcy, but I mean after Schwartz Carbonic took over.

Q. One more question, Mr. Beeler, and I'm through.

In the latter part of your direct testimony I didn't object to it, but weren't you more or less speculating or philosophizing when ycu were talking of down the road the pipeline outlet quantity might reach the economic limit and it might be impossible to drill a well that could be necessary, weren't you -- weren't you engaging in the pure realm of speculation?

A. No, sir, I'm a trained engineer and I've evaluated economic limits on production through pipelines, through plants. There's got to be an economic limit somewhere, where well production will get to the point that it's -- you'll have to cease operations of your whole system.

Q. What hard data, or what hard evidence, even a shred of evidence, do you have to present to this

Commission at this hearing that this will occur in the Bravo Dome Unit area?

Just a shred of evidence, Mr. Beeler?

A. Well, I've already presented it, that we have 320-acre drainage, approximately; if we only had one well per 640 acres, we wouldn't properly drain those areas. Maybe we would -- let's take a hypothetical case. Maybe we would get 50 or 60 percent of the gas that we could get with the present type of spacing. Okay, if we wait till later on to put the second well in on each section, at some point the pipeline is going to say, well, we don't have enough gas to keep the whole system going, so that's the end of it. Here these wells started much later and just didn't have the opportunity to effectively drain the reservoir.

It's as simple as that.

Q. Mr. Beeler, I take it from your testimony that you're under the impression that our recommendation would limit one well to a 640-acre spacing unit, if an operator wanted to drill more. Is that your understanding, that we would fervently limit one well to 640 acres?

A. I under -- I don't get the complete story, but from the way the Commission operates, you would have to come to the Commission to get an exception from the spacing that was established to drill a, in other words, to

prove the need to drill a second well.

Q. Let me just clear this up right now for you, Mr. Beeler, and --

A. Okay.

Q. -- it's already clear in the record. Under our recommendation an operator, if he wanted to and thought it was necessary, could drill four wells on a 640-acre spacing unit that we're recommending.

A. Okay.

Q. Has all of your testimony been given with this misconception?

A. No.

Q. About --

A. That was my understanding, the way I saw the spacing order, but no, I'm saying, have said from the beginning, the present spacing pattern fits the need of the western part of the Bravo Dome CO_2 gas area.

Q. And has it been your understanding, or has it not been your understanding, that in our recommendation an operator could simply apply for a permit to drill a well administratively for a second well as he did for the first well, and do the same thing with the third and fourth? There would be no exception hearing. What is your understanding in that regard?

A. Well, now that you've -- I've never heard during this hearing the specifics of the mechanics of drilling other wells on the 640-acre spacing unit that you recommend.

Q. So, actually, under our recommendation UGI, although they have no wells to your knowledge planned to be drilled in 1981, could drill four wells on the 640-acre spacing unit that we're recommending, could they not?

A. According to your latest information, yes.

MR. BUELL: May it please the Commission I believe that's all.

Thank you very much, Mr. Beeler.

MR. RAMEY: Any other questions of Mr. Beeler?

REDIRECT EXAMINATION

BY MR. COFFIELD:

Q. Well, one point on this matter that Mr. Buell is bringing out here in the latter part of his cross examination, with respect to the location of four wells, for example, on a 640-acre spacing area while 640 acres is the proper spacing, is it your understanding, Mr. Beeler, that as generally applied by the Commission, drilling more than

one well on a 640-acre spacing -- just generally as far as your answer --

A. Right.

Q. -- drilling one well, more than one well on a single proration spacing area, does normally involve some kind of penalty?

A. That's my experience in most cases.

MR. COFFIELD: No further questions.

RECROSS EXAMINATION

BY MR. BUELL:

Q. Well, is your misconception cleared up now, Mr. Beeler?

A. Well, I'm glad you have cleared it up.

Q. Thank you, sir.

A. Because I didn't see it that way until you explained it that way.

Q. I was having a hard time understanding your testimony on cross, and I'm glad that we finally got to the root source of our trouble, Mr. Beeler, and again I thank you very much.

A. Well, you did introduce earlier a sheet or an exhibit indicating where a well would be permitted to drill. It was a shaded area. I don't have that --

Q. Exhibit Six, Mr. Beeler.

A. Exhibit Six, okay. It was -- it showed shaded areas inside each 640-acre tract where the drilling of a well would be permitted. In total, this was 40 acres for the whole 640-acre tract. And my understanding, the way you presented that, those 40 acres were the only place, there were four 10-acre spots, were the only place you could drill within the 640-acre tract. Am I correct?

Q. If you're asking me a question, Mr. Beeler, the answer is yes, sir, Mr. Beeler.

A. Certainly it would severely limit the actual area in a 640-acre section of land. It would pin you down to 1/16th of the total area of the section, whereas, the present rule allows you to put a well inside each quarter section within 660 feet of the boundary of the governmental quarter quarter section. Quarter section. Which allows you for each section of land 1/4 of the whole section.

I think that would be greatly restrictive compared to the present situation.

Q. Mr. Beeler, if you would rather recommend a more flexible well spacing pattern for the 640-acre temporary spacing unit, I'm sure the Commission would be glad to consider that flexible spacing and so would Amoco.

And again I thank you, Mr. Beeler.

MR. RAMEY: Any other questions of Mr. Beeler? He may be excused.

MR. BEELER: Thank you.

MR. RAMEY: Anything further, Mr. Coffield?

MR. COFFIELD: No, sir.

MR. RAMEY: Mr. Kellahin, do you have a witness that you wish to --

MR. KELLAHIN: No, sir, we do not.

MR. RAMEY: Anything further? Any statements at this time?

MR. BUELL: May it please the Commission, we have no evidence to be submitted in rebuttal.

I don't know whether the Commission at this time is ready for closing statements, and if they are, I would like the right, since I as applicant have the burden, to close last.

MR. RAMEY: Right.

MR. STAMETS: Mr. Ramey, in light of the last bit of questioning between Mr. Buell and Mr. Beeler, perhaps those parties here subsequent to the hearing, might like to recommend some minimum distance between wells in this reservoir, 1980 feet between wells, something like that, which would permit the additional wells that might be drilled

on 640 to provide for better spacing and better drainage.

MR. BUELL: May it please the Commission, we would certainly be happy to consider Mr. Stamets' recommendation. Right off the top I think it has a lot of merit. I would like to say if anyone other than Amoco would like to take advantage of this recommendation, that we set a time limit so it wouldn't delay a decision on our application here today.

MR. RAMEY: I would think that perhaps seven days, if there's any suggestion, that one could be submitted by this time next week; at the end of the work day on the 25th of March? Leave the record open for technical proposals.

MR. BUELL: I think that's certainly ample time, Mr. Ramey.

MR. RAMEY: We will so do.

MR. KELLAHIN: Mr. Ramey, on behalf of Amerada Hess Corporation and Cities Service Company, we'd like to voice our support of Amoco in the application today.

We believe that the establishment of temporary 640-acre spacing for this area within the Bravo Dome Unit, the outer boundaries of the Bravo Dome Unit, is the only logical and reasonable way to at this time preserve orderly development of this carbon dioxide reservoir.

We have a unique opportunity at this point to effectively and efficiently control for purposes of conservation and prevention of waste, as well as avoiding the drilling of unnecessary wells, the establishment of wide spacing. To develop otherwise compounds the minimal problem that AmeriGas has presented today. If we fail to act now, then wells will be drilled on 160-acre spacing and we'll set upon a course of action that could not in the future be reversed.

By establishing 640-acre spacing now on a temporary basis, we have reserved to the Commission the maximum amount of flexibility in coming up with a system of spacing that will eventually and ultimately result in the greatest production of carbon dioxide from this reservoir.

MR. RAMEY: Thank you, Mr. Kellahin. Do you have a statement, Mr. Healy?

MR. HEALY: I have a short statement.

You'll all heard the testimony and seen the exhibits today. It's very complex subject matter, and I don't pretend to understand it fully or even adequately, but I think the Commission and its staff will have the time and the obligation to look at things very carefully and decide what they think is the best course of action.

I think that all I can say is that based

on our producing history that we don't believe that the change in spacing as proposed for the western portion of the field where we have acreage is proper.

I think the evidence, testimony that you've heard today supports that, and I'd like to move that if the Commission grants Amoco's application on the spacing, that acreage in the western part of the unit be excluded from that. I don't see any pressing need to change the spacing pattern in that area where there is production history and where the evidence supports continuing the present spacing pattern.

I'm not speaking to the rest of the unit which is a very large area, and I think Amoco's done a fine job on collecting the data that's available to them now. I think perhaps they ought to be on larger spacing than the rest of the field.

That's all I have.

MR. RAMEY: Mr. Healy, along that line, I think if you have an area which you feel has a separate common source of supply, that you would like excluded from this, I think it might be well to let us know what that is.

MR. HEALY: Submit that, okay. Is that okay, Mr. Buell, I'll put that in writing.

MR. BUELL: I'm sorry, Mr. Ramey, I was

thinking about what I was going to say to answer Mr. Healy, and I didn't hear your remarks.

MR. RAMEY: Well, basically I was proposing perhaps that the Bueyeros Field might be excluded, it being a separate common source of supply, as they have indicated that, that it might be excluded from the 640-acre requirement, if it were granted; that he would submit an area.

MR. BUELL: I would say, based on Mr. Beeler's testimony there is ample evidence in this record to be excluded, and I would stipulate that Amoco Production Company as applicant has no objection to the Commission excluding the wells in what we've been calling here the Bueyeros Field.

That's better than writing, isn't it, a stipulation on the record?

MR. HEALY: Yes, but the problem we have is our wells are very close to the other acreage we have and we would apply what we've learned from our wells to the acreage positioned within the unit boundary, so we'd want to exclude all of that acreage. Now that's not a very big area and I think, as I say, our production history is as easily extrapolated to the acreage that we haven't developed yet as Amoco's data is to the rest of the unit. I think it's

more powerful proof than perhaps some of the other proof we've had today.

I would propose that we exclude all of the acreage which we have with the Libby and Mitchell Ranches based on our production history.

MR. RAMEY: You may make the request, Mr. Healy, submit what you think should be taken out, and with that adequate reason, it probably will be done.

MR. HEALY: Fine, thank you.

MR. RAMEY: You may proceed, Mr. Buell.

MR. BUELL: Is that everyone?

MR. RAMEY: I think that's everyone.

MR. BUELL: In the interest of time, I predicted that we'd be through and you could start your next hearing by 3:00 o'clock, let me adopt Mr. Kellahin's closing statement for Amerada Hess and Cities Service, as to the conservation thrust of our application, and I'll limit my remarks to just one or two things outside that overall conservation thrust that are, I think, important for the Commission to consider.

Looking at Exhibit One, there are many windows in the Bravo Dome Unit that are not held by UGI under their Libby Ranch lease, which is mainly over here north of the Bueyeros Field area, which we've defined in the record.

There are many individual windows in this unit. Under most of them are people that don't desire to lease; some are people that can't be located. The only way their interest can be protected in these small window units is to be included in a well drilled on a larger unit.

Under our proposed 640-acre spacing units, we will be able to prove these small window tracts, which are scattered throughout the length and breadth of the Bravo Dome Unit into a unit and thus protect the correlative rights of those owners of interest.

So again I urge the Commission in order to protect the correlative rights of all the interest owners, in addition to the conservation benefits that Mr. Kellahin has so articulated in his closing statement, that you adopt our recommendation for the temporary operating rules, including 640-acre spacing units for the Bravo Dome Unit area.

Thank you.

MR. RAMEY: Thank you, Mr. Buell.

Does anyone have anything further to add in this hearing?

If not, we'll take the case 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 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 C.S.R.

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ROUGH

dr/

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION COMMISSION

IN THE MATTER OF THE HEARING CALLED BY THE OIL CONSERVATION COMMISSION OF NEW MEXICO FOR THE PURPOSE OF CONSIDERING:

CASE NO. 7198

Order No. _____

APPLICATION OF AMOCO PRODUCTION COMPANY FOR TEMPORARY SPECIAL AREA RULES FOR THE BRAVO DOME CARBON DIOXIDE AREA, INCLUDING PROVISION FOR 640-ACRE SPACING UNITS.

5/28
Emery Arnold approved
Mtn Area by telephone
EP

ORDER OF THE COMMISSION

BY THE COMMISSION:

This cause came on for hearing at 9 a.m. on March 18, 1981, at Santa Fe, New Mexico, before the Oil Conservation Commission of New Mexico, hereinafter referred to as the "Commission."

NOW, on this _____ day of _____, 1981, the Commission, a quorum being present, having considered the testimony presented and the exhibits received at said hearing, and being fully advised in the premises,

FINDS:

(1) That due public notice having been given as required by law, the Commission has jurisdiction of this cause and the subject matter thereof.

(2) That the applicant, Amoco Production Company seeks approval of temporary special area rules for the Bravo Dome carbon dioxide, including provision for 640-acre spacing units.

(3) That more specifically applicant seeks temporary special rules in the following regards:

"(1) Casing and Cementing

(a) Sufficient surface casing will be run to protect all fresh water zones with cement circulated behind casing to surface.

(b) Depth from surface to top of cement behind the production string will be furnished the Division on form C-103 based on temperature survey or other alternative methods approved by the District Director when cement is not circulated to surface.

(c) An affidavit specifying type and volumes of cement used in cementing all casing strings will be furnished the Oil Conservation Division on a form suitable to the Division.

(2) Injection of CO_2

The Division Director may grant administrative approval to inject CO_2 for the purpose of testing wells and surface production facilities only.

(3) Spacing

640 surface contiguous acres, more or less. Wells shall be located not closer than 1980' to any outer boundary of such tract, nor closer than 330' to any quarter-quarter section line. This rule will not prevent the drilling of more than one well on any 640 acre spacing unit."

(4) That the Bravo Dome carbon dioxide area is situated in portions of Harding, Quay, and Union Counties, New Mexico, and is more particularly described in Exhibit A attached hereto.

(5) That the development of the Bravo Dome carbon dioxide area is presently governed by the General Rules and Regulations of the Division, under which both the Commission and Division have concurrent jurisdiction.

(6) That the requirements of applicant's proposed special rules concerning casing and cementing are virtually identical with the requirements of the Division's current general regulations and as such are not necessary.

(7) That, with respect to the proposed affidavit requirements, the Commission's and Division's practice and policy has been and should continue to be that operators are responsible for compliance with sound drilling practices in accordance with the Division's rules and regulations.

(8) That the Division Director should have authority, without the necessity of hearing, to grant administrative approval to re-inject CO_2 gas produced for the purpose of testing wells and surface production facilities back into the formation.

(9) That concerning temporary 640-acre spacing rules and regulations the evidence presented by the applicant does not support -- even on a temporary basis -- an economic, engineering, geological or other valid and compelling justification, within the jurisdiction of the Commission, for such special rules.

(10) That applicant's request herein for special temporary rules and regulations should be denied with the exception of the contents of Finding (8) above.

(11) That denial of the application to the extent of Finding (10) above will not cause waste nor impair correlative rights.

IT IS THEREFORE ORDERED:

(1) That the Application of Amoco Production Company for temporary special area rules for the Bravo Dome carbon dioxide area, including provision for 640-acre spacing is hereby denied, except to the extent that the Director of the Oil Conservation Division is hereby authorized to grant administrative approval for the re-injection of CO_2 gas produced for the purpose of testing wells and surface production facilities back into the formation within the Bravo Dome carbon dioxide area as defined in Exhibit A attached hereto and by reference made a part hereof.

(2) That jurisdiction of this cause is retained for the entry of such further orders as the Commission may deem necessary.

DONE at Santa Fe, New Mexico, on the day and year hereinabove designated.

STATE OF NEW MEXICO
OIL CONSERVATION COMMISSION

ALEX J. ARMIJO, Member

EMERY C. ARNOLD, Member

JOE D. RAMEY, Member & Secretary

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION

IN THE MATTER OF THE HEARING
CALLED BY THE OIL CONSERVATION
COMMISSION OF NEW MEXICO FOR
THE PURPOSE OF CONSIDERING:

CASE NO. 7198
Order No. R-6645

APPLICATION OF AMOCO PRODUCTION
COMPANY FOR TEMPORARY SPECIAL RULES,
UNION, HARDING, AND QUAY COUNTIES,
NEW MEXICO.

ORDER OF THE COMMISSION

BY THE COMMISSION:

This cause came on for hearing at 9 a.m. on March 18, 1981, at Santa Fe, New Mexico, before the Oil Conservation Commission of New Mexico, hereinafter referred to as the "Commission."

NOW, on this_____day of May, 1981, the Commission, a quorum being present, having considered the testimony presented and the exhibits received at said hearing, and being fully advised in the premises,

FINDS:

(1) That due public notice having been given as required by law, the Commission has jurisdiction of this cause and the subject matter thereof.

(2) That the applicant, Amoco Production Company, is the operator of one or more carbon dioxide gas wells within those lands in Union, Harding, and Quay Counties, New Mexico, described on Exhibit A attached hereto.

(3) That the applicant seeks establishment of the Bravo Dome Carbon Dioxide Gas Area, hereinafter referred to as the "Area," and the promulgation of temporary rules therefor including provisions for 640-acre gas proration units and specified well locations.

(4) That approval of the application will permit the reasonable development of the Area and the more rapid gathering of reservoir data throughout.

(5) That the geologic evidence presented at the hearing justifies the development of said Area on 640-acre spacing for some reasonable temporary period of time.

(6) That it is anticipated that facilities for the gathering and transportation of carbon dioxide gas from the Area will be constructed and in operation within the not too distant future, said facilities being hereinafter referred to as the "System."

(7) That a reasonable period of time for the development of the Area on temporary 640-acre spacing would be that pending construction of the System and three years after first connection of any well thereto.

(8) That the commonly referred to "Bueyeros Pool" described as follows is a separate common source of supply within the Area:

HARDING COUNTY, NEW MEXICO
TOWNSHIP 20 NORTH, RANGE 31 EAST, NMPM
Section 30: E/2
Section 31: E/2
Section 32: NW/4

(9) That said Bueyeros Pool as described above, or as hereafter extended by order of the Division, should be exempt from the special rules and regulations of the Bravo Dome Carbon Dioxide Gas Area.

(10) That this case should be reopened at a hearing three years after initial connection of a well in the Area to the System at which time the operators in the subject Area should appear and show cause why the said Area should not be developed on 160-acre carbon dioxide gas proration units.

IT IS THEREFORE ORDERED:

(1) That an area for carbon dioxide gas production is hereby created and designated as the Bravo Dome Carbon Dioxide Gas Area comprising those lands described in the attached Exhibit A and made a part hereof.

(2) That the vertical limits of said Bravo Dome Carbon Dioxide Gas Area shall consist of the formation(s) found from the base of Cimarron Anhydrite to the top of the Granite.

(3) That special rules and regulations for the Bravo Dome Carbon Dioxide Gas Area are hereby promulgated as follows:

SPECIAL RULES AND REGULATIONS
FOR THE
BRAVO DOME CARBON DIOXIDE GAS AREA

RULE 1. Each well completed or recompleted in the Bravo Dome Carbon Dioxide Gas Area shall be spaced, drilled, and operated in accordance with the Special Rules and Regulations hereinafter set forth, provided however, said rules shall not apply to that area commonly referred to as the "Bueyeros Pool" as defined below or as hereafter extended by order of the Division:

BUEYEROS POOL, HARDING COUNTY, NEW MEXICO
TOWNSHIP 20 NORTH, RANGE 31 EAST, NMPM
Section 30: E/2
Section 31: E/2
Section 32: NW/4

and provided further, that said rules shall not apply to any carbon dioxide pool within the Area if said pool has been created and defined by the Division and is covered by Special Pool Rules in conflict herewith.

RULE 2. Each well shall be located on a standard unit containing 640 acres, more or less, consisting of a governmental section; provided, however, that nothing contained herein shall be construed as prohibiting the drilling of a well on each of the quarter sections in the unit.

RULE 3. The Director of the Oil Conservation Division may grant an exception to the requirements of Rule 2 without notice and hearing when an application has been filed for a non-standard unit and the unorthodox size or shape of the unit is necessitated by a variation in the legal subdivision of the United States Public Land Surveys, or the following facts exist and the following provisions are complied with:

(a) The non-standard unit consists of quarter-quarter sections or lots that are contiguous by a common bordering side.

(b) The non-standard unit lies wholly within a governmental section and contains less acreage than a standard unit.

(c) The applicant presents written consent in the form of waivers from all offset operators and from all operators owning lands in the section in which the non-standard unit is situated which lands are not included in said non-standard unit.

(d) In lieu of Paragraph (c) of this rule, the applicant may furnish proof of the fact that all of the aforesaid operators were notified by registered or certified mail of his intent to form such non-standard unit. The Director may approve the application if no such operator has entered an objection to the formation of such non-standard unit within 30 days after the Director has received the application.

RULE 4. Each well shall be located no nearer than 1650 feet to the outer boundary of the section and no nearer than 330 feet to any governmental quarter-quarter section line; provided, however, that any subsequent wells drilled on a unit shall be located no nearer than 1320 feet from any existing well drilling to or capable of producing from the Bravo Dome Carbon Dioxide Gas Area.

RULE 5. The Director may grant an exception to the requirements of Rule 4 without notice and hearing when an application has been filed for an unorthodox location necessitated by topographical conditions or the recompletion of a well previously drilled to another horizon. All operators offsetting the proration unit shall be notified of the application by registered or certified mail, and the application shall state that such notice has been furnished. The Director may approve the application upon receipt of written waivers from all operators offsetting the proration unit or if no objection to the unorthodox location has been entered within 20 days after the Director has received the application.

IT IS FURTHER ORDERED:

(1) That the Director of the Division may authorize the testing of wells and equipment within the Bravo Dome Carbon Dioxide Area in excess of normal four-point potential testing upon proper showing of the need and efficiency of such testing and provided that the produced gas shall be reinjected into the reservoir.

(2) That the applicant shall file for approval of any well to be used for injection purposes in accordance with Division rules and procedures then current.

(3) That the locations of all wells presently drilling to or completed in the Bravo Dome Carbon Dioxide Gas Area are hereby approved; that the operator of any well having an unorthodox location shall notify the Santa Fe District Office of the Division in writing of the name and location of the well on or before_____, 1981.

(4) That, pursuant to Paragraph A. of Section 70-2-18, NMSA 1978, contained in Chapter 271, Laws of 1969, existing wells in the Bravo Dome Carbon Dioxide Gas Area shall have dedicated thereto 640 acres in accordance with the foregoing pool rules; or, pursuant to Paragraph C. of said Section 70-2-18, existing wells may have non-standard spacing or proration units established by the Division and dedicated thereto.

Failure to file new Forms C-102 with the Division dedicating 640 acres to a well or to obtain a non-standard unit approved by the Division within 60 days from the date of this order shall subject the well being shut-in. Until said Form C-102 has been filed or until a non-standard unit has been approved, and subject to the 60 day limitation, each well presently drilling to or completed in the Bravo Dome Carbon Dioxide Gas Area shall receive no approved Form C-104, provided however, that no further approval shall be required for any non-standard spacing and proration unit comprising less than 160 acres or for any 160-acre unit consisting of other than a single governmental quarter section, provided such unit has previously been approved by order of the Division.

(5) That this case shall be reopened at a hearing three years from the date that the Area is serviced by the System and the first well is connected thereto, at which time the operators in the subject area may appear and show cause why the Bravo Dome Carbon Dioxide Gas Area should not be developed on 160-acre spacing units.

(6) That when the first well in the Area is connected to the System, the applicant shall notify the Division in writing of such fact, and the Division will thereupon issue a supplemental order designating the approximate date for reopening this case.

(7) That jurisdiction of this cause is retained for the entry of such further orders as the Commission may deem necessary.

DONE at Santa Fe, New Mexico, on the day and year hereinabove designated.

STATE OF NEW MEXICO
OIL CONSERVATION COMMISSION

ALEX J. ARMIJO, Member

EMERY C. ARNOLD, Member

JOE D. RAMEY, Member & Secretary

S E A L

fd/

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION

BRUCE KING
GOVERNOR

LARRY KEHOE
SECRETARY

POST OFFICE BOX 2088
STATE LAND OFFICE BUILDING
SANTA FE, NEW MEXICO 87501
(505) 827-2434

June 5, 1981

Re: CASE NO. 7198
ORDER NO. R-6645

Mr. William F. Carr
Campbell, Byrd & Black
Attorneys at Law
Post Office Box 2208
Santa Fe, New Mexico

Applicant:

~~Amoco Production Company~~

Dear Sir:

Enclosed herewith are two copies of the above-referenced Commission order recently entered in the subject case.

Yours very truly,

JOE D. RAMEY
Director

JDR/fd

Copy of order also sent to:

Hobbs OCC _____
Artesia OCC x
Aztec OCC _____

Other ~~Guy Buell, Conrad Coffield, Walter Healy, Clyde Mote, Thomas Kellahin~~

BRAVO DOME CARBON DIOXIDE GAS UNIT

UNION COUNTY, NEW MEXICO

TOWNSHIP 18 NORTH, RANGE 34 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 18 NORTH, RANGE 35 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 18 NORTH, RANGE 36 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 18 NORTH, RANGE 37 EAST, NMPM
Sections 6 and 7: All
Sections 18 and 19: All
Sections 30 and 31: All

TOWNSHIP 19 NORTH, RANGE 34 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 19 NORTH, RANGE 35 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 19 NORTH, RANGE 36 EAST, NMPM
Section 16: All
Section 18: S/2
Sections 19 and 20: All
Section 21: W/2, W/2 NE/4 and SE/4 NE/4
Section 26: S/2 S/2
Section 28: W/2 and SW/4 SE/4
Sections 29 through 36: All

TOWNSHIP 20 NORTH, RANGE 34 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 20 NORTH, RANGE 35 EAST, NMPM
Section 3: W/2
Sections 4 through 10: All
Section 11: SW/4
Section 14: NW/4
Sections 15 through 22: All
Section 23: NW/4
Sections 27 through 34: All

TOWNSHIP 21 NORTH, RANGE 34 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 21 NORTH, RANGE 35 EAST, NMPM
Sections 1 through 24: All
Section 25: N/2 and SW/4
Section 26: All
Section 27: NE/4 and N/2 NW/4
Section 28 through 33: All

TOWNSHIP 22 NORTH, RANGE 30 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 22 NORTH, RANGE 31 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 22 NORTH, RANGE 32 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 22 NORTH, RANGE 33 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 22 NORTH, RANGE 34 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 22 NORTH, RANGE 35 EAST, NMPM
Section 5: S/2
Sections 6 through 8: All
Section 9: W/2 and SE/4
Section 10: S/2 S/2
Sections 15 through 21: All
Section 22: N/2
Section 27: SW/4
Sections 28 through 33: All
Section 34: W/2
Sections 36: All

TOWNSHIP 23 NORTH, RANGE 30 EAST, NMPM
Section 36: All

TOWNSHIP 23 NORTH, RANGE 31 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 23 NORTH, RANGE 32 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 23 NORTH, RANGE 33 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 23 NORTH, RANGE 34 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 23 NORTH, RANGE 35 EAST, NMPM
Section 31: All

TOWNSHIP 24 NORTH, RANGE 31 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 24 NORTH, RANGE 32 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 24 NORTH, RANGE 33 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 24 NORTH, RANGE 34 EAST, NMPM
Sections 1 through 36: All

HARDING COUNTY, NEW MEXICO

TOWNSHIP 17 NORTH, RANGE 30 EAST, NMPM
Section 1: N/2, SE/4, E/2 SW/4
Section 11: SE/4, E/2 SW/4
Section 12: S/2, NE/4, E/2 NW/4
Section 13: All
Section 14: E/2, E/2 W/2, SW/4 NW/4
Section 15: SE/4 NE/4
Section 22: SE/4 SE/4
Sections 23 through 25: All
Section 26: NE/4, E/2 NW/4
Section 27: NE/4 NE/4
Section 35: SE/4
Section 36: All

TOWNSHIP 17 NORTH, RANGE 31 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 17 NORTH, RANGE 32 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 17 NORTH, RANGE 33 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 18 NORTH, RANGE 30 EAST, NMPM
Sections 1 and 2: All
Section 3: E/2 E/2, SW/4 SE/4
Section 10: E/2 NE/4
Section 11: N/2
Sections 12 through 14: All
Section 23: E/2, E/2 W/2
Section 24: All

Section 25: E/2, NW/4, E/2 SW/4, NW/4 SW/4
Section 26: N/2 S/2, NE/4, E/2 NW/4
Section 36: All

TOWNSHIP 18 NORTH, RANGE 31 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 18 NORTH, RANGE 32 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 18 NORTH, RANGE 33 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 19 NORTH, RANGE 29 EAST, NMPM
Section 1: NE/4 and E/2 NW/4

TOWNSHIP 19 NORTH, RANGE 30 EAST, NMPM
Sections 1 through 4: All
Section 5: E/2
Section 6: E/2 SE/4, NW/4 SE/4, NE/4 SW/4
Section 7: NE/4 NE/4, NE/4 SE/4, SE/4 SW/4, SW/4 SE/4
Section 8: N/2, SE/4, SE/4 SW/4
Sections 9 through 16: All
Section 17: N/2, SE/4
Section 18: NE/4 NE/4
Section 20: S/2 SE/4, W/2 NE/4
Sections 21 through 28: All
Section 29: NE/4
Section 32: NE/4 NE/4
Section 33: N/2 N/2, SW/4 NE/4, NW/4 SE/4, NE/4 SW/4, S/2 NW/4
Section 34: N/2, E/2 SE/4
Sections 35 and 36: All

TOWNSHIP 19 NORTH, RANGE 31 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 19 NORTH, RANGE 32 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 19 NORTH, RANGE 33 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 20 NORTH, RANGE 29 EAST, NMPM
Sections 1 and 2: All
Section 3: S/2, S/2 N/2, NE/4 NW/4, N/2 NE/4
Section 4: E/2 SE/4, SE/4 NE/4, NW/4 NW/4

Section 5: SW/4, SW/4 SE/4
Section 6: E/2, E/2 NW/4, NE/4 SW/4
Section 7: N/2 S/2, SW/4 NW/4
Section 8: W/2 SW/4, NW/4 NW/4
Section 9: E/2 E/2, SW/4 NE/4, NE/4 NW/4
Sections 10 through 15: All
Section 16: W/2 SW/4, SE/4 SW/4, E/2, NE/4 NW/4
Section 17: W/2 NW/4, SE/4 NW/4, SW/4 NE/4, S/2
Section 18: E/2, SW/4, W/2 NW/4, SE/4 NW/4
Section 19: E/2, E/2 W/2, W/2 NW/4
Section 20: All
Section 21: NE/4, NE/4 SE/4, W/2 NW/4, NW/4 SW/4
Section 22 through 26: All
Section 27: N/2, SE/4, NE/4 SW/4
Section 28: NE/4 NE/4
Section 29: N/2
Section 30: N/2 NE/4, SE/4 NE/4
Section 34: NE/4 NE/4
Section 35: N/2, SE/4
Section 36: All

TOWNSHIP 20 NORTH, RANGE 30 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 20 NORTH, RANGE 31 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 20 NORTH, RANGE 32 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 20 NORTH, RANGE 33 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 21 NORTH, RANGE 29 EAST, NMPM
Sections 1 through 27: All
Section 28: E/2, NW/4, E/2 SW/4
Section 29: All
Section 30: N/2, N/2 SE/4, SE/4 SE/4, SW/4 SW/4
Section 31: All
Section 32: S/2, S/2 N/2, N/2 NW/4, NW/4 NE/4
Section 33: N/2 NE/4, NE/4 NW/4, N/2 SW/4, SW/4 SW/4
Section 34 through 36: All

TOWNSHIP 21 NORTH, RANGE 30 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 21 NORTH, RANGE 31 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 21 NORTH, RANGE 32 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 21 NORTH, RANGE 33 EAST, NMPM
Sections 1 through 36: All

QUAY COUNTY, NEW MEXICO

TOWNSHIP 16 NORTH, RANGE 34 EAST, NMPM
Section 3: Lots 3 through 6, 11 and 12
Section 4: Lots 1, 2, 5 through 12, N/2 SE/4 and SW/4

TOWNSHIP 16 NORTH, RANGE 35 EAST, NMPM
Section 1: Lots 1 through 8, NW/4 SW/4 and S/2 SW/4
Sections 2 through 6: All
Section 7: N/2, SE/4
Sections 8 through 10: All
Section 11: NW/4, N/2 SW/4 and N/2 S/2 SW/4, N/2 S/2 S/2 SW/4

TOWNSHIP 16 NORTH, RANGE 36 EAST, NMPM
Section 5: Lots 4 and 5
Section 6: Lots 1 through 8 and 10

TOWNSHIP 17 NORTH, RANGE 34 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 17 NORTH, RANGE 35 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 17 NORTH, RANGE 36 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 17 NORTH, RANGE 37 EAST, NMPM
Sections 6 and 7: All
Sections 18 and 19: All
Sections 30 and 31: All

Amoco Production Company
[illegible]
[illegible]
Houston, Texas 77001

Richard E. Ogden
[illegible]
Manager

February 6, 1981

Case 7198

File: JCA-986.51NM-439

Re: Request for Hearing for Approval
of Temporary Special Pool Rules
Bravo Dome CO_2 Gas Unit
Union, Harding, and Quay Counties, New Mexico

State of New Mexico
Energy and Minerals Department
Oil Conservation Division
Post Office Box 2088
Santa Fe, New Mexico 87501

Attention: Mr. Joe D. Ramey

Gentlemen:

Amoco Production Company respectfully requests a hearing be scheduled before the Commissioners of the Oil Conservation Division for Approval of Temporary Special Pool Rules for the Bravo Dome CO_2 Gas Unit, Union, Harding, and Quay Counties, New Mexico. The following temporary special pool rules will be requested:

(1) Casing and Cementing

(a) Sufficient surface casing will be run to protect all fresh water zones with cement circulated behind casing to surface.

(b) Depth from surface to top of cement behind the production string will be furnished the Division on form C-103 based on temperature survey or other alternative methods approved by the District Director when cement is not circulated to surface.

(c) An affidavit specifying type and volumes of cement used in cementing all casing strings will be furnished the Oil Conservation Division on a form suitable to the Division.

(2) Injection of CO_2

The Division Director may grant administrative approval to inject CO_2 for the purpose of testing wells and surface production facilities only.

(3) Spacing

640 surface contiguous acres, more or less. Wells shall be located not closer than 1980' to any outer boundary of such tract, nor closer than 330' to any quarter-quarter section line. This rule will not prevent the drilling of more than one well on any 640 acre spacing unit.

Attached for your information is a plat of the Bravo Dome CO_2 Gas Unit. Any questions concerning the hearing can be directed to Mr. Jim Allen (713) 642-5497.

Very truly yours,

R. E. Ogden jr

JGA/lg
497/V

Attachment

CAMPBELL, BYRD & BLACK, P.A.
LAWYERS

JACK M. CAMPBELL
HARL D. BYRD
BRUCE D. BLACK
MICHAEL B. CAMPBELL
WILLIAM F. CARR
BRADFORD C. BERGE
WILLIAM G. WARDLE

JEFFERSON PLACE
SUITE 1 - 110 NORTH GUADALUPE
POST OFFICE BOX 2208
SANTA FE, NEW MEXICO 87501
TELEPHONE: (505) 988-4421
TELECOPIER: (505) 983-6043

April 9, 1981

RECEIVED
APR 09 1981
OIL CONSERVATION DIVISION
SANTA FE

Mr. R. L. Stamets
Technical Support Chief
Oil Conservation Division
New Mexico Department of
Energy and Minerals
Post Office Box 2088
Santa Fe, New Mexico 87501

Re: Case 7198: Application of Amoco Production Company for Temporary Special Pool Rules for the Bravo Dome Unit Area

Dear Dick:

Enclosed is a description of all acreage included in the Bravo Dome Unit which you requested.

Best regards.

Very truly yours,

William F. Carr

WFC:lr

Enclosure

cc: Mr. Guy Buell
Mr. Clyde Mote
Mr. Tom B. Cuny, Jr.

NEW MEXICO OIL CONSERVATION COMMISSION

COMMISSION HEARING

SANTA FE, NEW MEXICO

Hearing Date MARCH 18, 1981 Time: 9:00 A.M.

NAME	REPRESENTING	LOCATION
Gus T. Buell	Amoco Production Co.	Austin
[illegible]	Amoco Production Co.	Houston
Dan Correas	" " "	"
[illegible]	" " "	Houston
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	El Paso
[illegible]	[illegible]	[illegible]
Walter Healy	Amerada + Schwartz Cabinn	Valley Forge PA
Phil Becker	" " "	Norman OK
[illegible]	Ashbrook Production Co.	Pittsburgh, Pa.
James C. Allen	Amoco Production Co.	Houston, TX
[illegible]	Kellahin & Kellahin	Santa Fe
[illegible]	Amoco Production Co	Houston
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

NEW MEXICO OIL CONSERVATION COMMISSION

COMMISSION HEARING

SANTA FE, NEW MEXICO

Hearing Date MARCH 18, 1981 Time: 9:00 A.M.

NAME	REPRESENTING	LOCATION
Leo. John L Morris	Pengole	
Wm. P. Aycock	Roadtice, Aycock & Assoc.	Midland
Don Maddox	Maddox & Maddox	Hobbs
Dave Stone	ARCO	MIDLAND
Hiram Plum	ARCO	MIDLAND
Jerry Morris	Montgomery + Andrews	Santa Fe
Pat H. Lankford	Doyle Hartman, Oil Op	MIDLAND

NEW MEXICO OIL CONSERVATION COMMISSION

COMMISSION HEARING

SANTA FE, , NEW MEXICO

Hearing Date MARCH 18, 1981 Time: 9:00 A.M.

NAME	REPRESENTING	LOCATION

NEW MEXICO OIL CONSERVATION COMMISSION

COMMISSION HEARING

SANTA FE, NEW MEXICO

Hearing Date MARCH 18, 1981 Time: 9:00 A.M.

NAME	REPRESENTING	LOCATION

RECEIVED
MAR 30 1981
OIL CONSERVATION DIVISION
SANTA FE

BEFORE THE

NEW MEXICO OIL CONSERVATION COMMISSION

IN THE MATTER OF:

APPLICATION OF AMOCO PRODUCTION COMPANY FOR OPERATING RULES FOR THE BRAVO DOME CO_2 UNIT AREA, HARDING, QUAY AND UNION COUNTIES, NEW MEXICO	§ § § § §	CASE 7198

TO THE HONORABLE OIL CONSERVATION COMMISSION:

Comes now Amoco Production Company (Amoco), applicant in the above referenced case, and files, this its recommendations with respect to the two matters for which Commissioner Ramey ruled the record would be held open.

I.

Acreage To Be Excluded

Evidence presented in this case on March 18, 1981, indicated two carbon dioxide pools have been areally defined. These two separate common sources of supply of CO_2 were described in the record as the Mitchell "Field" and the Bueyeros "Field". The Mitchell Pool is excluded by Amoco's recommendation that the rules apply only to acreage within the outer boundaries of the Bravo Dome CO_2 Unit. The defined Mitchell Pool is outside the western boundary of the Unit. With regard to the Bueyeros Pool the testimony showed the defined pool to consist of 600 acres, all of which is inside the outer boundary of the Unit. All production from the Bueyeros Pool is operated by U.G.I. Corporation (U.G.I.) through a subsidiary company.

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Linear Distance Between Wells

Amoco recommended that well locations on the 640 acre spacing unit be 1650' from any outer boundary of the spacing unit and 330' from any internal subdivision line. An observation -- or rather a complaint -- was made by U.G.I. that this well spacing was too rigid. The suggestion was then made by Commission staff that a linear distance between wells on the same 640 acre unit might possibly result in more flexibility. Amoco has given this staff suggestion serious consideration. There are advantages but there are also disadvantages. Amoco's study shows the disadvantages outnumbers the advantages. In view of this Amoco renews its recommendation that the Commission adopt the 1650'-330' well spacing pattern.

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Respectfully submitted,

AMOCO PRODUCTION COMPANY

By _____
Guy T. Buell, Its Attorney
1200 City National Bank Bldg.
Austin, Texas 78701
(512) 476-6337

Certificate of Service

I hereby certify that a true and correct copy of the foregoing recommendations have been mailed to Mr. Conrad Coffield, counsel for U.G.I. Corporation, P.O. Box 3580, Midland, Texas 79701, on this the 24th day of March, 1981.

_____
Guy T. Buell

RECEIVED
MAR 30 1981
OIL CONSERVATION DIVISION
SANTA FE

BEFORE THE

NEW MEXICO OIL CONSERVATION COMMISSION

IN THE MATTER OF:

APPLICATION OF AMOCO PRODUCTION COMPANY FOR OPERATING RULES FOR THE BRAVO DOME CO_2 UNIT AREA, HARDING, QUAY AND UNION COUNTIES, NEW MEXICO	§ § § § §	CASE 7198

TO THE HONORABLE OIL CONSERVATION COMMISSION:

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NEW MEXICO OIL CONSERVATION COMMISSION

IN THE MATTER OF:

APPLICATION OF AMOCO PRODUCTION COMPANY FOR OPERATING RULES FOR THE BRAVO DOME CO_2 UNIT AREA, HARDING, QUAY AND UNION COUNTIES, NEW MEXICO	§	CASE 7198

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OIL C
SANTA FE

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_____
Guy T. Buell

Amoco Production Company

Richard E. Ogden
[illegible] Engineering
Manager

February 6, 1981

Case 7198

File: JCA-986.51NM-439

Re: Request for Hearing for Approval
of Temporary Special Pool Rules
Bravo Dome CO_2 Gas Unit
Union, Harding, and Quay Counties, New Mexico

State of New Mexico
Energy and Minerals Department
Oil Conservation Division
Post Office Box 2088
Santa Fe, New Mexico 87501

Attention: Mr. Joe D. Ramey

Gentlemen:

Amoco Production Company respectfully requests a hearing be scheduled before the Commissioners of the Oil Conservation Division for Approval of Temporary Special Pool Rules for the Bravo Dome CO_2 Gas Unit, Union, Harding, and Quay Counties, New Mexico. The following temporary special pool rules will be requested:

(1) Casing and Cementing

(a) Sufficient surface casing will be run to protect all fresh water zones with cement circulated behind casing to surface.

(b) Depth from surface to top of cement behind the production string will be furnished the Division on form C-103 based on temperature survey or other alternative methods approved by the District Director when cement is not circulated to surface.

(c) An affidavit specifying type and volumes of cement used in cementing all casing strings will be furnished the Oil Conservation Division on a form suitable to the Division.

(2) Injection of CO_2

The Division Director may grant administrative approval to inject CO_2 for the purpose of testing wells and surface production facilities only.

(3) Spacing

640 surface contiguous acres, more or less. Wells shall be located not closer than 1980' to any outer boundary of such tract, nor closer than 330' to any quarter-quarter section line. This rule will not prevent the drilling of more than one well on any 640 acre spacing unit.

Attached for your information is a plat of the Bravo Dome CO_2 Gas Unit. Any questions concerning the hearing can be directed to Mr. Jim Allen (713) 642-5497.

Very truly yours,

R. E. Ogden Jr.

JGA/lg
497/V

Attachment

AmeriGas

Walter F. X. Healy
Vice President and General Counsel

March 25, 1981

Oil Conservation Division
Energy and Minerals Department
State of New Mexico
P.O. Box 2088
Santa Fe, New Mexico 87501

Attention: Mr. Joe D. Ramey

Re: Bravo Dome Unit

Gentlemen:

I'm submitting this letter to you in accordance with your request made after testimony had been presented to you at the hearing on Wednesday, March 18, 1981 regarding the temporary spacing and other special pool rule changes proposed by Amoco Production Company for those lands within the outer boundary of the Bravo Dome Carbon Dioxide Gas Unit.

You will recall that I had moved to have the tracts on which AmeriGas and its subsidiary, Schwartz Carbonic, have carbon dioxide rights excluded from the proposed change from 160-acre to 640-acre spacing. As our witness, Mr. Willis Beeler, testified at the hearing, our development and production history on those tracts demonstrates that one well will not effectively, efficiently and economically drain 640 acres. In addition, the carbon dioxide that we now produce is marketed in liquid form and as dry ice while Amoco's use of carbon dioxide would be in the form of gas for transportation through pipeline to oilfields for use in tertiary recovery. Hence, as Mr. Beeler testified, the economic factors affecting our production of carbon dioxide are substantially different from Amoco's and justify 160-acre spacing on our tracts.

In summary, based on this experience, he and we believe the 160-acre spacing rule now in effect in the Southwest area of the Bravo Dome Unit where our tracts are located should not be changed.

The following motion contains the description of the specific tracts for which no change in spacing rules would be made:

> MOVED: that the general 160-acre spacing rules currently in effect throughout Union, Harding and Quay Counties shall continue to apply in the following Townships:
>
> Townships 17 through 20 North, Ranges 29 through 31 East
> Township 21 North, Range 29 East

Box 858, Valley Forge, PA 19482 ☐ 215-337-1094

We believe this motion should be granted because it was supported by the evidence presented at the hearing. In particular, there was no substantial evidence controverting Mr. Beeler's testimony that 640-acre spacing in the Townships where our tracts are located would not recover as much carbon dioxide as would the present 160-acre spac[illegible].

We hope the Commission and Amoco Production Company will agree with us on this proposal so that we all can avoid the delay and expense of further hearings or appeals in resolving this matter.

Please call me if I can provide any more information.

Very truly yours,

Walter F. Healy

WFXH/mjr

cc: Ernest L. Padilla, Esquire
Mr. Ron Barnett
William Carr, Esquire
Guy Buell, Esquire
Conrad Coffield, Esquire
W. Thomas Kellahin, Esquire

AmeriGas

Walter F. X. Healy
Vice President and General Counsel

RECEIVED
MAR 30 1981
OIL CONSERVATION DIVISION
SANTA FE

March 25, 1981

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Docket No. 9-81

Dockets Nos. 12-81 and 13-81 are tentatively set for April 8 and 22, 1981. Applications for hearing must be filed at least 22 days in advance of hearing date.

DOCKET: COMMISSION HEARING - MONDAY - MARCH 16, 1981

OIL CONSERVATION COMMISSION - 9 A.M. - ROOM 205
STATE LAND OFFICE BUILDING, SANTA FE, NEW MEXICO

The following cases are continued from the February 18, 1981, Commission Hearing:

CASE 7155: Application of Southland Royalty Company for compulsory pooling, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests in the Pennsylvanian formation underlying the E/2 of Section 35, Township 18 South, Range 29 East, to be dedicated to a well to be drilled at a standard location thereon. Also to be considered will be the cost of drilling and completing said well and the allocation of the cost thereof as well as actual operating costs and charges for supervision, designation of applicant as operator of the well, and a charge for risk involved in drilling said well.

CASE 7057: (DE NOVO)

Application of Doyle Hartman for the extension of the vertical limits of the Langlie Mattix Pool, Lea County, New Mexico. Applicant, in the above-styled cause, seeks the contraction of the vertical limits of the Jalmat Pool and the upward extension of the vertical limits of the Langlie Mattix Pool to the following depths underlying the following 40-acre tracts in Township 24 South, Range 37 East: SE/4 SE/4 of Section 30: 3364 feet; NE/4 SE/4 of Section 30: 3389 feet; and SE/4 SW/4 of Section 20: 3390 feet.

Upon application of ARCO Oil and Gas Company this case will be heard De Novo pursuant to the provisions of Rule 1220.

****

Docket No. 10-81

DOCKET: COMMISSION HEARING - WEDNESDAY - MARCH 18, 1981

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

CASE 7198: Application of Amoco Production Company for temporary special rules, Union, Harding, and Quay Counties, New Mexico. Applicant, in the above-styled cause, seeks the promulgation of temporary special area rules for the Bravo Dome carbon dioxide gas area, including provision for 640-acre spacing units, specified well locations, casing and cementing rules, and authority to inject carbon dioxide gas for test purposes only.

****

Docket No. 11-81

DOCKET: EXAMINER HEARING - WEDNESDAY - MARCH 25, 1981

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

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

CASE 7199: In the matter of the hearing called by the Oil Conservation Division on its own motion to consider amendments to its SPECIAL RULES FOR APPLICATIONS FOR WELLHEAD PRICE CEILING CATEGORY DETERMINATIONS as promulgated by Division Order No. R-5878, as amended. The proposed amendments relate to individual well filing requirements for price category determinations for the following categories:

(1) High cost production enhancement gas under Section 107 of the NGPA;

(2) Continued stripper qualification resulting from temporary pressure buildups under Section 108 of the NGPA.

ROUGH

dr/

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION COMMISSION

IN THE MATTER OF THE HEARING
CALLED BY THE OIL CONSERVATION
COMMISSION OF NEW MEXICO FOR
THE PURPOSE OF CONSIDERING:

CASE NO. 7198

Order No. R-6645

APPLICATION OF AMOCO PRODUCTION
COMPANY FOR TEMPORARY SPECIAL RULES,
UNION, HARDING, AND QUAY COUNTIES,
NEW MEXICO.

ORDER OF THE COMMISSION

BY THE COMMISSION:

This cause came on for hearing at 9:00 A.M. on March 18, 1981, at Santa Fe, New Mexico, before the Oil Conservation Commission of New Mexico, hereinafter referred to as the "Commission."

NOW, on this ____ day of April, 19 81, the Commission, a quorum being present, having considered the testimony presented and the exhibits received at said hearing, and being fully advised in the premises,

FINDS:

(1) That due public notice having been given as required by law, the Commission has jurisdiction of this cause and the subject matter thereof.

(2) That the applicant, Amoco Production Company, is the operator of one or more carbon dioxide gas wells within those lands in Union, Harding, and Quay Counties, New Mexico, described on Exhibit A attached hereto.

(3) That the applicant seeks establishment of the Bravo Dome Carbon Dioxide Gas Area, hereinafter referred to as the "Area," and the promulgation of temporary rules therefor including provisions for 640-acre gas proration units and specified well locations.

(4) That approval of the application will permit the reasonable development of the ~~proposed~~ Area and the more rapid gathering of reservoir data throughout.

(5) That the geologic evidence presented at the hearing justifies the development of said Area on 640-acre spacing for some reasonable temporary period of time.

(6) That it is anticipated that facilities for the gathering and transportation of carbon dioxide gas from the Area will be constructed and in operation within the not too distant future, said facilities being hereinafter referred to as the "System."

(7) That a reasonable period of time for the development of the Area on temporary 640-acre spacing would be that pending construction of ~~said gathering and transportation facilities~~ the System and three years after first connection of any well thereto.

(8) That the commonly referred to "Bueyeros Pool" described as follows is a separate common source of supply within the Area:

HARDING COUNTY, NEW MEXICO
TOWNSHIP 20 NORTH, RANGE 31 EAST, NMPM
Section 30: E/2
Section 31: E/2
Section 32: NW/4

(9) That said Bueyeros Pool as described above, or ~~a~~ hereafter by order of the Division, should be exempt from the special rules and regulations of the Bravo Dome Carbon Dioxide Gas Area.

(10) That this case should be reopened at a hearing three years after initial connection of a well in the Area to ~~the pipeline~~ the system at which time the operators in the subject Area should appear and show cause why the said Area should not be developed on 160-acre carbon dioxide gas proration units.

IT IS THEREFORE ORDERED:

(1) That an area for carbon dioxide gas production is hereby created and designated as the Bravo Dome Carbon Dioxide Gas Area comprising those lands described in the attached Exhibit A and made a part hereof.

(2) That the vertical limits of said Bravo Dome Carbon Dioxide Gas Area shall consist of the formation(s) found from the base of Cimarron Anhydrite to the top of the Granite.

(3) That special rules and regulations for the Bravo Dome Carbon Dioxide Gas Area are hereby promulgated as follows:

SPECIAL RULES AND REGULATIONS
FOR THE
BRAVO DOME CARBON DIOXIDE GAS AREA

RULE 1. Each well completed or recompleted in the Bravo Dome Carbon Dioxide Gas Area shall be spaced, drilled, and operated in accordance with the Special Rules and Regulations hereinafter set forth, provided however, said rules shall not apply to that area commonly referred to as the "Bueyeros Pool" as defined below or as hereafter extended by order of the Division:

[illegible]

BUEYEROS POOL, HARDING COUNTY, NEW MEXICO
Township 20 North, Range 31 East, NMPM
Section 30: E/2
Section 31: E/2
Section 32: NW/4

and provided further, that said rules shall not apply to any carbon dioxide pool within the Area if said pool has been created and defined by the Division and is covered by Special Pool Rules in conflict herewith.

RULE 2. Each well shall be located on a standard unit containing 640 acres, more or less, consisting of a governmental section; provided, however, that nothing contained herein shall be construed as prohibiting the drilling of a well on each of the quarter sections in the unit.

RULE 3. The Director of the Oil Conservation Division may grant an exception to the requirements of Rule 2 without notice and hearing when an application has been filed for a non-standard unit and the unorthodox size or shape of the unit is necessitated by a variation in the legal subdivision of the United States Public Land Surveys, or the following facts exist and the following provisions are complied with:

(a) The non-standard unit consists of quarter-quarter sections or lots that are contiguous by a common bordering side.

(b) The non-standard unit lies wholly within a governmental section and contains less acreage than a standard unit.

(c) The applicant presents written consent in the form of waivers from all offset operators and from all operators owning ~~interests~~ lands in the section in which the non-standard unit is situated ~~and~~ which ~~acreage is~~ lands are not included in said non-standard unit.

(d) In lieu of Paragraph (c) of this rule, the applicant may furnish proof of the fact that all of the aforesaid operators were notified by registered or certified mail of his intent to form such non-standard unit. The Director may approve the application if no such operator has entered an objection to the formation of such non-standard unit within 30 days after the Director has received the application.

RULE 4. Each well shall be located no nearer than 1650 feet to the outer boundary of the section and no nearer than 330 feet to any governmental quarter-quarter section line; provided, however, that any subsequent wells ~~are~~ drilled on a unit ~~thereof~~ shall be located no nearer than 1320 feet from any existing well drilling to or capable of producing from the Bravo Dome Carbon Dioxide Gas Area.

RULE 5. The Director may grant an exception to the requirements of Rule 4 without notice and hearing when an application has been filed for an unorthodox location necessitated by topographical conditions or the recompletion of a well previously drilled to another horizon. All operators offsetting the proration unit shall be notified of the application by registered or certified mail, and the application shall state that such notice has been furnished. The Director may approve the application upon receipt of written waivers from all operators offsetting the proration unit or if no objection to the unorthodox location has been entered within 20 days after the Director has received the application.

IT IS FURTHER ORDERED:

(1) That the Director of the Division may authorize the testing of wells and equipment within the Bravo Dome Carbon Dioxide Area in excess of normal four-point potential testing upon proper showing of the need and efficiency of such testing and provided that the produced gas shall be reinjected into the reservoir.

(2) That the applicant shall file for approval of any well to be used for injection purposes in accordance with Division rules and procedures then current.

(3) That the locations of all wells presently drilling to or completed in the Bravo Dome Carbon Dioxide Gas Area are hereby approved; that the operator of any well having an unorthodox location shall notify the Santa Fe District Office of the Division in writing of the name and location of the well on or before _____, 1981.

(approx 1 mo after order is to be signed)

(4) That, pursuant to Paragraph A. of Section 70-2-18, NMSA 1978, contained in Chapter 271, Laws of 1969, existing wells in the Bravo Dome Carbon Dioxide Gas Area shall have dedicated thereto 640 acres in accordance with the foregoing pool rules; or, pursuant to Paragraph C. of said Section 70-2-18, existing wells may have non-standard spacing or proration units established by the Division and dedicated thereto.

Failure to file new Forms C-102 with the Division dedicating 640 acres to a well or to obtain a non-standard unit approved by the Division within 60 days from the date of this order shall subject the well being shut-in. Until said Form C-102 has been filed or until a non-standard unit has been approved, and subject to the 60 day limitation, each well presently drilling to or completed in the Bravo Dome Carbon Dioxide Gas Area shall receive no approved Form C-104, provided however, that no further approval shall be required for any non-standard spacing and proration unit comprising less than 160 acres or for any 160-acre unit consisting of other than a single governmental quarter section, provided such unit has previously been approved by order of the Division.

(5) That this case shall be reopened at a hearing three years from the date that the Area is serviced by ~~a pipeline~~ the System and the first well is connected thereto, at which time the operators in the subject area may appear and show cause why the Bravo Dome Carbon Dioxide Gas Area should not be developed on 160-acre spacing units.

(6) That when the first well in the Area is connected to ~~said~~ the ~~pipeline~~ System, the applicant shall notify the Division in writing of such fact, and the Division will thereupon issue a supplemental order designating the approximate ~~time~~ date for reopening this case.

(7) That jurisdiction of this cause is retained for the entry of such further orders as the Division may deem necessary.

DONE at Santa Fe, New Mexico, on the day and year hereinabove designated.

ROUGH

dr/

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION COMMISSION

IN THE MATTER OF THE HEARING
CALLED BY THE OIL CONSERVATION
COMMISSION OF NEW MEXICO FOR
THE PURPOSE OF CONSIDERING:

CASE NO. 7198

Order No. R-6645

APPLICATION OF AMOCO PRODUCTION
COMPANY FOR TEMPORARY SPECIAL AREA
RULES FOR THE BRAVO DOME CARBON
DIOXIDE AREA, INCLUDING PROVISION FOR
640-ACRE SPACING UNITS.

ORDER OF THE COMMISSION

BY THE COMMISSION:

This cause came on for hearing at 9 a.m. on March 18, 19 81, at Santa Fe, New Mexico, before the Oil Conservation Commission of New Mexico, hereinafter referred to as the "Commission."

NOW, on this _____ day of _____, 19 81, the Commission, a quorum being present, having considered the testimony presented and the exhibits received at said hearing, and being fully advised in the premises,

FINDS:

(1) That due public notice having been given as required by law, the Commission has jurisdiction of this cause and the subject matter thereof.

(2) That the applicant, Amoco Production Company seeks approval of temporary special area rules for the Bravo Dome carbon dioxide, including provision for 640-acre spacing units.

(3) That more specifically applicant seeks temporary special rules in the following regards:

"(1) Casing and Cementing

(a) Sufficient surface casing will be run to protect all fresh water zones with cement circulated behind casing to surface.

(b) Depth from surface to top of cement behind the production string will be furnished the Division on form C-103 based on temperature survey or other alternative methods approved by the District Director when cement is not circulated to surface.

(c) An affidavit specifying type and volumes of cement used in cementing all casing strings will be furnished the Oil Conservation Division on a form suitable to the Division.

(2) Injection of CO_2

The Division Director may grant administrative approval to inject CO_2 for the purpose of testing wells and surface production facilities only.

(3) Spacing

640 surface contiguous acres, more or less. Wells shall be located not closer than 1980' to any outer boundary of such tract, nor closer than 330' to any quarter-quarter section line. This rule will not prevent the drilling of more than one well on any 640 acre spacing unit."

(4) That the Bravo Dome carbon dioxide area is situated in portions of Harding, Quay, and Union Counties, New Mexico, and is more particularly described in Exhibit A attached hereto.

(5) That the development of the Bravo Dome carbon dioxide area is presently governed by the General Rules and Regulations of the Division, under which both the Commission and Division have concurrent jurisdiction.

(6) That the requirements of applicant's proposed special rules concerning casing and cementing are virtually identical with the requirements of the Division's current general regulations and as such are not necessary.

(7) That, with respect to the proposed affidavit requirements, the Commission's and Division's practice and policy has been and should continue to be that operators are responsible for compliance with sound drilling practices in accordance with the Division's rules and regulations.

(8) That the Division Director should have authority, without the necessity of hearing, to grant administrative approval to re-inject CO_2 gas produced for the purpose of testing wells and surface production facilities back into the formation.

(9) That concerning temporary 640-acre spacing rules and regulations the evidence presented by the applicant does not support -- even on a temporary basis -- an economic, engineering, geological or other valid and compelling justification, within the jurisdiction of the Commission, for such special rules.

(10) That applicant's request herein for special temporary rules and regulations should be denied with the exception of the contents of Finding (8) above.

(11) That denial of the application to the extent of finding (10) above will not cause waste nor impair correlative rights.

IT IS THEREFORE ORDERED:

(1) That the Application of Amoco Production Company for temporary special area rules for the Bravo Dome carbon dioxide area, including provision for 640-acre spacing is hereby denied, except to the extent that the Director of the Oil Conservation Division is hereby authorized to grant administrative approval for the re-injection of CO_2 gas produced for the purpose of testing wells and surface production facilities back into the formation within the Bravo Dome carbon dioxide area as defined in Exhibit A attached hereto and by reference made a part hereof.

(2) That jurisdiction of this cause is retained for the entry of such further orders as the Commission may deem necessary.

DONE at Santa Fe, New Mexico, on the day and year hereinabove designated.

STATE OF NEW MEXICO
OIL CONSERVATION COMMISSION

ALEX J. ARMIJO, Member

EMERY C. ARNOLD, Member

JOE D. RAMEY, Member & Secretary

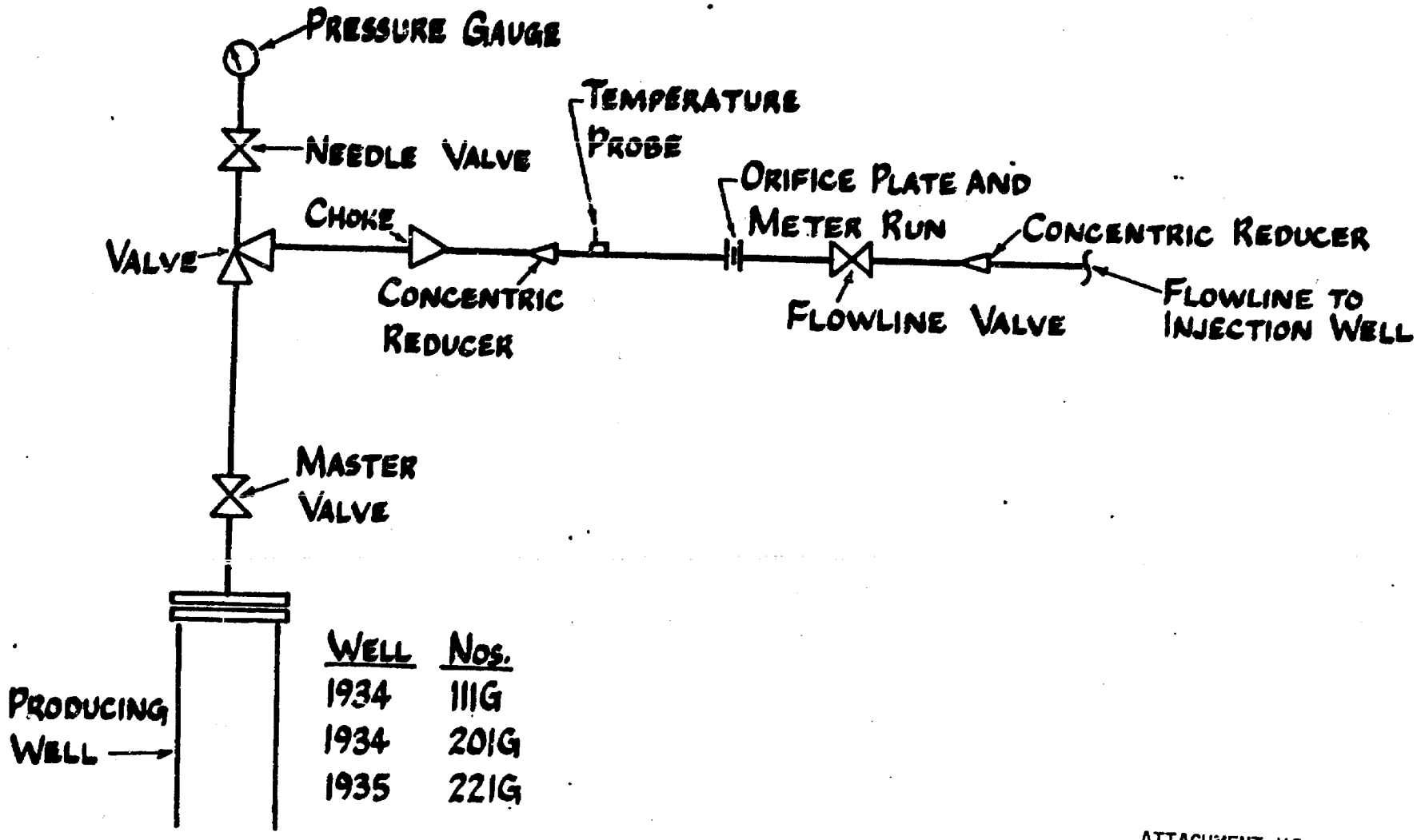
ATTACHMENT V
Producing and Injection Pressures and Rates

Test Site	Producer	At Start			At 1 Year	
		Rate (MCFD)	Pwf (psia)	FTP (psig)	Pwf (psia)	FTP (psig)
1935 221G/1935 241J	1935 221G	1300	275	206	184	115
1934 201G/1934 081F	1934 201G	1100	271	207	179	115
1934 111G/1934 041K	1934 111G	1700	320	224	209	115

Test Site	Injector	Pressure (Bottomhole-psig)	Pressure (Surface-psig)	
			130° F	200° F
1935 221G/1935 241J	1935 241J	562	477	481
1934 201G/1934 081F	1934 081F	788	667	678
1934 111G/1934 041K	1934 041K	605	507	548

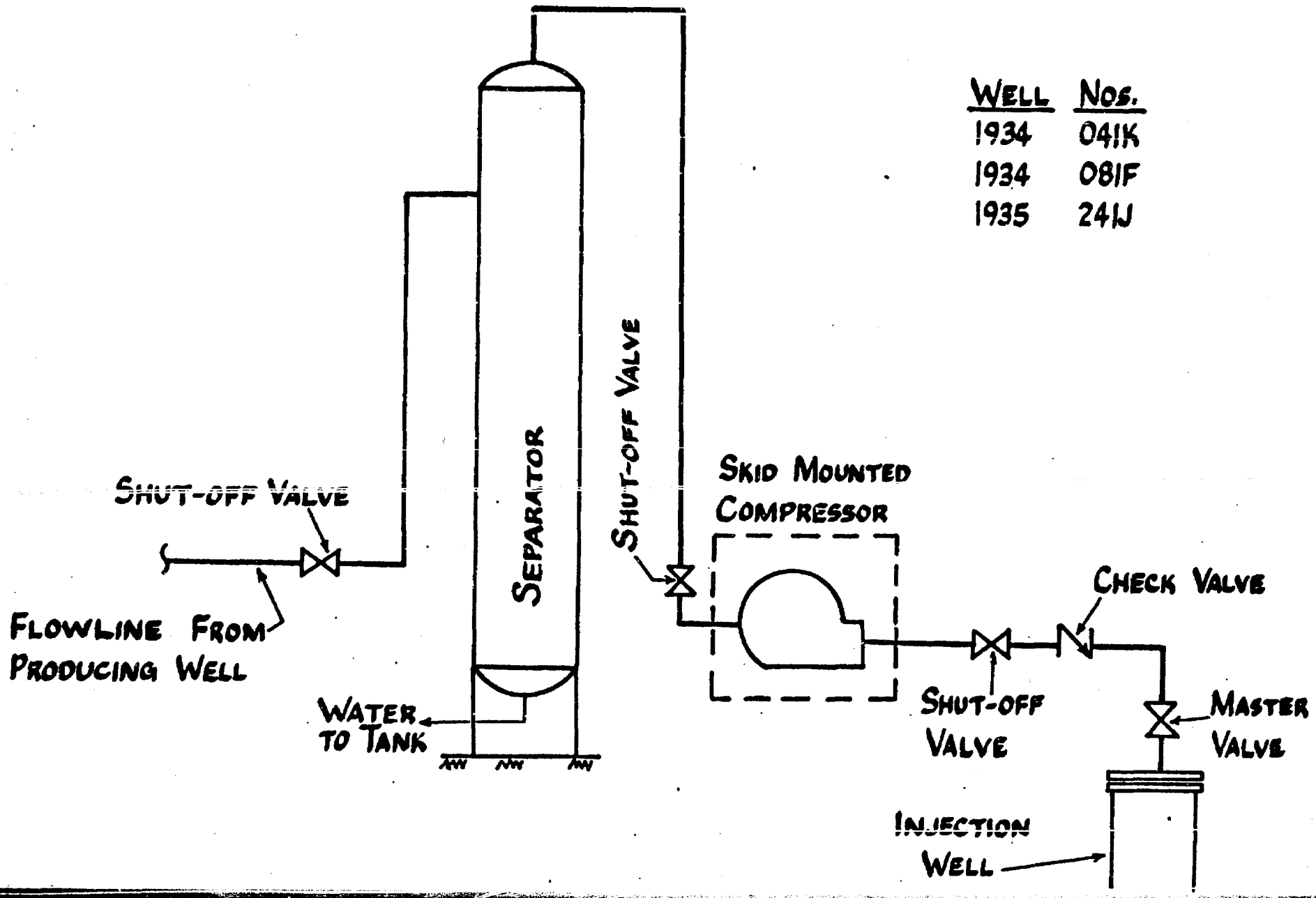
AA/dc
1/935

Surface Equipment at Typical Production Well



ATTACHMENT VI

SURFACE EQUIPMENT AT TYPICAL INJECTION WELL



WELL	NOS.
1934	041K
1934	081F
1935	241J

ATTACHMENT VII

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION

BRUCE KING
GOVERNOR

LARRY KEHOE
SECRETARY

POST OFFICE BOX 2088
STATE LAND OFFICE BUILDING
SANTA FE, NEW MEXICO 87501
(505) 827-2434

June 11, 1982

Amoco Production Company (USA)
P. O. Box 3092
Houston, Texas 77253

Case 7198

Attention: Mr. R. G. Smith

Dear Mr. Smith:

By your letter and attachments of June 2, 1982, Amoco Production Company (USA) made administrative application to produce and reinject CO_2 gas from and into certain pairs of wells in the Bravo Dome Carbon Dioxide Gas Unit as noted below:

Unit Well No.	Unit	Section	Township	Range	Producer/ Injector
201	G	20	19N	34E	Producer
081	F	8	19N	34E	Injector
111	G	11	19N	34E	Producer
041	K	4	19N	34E	Injector
221	G	22	19N	35E	Producer
241	J	24	19N	35E	Injector

By the authority granted to me under the provisions of Division Order No. R-6645 Amoco is hereby authorized to conduct the requested production/injection tests utilizing the pairs of Unit wells listed above.

The operation of these wells shall be governed by the following:

(1) Amoco shall notify this office of the date and time injection commences.

(2) The test period shall not exceed one year for each pair of wells.

(3) Amoco shall file a monthly report showing the production (gas and water) from each well as well as individual well injection volumes and pressures.

(4) All injection operations shall be through tubing under a packer at pressures less than necessary to initiate fractures in the formation.

(5) Amoco shall promptly report the failure of any injection well.

(6) Amoco shall file monthly analyses of the produced water until this requirement should be waived or modified.

Amoco should be advised that this approval does not preclude the filing of applications relative to this matter by parties who may feel that their correlative rights are being violated. Such an application would be set for public hearing. At such a hearing Amoco would be expected to demonstrate that they should be permitted to continue the production/injection operations approved herein.

Very truly yours,

JOE D. RAMEY
Director

JDR/RLS/fd

cc: Carl Ulvog
Minerals Management Service Albuquerque
Commissioner of Public Lands

Amoco Production Company (USA)
500 Jefferson Building
P.O. Box 3092
Houston, Texas ~~77001~~ 77253

June 2, 1982

File: JCA-986.51NM-1507

Re: Reinjection of CO_2 Gas
Bravo Dome Carbon Dioxide Gas Unit
Union, Harding and Quay Counties, New Mexico

State of New Mexico
Energy and Minerals Department
Oil Conservation Division
P. O. Box 2088
Santa Fe, NM 87501

Attention: Mr. Joe D. Ramey

Gentlemen:

In accordance with Commission Order No. R-6645 Amoco Production Company requests administrative approval to reinject produced CO_2 gas into the Bravo Dome Carbon Dioxide Gas Unit. The need for long term production data from the Bravo Dome Unit leads us to request approval for these three reinjection projects which have been carefully designed to provide the maximum amount of useful data possible. The three pairs of wells and their test purposes are as follows:

1. BDCDU Well No. 1934 201G (Producer)
   BDCDU Well No. 1934 081F (Injector)
   Data from this test will provide long term production characteristics from a well that has not been fracture stimulated.

2. BDCDU Well No. 1934 111G (Producer)
   BDCDU Well No. 1934 041K (Injector)
   Data from this test will provide long term production characteristics from a well that has been fracture stimulated and shut in prior to recovering all load water.

3. BDCDU Well No. 1935 221G (Producer)
   BDCDU Well No. 1935 241J (Injector)
   Data from this test will provide long term production characteristics from a well that has been fracture stimulated and immediately placed on production.

Attachment I shows the location of the three tests within the Bravo Dome Carbon Dioxide Gas Unit, while Attachment II is a larger scale map of the test area with the well pairs indicated. Attachments III (A-F) are wellbore sketches showing the perforated intervals in each well and Attachments IV (A-F) are the corresponding porosity logs for each well. For each well pair the producer and injector belong to the same basic lease and are committed to the Unit. Producing and injection pressures and rates are shown on Attachment V, and Attachment VI and VII shows the wellhead configurations for production and injection. Our current plan is to continue to accumulate production and injection data for a period of one year. Should any additional information be required concerning this request, please contact Ms. April Adams at (713) 652-5472.

Yours very truly,

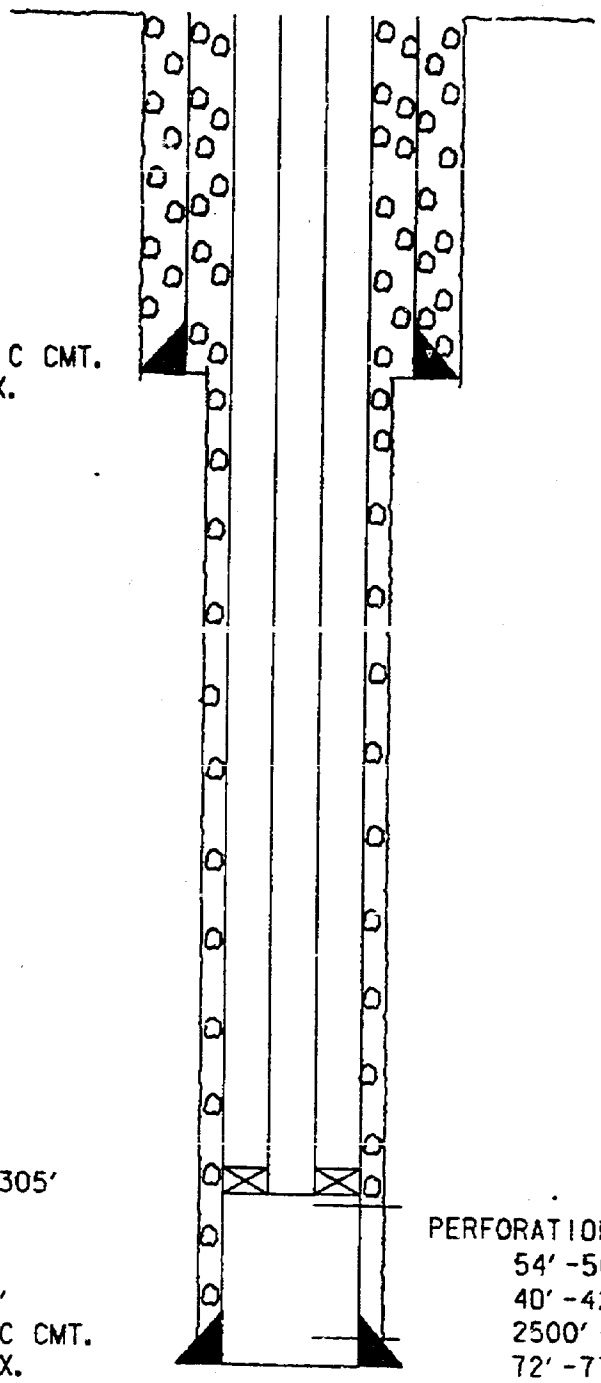
R. G. Smith

R. G. Smith
Regional Engineering Manager, West

AA/dc
1/935

Attachments

BDCDU WELL NO. 1934 081F
(HUTCHERSON 'B' NO. 29)
ELEV. 4942' RDB



8-5/8" CSA 706'
W/450 SX. CLASS C CMT.
CIRCULATE 25 SX.

* PKR. SA 2305'
2-7/8" TBG. SA 2305'

5-1/2" CSA 2640'
W/700 SX. CLASS C CMT.
CIRCULATE 200 SX.

PERFORATIONS 2325'-36', 39'-42',
54'-56', 87'-89', 2410'-16',
40'-42', 56'-60', 64'-76',
2500'-10', 25'-31', 52'-57',
72'-77' W/ 1SPF

PBTD 2589'
TD 2640'

* NOTE: PKR. XTBG SETTING DEPTHS ARE PROPOSED DEPTHS.

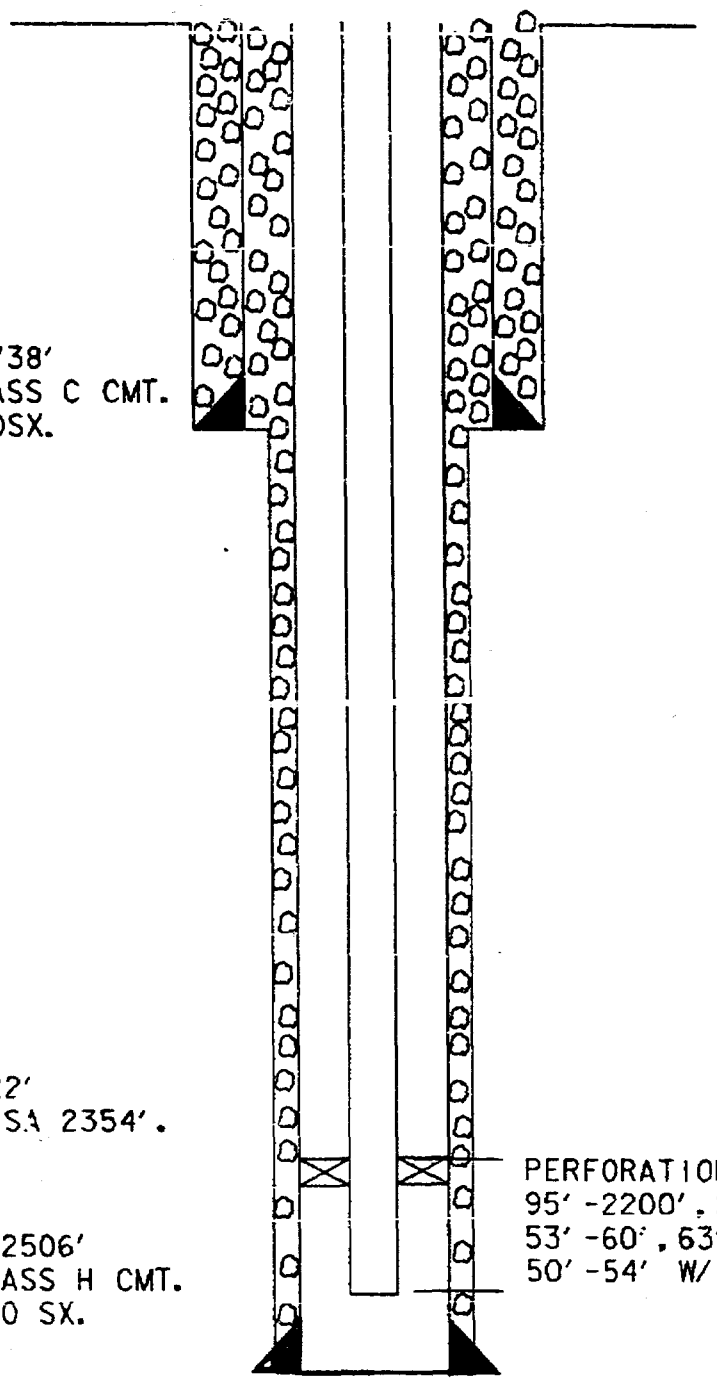
ATTACHMENT III-B

021-10

BDCDU WELL NO. 1934 111G

(HUTCHERSON 'B' NO. 9)

ELEV. 4728' RDB

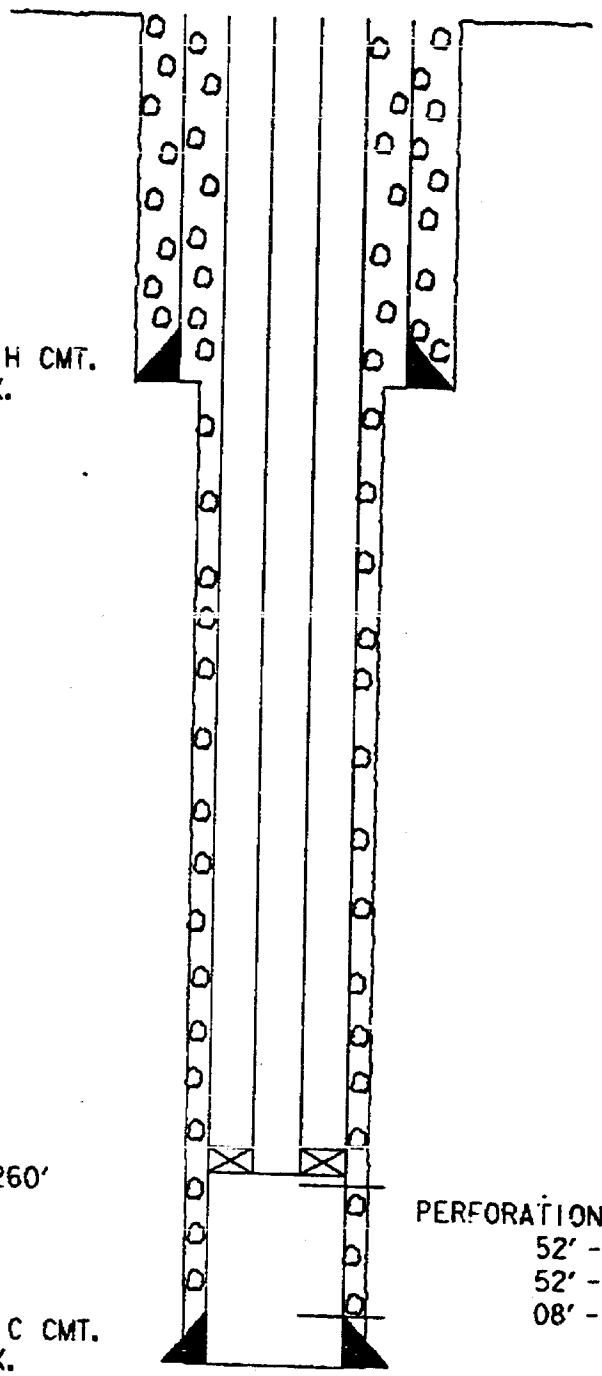


*NOTE: PKR. XTBG SETTING DEPTHS ARE PROPOSED DEPTHS.
2-7/8" FIBERGLASS TBG. WILL BE RUN BELOW THE PKR AS A TAILPIPE.

021-12

ATTACHMENT III-C

BDCDU WELL NO 1934 041K
(HUTCHERSON 'B' NO. 28)
ELEV 4886' GL



8-5/8" CSA 714'
W/450 SX. CLASS H CMT.
CIRCULATE 25 SX.

* PKR. SA 2260'
2-7/8" IBG. SA 2260'

5-1/2" CSA 2643'
W/1000 SX. CLASS C CMT.
CIRCULATE 150 SX.

PERFORATIONS 2280'-2300', 26'-30',
52'-70', 73'-82', 2414'-35',
52'-54', 68'-70', 97'-2500',
08'-17', 26'-33' W/1SPF

PBTD 2550'
TD 2643'

* NOTE: PKR XTBG SETTING DEPTHS ARE PROPOSED DEPTHS.

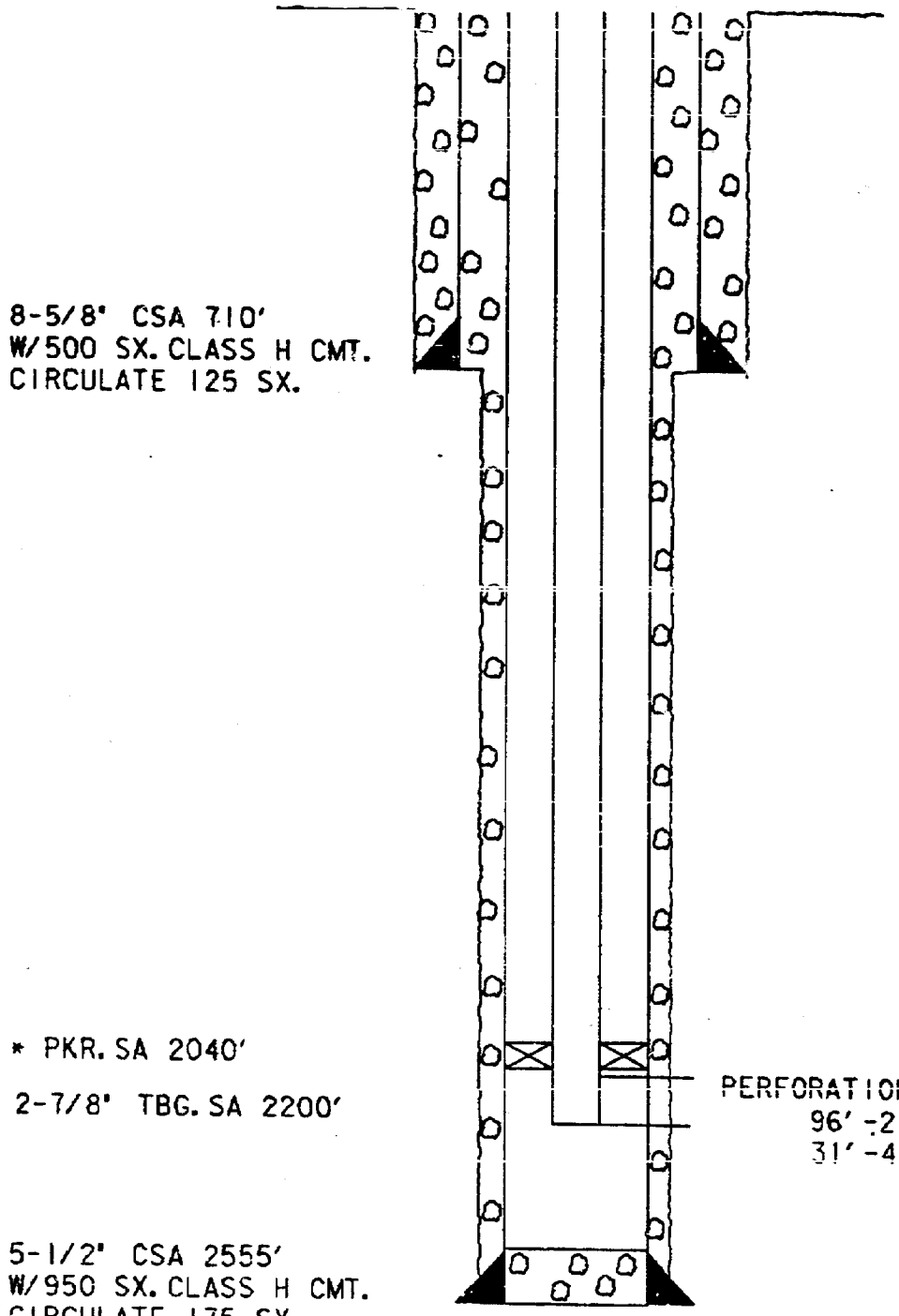
021-09

ATTACHMENT III-D

BDCDU WELL NO. 1935 221G

(CAIN 'E' NO. 1)

ELEV. 4597' RDB

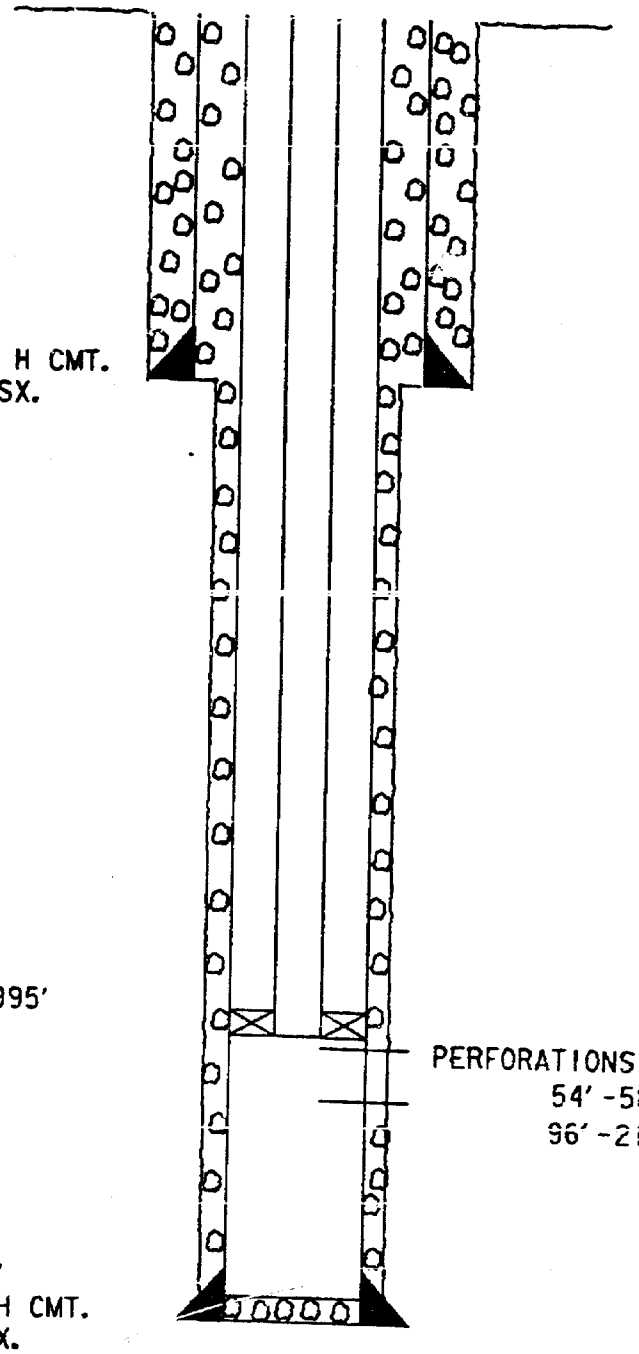


* NOTE: PKR X TBG SETTING DEPTHS ARE PROPOSED DEPTHS.
2-7/8" FIBERGLASS TBG WILL BE RUN BELOW THE PKR AS TAILPIPE.

BDCDU WELL NO 1935 241J

(CAIN 'C' NO. 1)

ELEV. 4483' RDB



8-5/8" CSA 715'
W/500 SX. CLASS H CMT.
CIRCULATE 200 SX.

* PKR. SA 1995'
2-7/8" TBG. SA 1995'

PERFORATIONS 2015'-19', 25'-34', 38'-48',
54'-58', 60'-66', 68'-71', 75'-88',
96'-2100', 04'-12', 16'-20' W/ 1SPF

5-1/2" CSA 2557'
W/850 SX. CLASS H CMT.
CIRCULATE 188 SX.

PBTD 2504'
TD 2557'

* NOTE: PKR. XTBG SETTING DEPTHS ARE PROPOSED DEPTHS.

021-08

ATTACHEMENT III-F

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION

IN THE MATTER OF THE HEARING
CALLED BY THE OIL CONSERVATION
COMMISSION OF NEW MEXICO FOR
THE PURPOSE OF CONSIDERING:

CASE NO. 7198
Order No. R-6645

APPLICATION OF AMOCO PRODUCTION
COMPANY FOR TEMPORARY SPECIAL RULES,
UNION, HARDING, AND QUAY COUNTIES,
NEW MEXICO.

ORDER OF THE COMMISSION

BY THE COMMISSION:

This cause came on for hearing at 9 a.m. on March 18, 1981, at Santa Fe, New Mexico, before the Oil Conservation Commission of New Mexico, hereinafter referred to as the "Commission."

NOW, on this_____day of May, 1981, the Commission, a quorum being present, having considered the testimony presented and the exhibits received at said hearing, and being fully advised in the premises,

FINDS:

(1) That due public notice having been given as required by law, the Commission has jurisdiction of this cause and the subject matter thereof.

(2) That the applicant, Amoco Production Company, is the operator of one or more carbon dioxide gas wells within those lands in Union, Harding, and Quay Counties, New Mexico, described on Exhibit A attached hereto.

(3) That the applicant seeks establishment of the Bravo Dome Carbon Dioxide Gas Area, hereinafter referred to as the "Area," and the promulgation of temporary rules therefor including provisions for 640-acre gas proration units and specified well locations.

(4) That approval of the application will permit the reasonable development of the Area and the more rapid gathering of reservoir data throughout.

(5) That the geologic evidence presented at the hearing justifies the development of said Area on 640-acre spacing for some reasonable temporary period of time.

(6) That it is anticipated that facilities for the gathering and transportation of carbon dioxide gas from the Area will be constructed and in operation within the not too distant future, said facilities being hereinafter referred to as the "System."

(7) That a reasonable period of time for the development of the Area on temporary 640-acre spacing would be that pending construction of the System and three years after first connection of any well thereto.

(8) That the commonly referred to "Bueyeros Pool" described as follows is a separate common source of supply within the Area:

HARDING COUNTY, NEW MEXICO
TOWNSHIP 20 NORTH, RANGE 31 EAST, NMPM
Section 30: E/2
Section 31: E/2
Section 32: NW/4

(9) That said Bueyeros Pool as described above, or as hereafter extended by order of the Division, should be exempt from the special rules and regulations of the Bravo Dome Carbon Dioxide Gas Area.

(10) That this case should be reopened at a hearing three years after initial connection of a well in the Area to the System at which time the operators in the subject Area should appear and show cause why the said Area should not be developed on 160-acre carbon dioxide gas proration units.

IT IS THEREFORE ORDERED:

(1) That an area for carbon dioxide gas production is hereby created and designated as the Bravo Dome Carbon Dioxide Gas Area comprising those lands described in the attached Exhibit A and made a part hereof.

(2) That the vertical limits of said Bravo Dome Carbon Dioxide Gas Area shall consist of the formation(s) found from the base of Cimarron Anhydrite to the top of the Granite.

(3) That special rules and regulations for the Bravo Dome Carbon Dioxide Gas Area are hereby promulgated as follows:

SPECIAL RULES AND REGULATIONS
FOR THE
BRAVO DOME CARBON DIOXIDE GAS AREA

RULE 1. Each well completed or recompleted in the Bravo Dome Carbon Dioxide Gas Area shall be spaced, drilled, and operated in accordance with the Special Rules and Regulations hereinafter set forth, provided however, said rules shall not apply to that area commonly referred to as the "Bueyeros Pool" as defined below or as hereafter extended by order of the Division:

BUEYEROS POOL, HARDING COUNTY, NEW MEXICO
TOWNSHIP 20 NORTH, RANGE 31 EAST, NMPM
Section 30: E/2
Section 31: E/2
Section 32: NW/4

and provided further, that said rules shall not apply to any carbon dioxide pool within the Area if said pool has been created and defined by the Division and is covered by Special Pool Rules in conflict herewith.

RULE 2. Each well shall be located on a standard unit containing 640 acres, more or less, consisting of a governmental section; provided, however, that nothing contained herein shall be construed as prohibiting the drilling of a well on each of the quarter sections in the unit.

RULE 3. The Director of the Oil Conservation Division may grant an exception to the requirements of Rule 2 without notice and hearing when an application has been filed for a non-standard unit and the unorthodox size or shape of the unit is necessitated by a variation in the legal subdivision of the United States Public Land Surveys, or the following facts exist and the following provisions are complied with:

(a) The non-standard unit consists of quarter-quarter sections or lots that are contiguous by a common bordering side.

(b) The non-standard unit lies wholly within a governmental section and contains less acreage than a standard unit.

(c) The applicant presents written consent in the form of waivers from all offset operators and from all operators owning lands in the section in which the non-standard unit is situated which lands are not included in said non-standard unit.

(d) In lieu of Paragraph (c) of this rule, the applicant may furnish proof of the fact that all of the aforesaid operators were notified by registered or certified mail of his intent to form such non-standard unit. The Director may approve the application if no such operator has entered an objection to the formation of such non-standard unit within 30 days after the Director has received the application.

RULE 4. Each well shall be located no nearer than 1650 feet to the outer boundary of the section and no nearer than 330 feet to any governmental quarter-quarter section line; provided, however, that any subsequent wells drilled on a unit shall be located no nearer than 1320 feet from any existing well drilling to or capable of producing from the Bravo Dome Carbon Dioxide Gas Area.

RULE 5. The Director may grant an exception to the requirements of Rule 4 without notice and hearing when an application has been filed for an unorthodox location necessitated by topographical conditions or the recompletion of a well previously drilled to another horizon. All operators offsetting the proration unit shall be notified of the application by registered or certified mail, and the application shall state that such notice has been furnished. The Director may approve the application upon receipt of written waivers from all operators offsetting the proration unit or if no objection to the unorthodox location has been entered within 20 days after the Director has received the application.

IT IS FURTHER ORDERED:

(1) That the Director of the Division may authorize the testing of wells and equipment within the Bravo Dome Carbon Dioxide Area in excess of normal four-point potential testing upon proper showing of the need and efficiency of such testing and provided that the produced gas shall be reinjected into the reservoir.

(2) That the applicant shall file for approval of any well to be used for injection purposes in accordance with Division rules and procedures then current.

(3) That the locations of all wells presently drilling to or completed in the Bravo Dome Carbon Dioxide Gas Area are hereby approved; that the operator of any well having an unorthodox location shall notify the Santa Fe District Office of the Division in writing of the name and location of the well on or before_____, 1981.

(4) That, pursuant to Paragraph A. of Section 70-2-18, NMSA 1978, contained in Chapter 271, Laws of 1969, existing wells in the Bravo Dome Carbon Dioxide Gas Area shall have dedicated thereto 640 acres in accordance with the foregoing pool rules; or, pursuant to Paragraph C. of said Section 70-2-18, existing wells may have non-standard spacing or proration units established by the Division and dedicated thereto.

Failure to file new Forms C-102 with the Division dedicating 640 acres to a well or to obtain a non-standard unit approved by the Division within 60 days from the date of this order shall subject the well being shut-in. Until said Form C-102 has been filed or until a non-standard unit has been approved, and subject to the 60 day limitation, each well presently drilling to or completed in the Bravo Dome Carbon Dioxide Gas Area shall receive no approved Form C-104, provided however, that no further approval shall be required for any non-standard spacing and proration unit comprising less than 160 acres or for any 160-acre unit consisting of other than a single governmental quarter section, provided such unit has previously been approved by order of the Division.

(5) That this case shall be reopened at a hearing three years from the date that the Area is serviced by the System and the first well is connected thereto, at which time the operators in the subject area may appear and show cause why the Bravo Dome Carbon Dioxide Gas Area should not be developed on 160-acre spacing units.

(6) That when the first well in the Area is connected to the System, the applicant shall notify the Division in writing of such fact, and the Division will thereupon issue a supplemental order designating the approximate date for reopening this case.

(7) That jurisdiction of this cause is retained for the entry of such further orders as the Commission may deem necessary.

DONE at Santa Fe, New Mexico, on the day and year hereinabove designated.

STATE OF NEW MEXICO
OIL CONSERVATION COMMISSION

ALEX J. ARMIJO, Member

EMERY C. ARNOLD, Member

JOE D. RAMEY, Member & Secretary

S E A L

/ca/

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION

IN THE MATTER OF THE HEARING CALLED BY THE OIL CONSERVATION COMMISSION OF NEW MEXICO FOR THE PURPOSE OF CONSIDERING:

CASE NO. 7198
Order No. R-6645

APPLICATION OF AMOCO PRODUCTION COMPANY FOR TEMPORARY SPECIAL AREA RULES FOR THE BRAVO DOME CARBON DIOXIDE AREA, INCLUDING PROVISION FOR 640-ACRE SPACING UNITS, UNION, HARDING, AND QUAY COUNTIES, NEW MEXICO.

ORDER OF THE COMMISSION

BY THE COMMISSION:

This cause came on for hearing at 9 a.m. on March 18, 1981, at Santa Fe, New Mexico, before the Oil Conservation Commission of New Mexico, hereinafter referred to as the "Commission."

NOW, on this 4th day of June, 1981, the Commission, a quorum being present, having considered the testimony presented and the exhibits received at said hearing, and being fully advised in the premises,

FINDS:

(1) That due public notice having been given as required by law, the Commission has jurisdiction of this cause and the subject matter thereof.

(2) That the applicant, Amoco Production Company, seeks approval of temporary special area rules for the Bravo Dome Carbon Dioxide Area, including provision for 640-acre spacing units.

(3) That more specifically applicant seeks temporary special rules in the following regards:

"(1) Casing and Cementing

(a) Sufficient surface casing will be run to protect all fresh water zones with cement circulated behind casing to surface.

(b) Depth from surface to top of cement behind the production string will be furnished the Division on Form C-103 based on temperature survey or other alternative methods approved by the District Director when cement is not circulated to surface.

(c) An affidavit specifying type and volumes of cement used in cementing all casing strings will be furnished the Oil Conservation Division on a form suitable to the Division.

(2) Injection of CO_2

The Division Director may grant administrative approval to inject CO_2 for the purpose of testing wells and surface production facilities only.

(3) Spacing

640 surface contiguous acres, more or less. Wells shall be located not closer than 1980' to any outer boundary of such tract, nor closer than 330' to any quarter-quarter section line. This rule will not prevent the drilling of more than one well on any 640 acre spacing unit."

(4) That the Bravo Dome carbon dioxide area is situated in portions of Harding, Quay, and Union Counties, New Mexico, and is more particularly described in Exhibit A attached hereto.

(5) That the development of the Bravo Dome carbon dioxide area is presently governed by the General Rules and Regulations of the Division, under which both the Commission and Division have concurrent jurisdiction.

(6) That the requirements of applicant's proposed special rules concerning casing and cementing are virtually identical with the requirements of the Division's current general regulations and as such are not necessary.

(7) That, with respect to the proposed affidavit requirements, the Commission's and Division's practice and policy has been and should continue to be that operators are responsible for compliance with sound drilling practices in accordance with the Division's rules and regulations.

(8) That the Division Director should have authority, without the necessity of hearing, to grant administrative approval to re-inject CO_2 gas produced for the purpose of testing wells and surface production facilities back into the formation.

(9) That concerning temporary 640-acre spacing rules and regulations the evidence presented by the applicant does not support -- even on a temporary basis -- an economic, engineering, geological or other valid and compelling justification, within the jurisdiction of the Commission, for such special rules.

(10) That applicant's request herein for special temporary rules and ragulations should be denied with the exception of the contents of finding (8) above.

(11) That denial of the application to the extent of finding (10) above will not cause waste nor impair correlative rights.

IT IS THEREFORE ORDERED:

(1) That the Application of Amoco Production Company for temporary special area rules for the Bravo Dome carbon dioxide area, including provision for 640-acre spacing is hereby denied, except to the extent that the Director of the Oil Conservation Division is hereby authorized to grant administrative approval for the re-injection of CO_2 gas produced for the purpose of testing wells and surface production facilities back into the formation within the Bravo Dome carbon dioxide area as defined in Exhibit A attached hereto and by reference made a part hereof.

(2) That jurisdiction of this cause is retained for the entry of such further orders as the Commission may deem necessary.

DONE at Santa Fe, New Mexico, on the day and year hereinabove designated.

STATE OF NEW MEXICO
OIL CONSERVATION COMMISSION

ALEX J. ARMIJO, Member

EMERY C. ARNOLD, Member

JOE D. RAMEY, Member & Secretary

S E A L
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BRAVO DOME CARBON DIOXIDE GAS UNIT

UNION COUNTY, NEW MEXICO

TOWNSHIP 18 NORTH, RANGE 34 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 18 NORTH, RANGE 35 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 18 NORTH, RANGE 36 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 18 NORTH, RANGE 37 EAST, NMPM
Sections 6 and 7: All
Sections 18 and 19: All
Sections 30 and 31: All

TOWNSHIP 19 NORTH, RANGE 34 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 19 NORTH, RANGE 35 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 19 NORTH, RANGE 36 EAST, NMPM
Section 16: All
Section 18: S/2
Sections 19 and 20: All
Section 21: W/2, W/2 NE/4 and SE/4 NE/4
Section 26: S/2 S/2
Section 28: W/2 and SW/4 SE/4
Sections 29 through 36: All

TOWNSHIP 20 NORTH, RANGE 34 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 20 NORTH, RANGE 35 EAST, NMPM
Section 3: W/2
Sections 4 through 10: All
Section 11: SW/4
Section 14: NW/4
Sections 15 through 22: All
Section 23: NW/4
Sections 27 through 34: All

TOWNSHIP 21 NORTH, RANGE 34 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 21 NORTH, RANGE 35 EAST, NMPM
Sections 1 through 24: All
Section 25: N/2 and SW/4
Section 26: All
Section 27: NE/4 and N/2 NW/4
Sections 28 through 33: All

TOWNSHIP 22 NORTH, RANGE 30 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 22 NORTH, RANGE 31 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 22 NORTH, RANGE 32 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 22 NORTH, RANGE 33 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 22 NORTH, RANGE 34 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 22 NORTH, RANGE 35 EAST, NMPM
Section 5: S/2
Sections 6 through 8: All
Section 9: W/2 and SE/4
Section 10: S/2 S/2
Sections 15 through 21: All
Section 22: N/2
Section 27: SW/4
Sections 28 through 33: All
Section 34: W/2
Section 36: All

TOWNSHIP 23 NORTH, RANGE 30 EAST, NMPM
Section 36: All

TOWNSHIP 23 NORTH, RANGE 31 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 23 NORTH, RANGE 32 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 23 NORTH, RANGE 33 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 23 NORTH, RANGE 34 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 23 NORTH, RANGE 35 EAST, NMPM
Section 31: All

TOWNSHIP 24 NORTH, RANGE 31 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 24 NORTH, RANGE 32 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 24 NORTH, RANGE 33 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 24 NORTH, RANGE 34 EAST, NMPM
Sections 1 through 36: All

HARDING COUNTY, NEW MEXICO

TOWNSHIP 17 NORTH, RANGE 30 EAST, NMPM
Section 1: N/2, SE/4, and E/2 SW/4
Section 11: SE/4 and E/2 SW/4
Section 12: S/2, NE/4, and E/2 NW/4
Section 13: All
Section 14: E/2, E/2 W/2, and SW/4 NW/4
Section 15: SE/4 NE/4
Section 22: SE/4 SE/4
Sections 23 through 25: All
Section 26: NE/4 and E/2 NW/4
Section 27: NE/4 NE/4
Section 35: SE/4
Section 36: All

TOWNSHIP 17 NORTH, RANGE 31 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 17 NORTH, RANGE 32 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 17 NORTH, RANGE 33 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 18 NORTH, RANGE 30 EAST, NMPM
Sections 1 and 2: All
Section 3: E/2 E/2 and SW/4 SE/4
Section 10: E/2 NE/4
Section 11: N/2
Sections 12 through 14: All
Section 23: E/2 and E/2 W/2
Section 24: All

TOWNSHIP 18 NORTH, RANGE 30 EAST, NMPM (Continued)
Section 25: E/2, NW/4, E/2 SW/4, and NW/4 SW/4
Section 26: N/2 S/2, NE/4, and E/2 NW/4
Section 36: All

TOWNSHIP 18 NORTH, RANGE 31 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 18 NORTH, RANGE 32 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 18 NORTH, RANGE 33 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 19 NORTH, RANGE 29 EAST, NMPM
Section 1: NE/4 and E/2 NW/4

TOWNSHIP 19 NORTH, RANGE 30 EAST, NMPM
Sections 1 through 4: All
Section 5: E/2
Section 6: E/2 SE/4, NW/4 SE/4, and NE/4 SW/4
Section 7: NE/4 NE/4, NE/4 SE/4, SE/4 SW/4, and SW/4 SE/4
Section 8: N/2, SE/4, and SE/4 SW/4
Sections 9 through 16: All
Section 17: N/2 and SE/4
Section 18: NE/4 NE/4
Section 20: S/2 SE/4 and W/2 NE/4
Sections 21 through 28: All
Section 29: NE/4
Section 32: NE/4 NE/4
Section 33: N/2 N/2, SW/4 NE/4, NW/4 SE/4, NE/4 SW/4, and S/2 NW/4
Section 34: N/2 and E/2 SE/4
Sections 35 and 36: All

TOWNSHIP 19 NORTH, RANGE 31 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 19 NORTH, RANGE 32 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 19 NORTH, RANGE 33 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 20 NORTH, RANGE 29 EAST, NMPM
Sections 1 and 2: All
Section 3: S/2, S/2 N/2, NE/4 NW/4, and N/2 NE/4

TOWNSHIP 20 NORTH, RANGE 29 EAST, NMPM (Continued)

Section 4: E/2 SE/4, SE/4 NE/4, and NW/4 NW/4
Section 5: SW/4 and SW/4 SE/4
Section 6: E/2, E/2 NW/4, and NE/4 SW/4
Section 7: N/2 S/2 and SW/4 NW/4
Section 8: W/2 SW/4 and NW/4 NW/4
Section 9: E/2 E/2, SW/4 NE/4, and NE/4 NW/4
Sections 10 through 15: All
Section 16: W/2 SW/4, SE/4 SW/4, E/2, and NE/4 NW/4
Section 17: W/2 NW/4, SE/4 NW/4, SW/4 NE/4, and S/2
Section 18: E/2, SW/4, W/2 NW/4, and SE/4 NW/4
Section 19: E/2, E/2 W/2, and W/2 NW/4
Section 20: All
Section 21: NE/4, NE/4 SE/4, W/2 NW/4, and NW/4 SW/4
Sections 22 through 26: All
Section 27: N/2, SE/4, and NE/4 SW/4
Section 28: NE/4 NE/4
Section 29: N/2
Section 30: N/2 NE/4 and SE/4 NE/4
Section 34: NE/4 NE/4
Section 35: N/2 and SE/4
Section 36: All

TOWNSHIP 20 NORTH, RANGE 30 EAST, NMPM

Sections 1 through 36: All

TOWNSHIP 20 NORTH, RANGE 31 EAST, NMPM

Sections 1 through 36: All

TOWNSHIP 20 NORTH, RANGE 32 EAST, NMPM

Sections 1 through 36: All

TOWNSHIP 20 NORTH, RANGE 33 EAST, NMPM

Sections 1 through 36: All

TOWNSHIP 21 NORTH, RANGE 29 EAST, NMPM

Sections 1 through 27: All
Section 28: E/2, NW/4, and E/2 SW/4
Section 29: All
Section 30: N/2, N/2 SE/4, SE/4 SE/4, and SW/4 SW/4
Section 31: All
Section 32: S/2, S/2 N/2, N/2 NW/4, and NW/4 NE/4
Section 33: N/2 NE/4, NE/4 NW/4, N/2 SW/4, and SW/4 SW/4
Sections 34 through 36: All

TOWNSHIP 21 NORTH, RANGE 30 EAST, NMPM

Sections 1 through 36: All

TOWNSHIP 21 NORTH, RANGE 31 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 21 NORTH, RANGE 32 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 21 NORTH, RANGE 33 EAST, NMPM
Sections 1 through 36: All

QUAY COUNTY, NEW MEXICO

TOWNSHIP 16 NORTH, RANGE 34 EAST, NMPM
Section 3: Lots 3 through 6, 11 and 12
Section 4: Lots 1, 2, 5 through 12, N/2 SE/4 and SW/4

TOWNSHIP 16 NORTH, RANGE 35 EAST, NMPM
Section 1: Lots 1 through 8, NW/4 SW/4, and S/2 SW/4
Sections 2 through 6: All
Section 7: N/2 and SE/4
Sections 8 through 10: All
Section 11: NW/4, N/2 SW/4, N/2 S/2 SW/4, and N/2 S/2 S/2 SW/4

TOWNSHIP 16 NORTH, RANGE 36 EAST, NMPM
Section 5: Lots 4 and 5
Section 6: Lots 1 through 8 and 10

TOWNSHIP 17 NORTH, RANGE 34 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 17 NORTH, RANGE 35 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 17 NORTH, RANGE 36 EAST, NMPM
Sections 1 through 36: All

TOWNSHIP 17 NORTH, RANGE 37 EAST, NMPM
Sections 6 and 7: All
Sections 18 and 19: All
Sections 30 and 31: All