CASE 4953: Appli. of ATLANTIC RICHFIELD FOR A PRESSURE MAINTENANCE PROJECT, EDDY COUNTY, N.M.

CASE No. 4953

Application,

Transcripts,

Small Exhibits

ETC.

BEFORE THE
NEW MEXICO OIL CONSERVATION COMMISSION
MORGAN HALL
STATE LAND OFFICE BUILDING
SANTA FE, NEW MEXICO
Wednesday, April 25, 1973

EXAMINER HEARING

IN THE MATTER OF: Application of Atlantic Richfield Company for a unit agreement, Eddy County, New Mexico	Case No. 4952
IN THE MATTER OF: Application of Atlantic Richfield Company for a pressure maintenance project, Eddy County, New Mexico	Case No. 4953

BEFORE: Richard L. Stamets

TRANSCRIPT OF HEARING

MR. STAMETS: The hearing will come to order, please. We will take next Case 4952; and I believe that will be consolidated with Case 4953 for testimony.

MR. CARR: Case 4952, Application of Atlantic Richfield Company for a unit agreement, Eddy County, New Mexico. And Case 4952, application of Atlantic Richfield Company for a pressure maintenance project, Eddy County, New Mexico.

MR. STAMETS: I'd like to call for appearances in these two cases. Mr. Hinkle, the cases are consolidated on your recommendation.

MR. HINKLE: Clarence Hinkle, Hinkle, Rondurant, Cox & Eaton, appearing on behalf of Atlantic Richfield.

MR. STAMETS: Other appearances, please.

MR. LANDIS: Bruce Landis appearing on behalf of Amoco Production Company.

MR. LOSEE: F. A. Losee appearing on behalf of Yates Petroleum Corporation and the various interests.

MR. MORRIS: Richard Morris of Montgomery, Federici, Andrews, Hannahs, & Morris of Santa Fe, appearing on behalf of Signal Oil and Gas Company.

MR. STAMETS: Are there any other appearances in this case?

MR. KELLAHIN: Jason Kellahin, Kellahin & Fox of Santa Fe appearing for Cities Service Oil Company, Samedan Oil Corporation, Penroc Oil Corporation, and C & K Petroleum, Inc.

Fred Turner and V.P. Shelton.

MR. STAMETS: At this point I would like that all witnesses and prospective witnesses stand and be sworn at one time. This should save us quite a bit of time.

(Whereupon, the witnesses were sworn.)

MR. HINKLE: Mr. Examiner, we have two witnesses and 12 exhibits. This is the official marked copy and here is one other copy for the attorney. We have two extra copies if anybody wants them.

BILL EMBRY

previously sworn as a witness, testifed as follows:

DIRECT EXAMINATION

BY MR. HINKLE:

Q Would you state your name, your residence, and by whom you are employed?

A Bill Embry. I work for Atlantic Richfield in Midland, Texas.

Q What is your position with Atlantic Richfield?

A I'm land man.

Q Are you familiar with the Empire-Abo proposed unit area?

A Yes, sir.

Q What has been your position with the company with respect to this unit?

A Well, I'm a land man; and I prepared the agreements for the final drafts and for final mailing to the working-interest

owners and the royalty owners. And then I was concerned primarily with the royalty sign up and the working-interest owner's sign up.

MR. KELLAHIN: Could the witness speak up a little louder, please?

Q So it's been your duty to try to get the unit agreement signed up by the working-interest owners and royalty owners?

A Yes, sir.

Q Have you prepared or has there been prepared under your direction certain exhibits for introduction in this case?

A Yes, sir.

Q And they are exhibits which have been marked exhibits 1 through 3?

A Right.

MR. STAMETS: Mr. Embry, I'm sure that they can't hear you in the back row there. It is necessary to speak up quite a bit in this room.

Q Refer to exhibit number 1.

MR. STAMETS: One thing I'm not clear on, Mr. Embry. You have been a land man with Atlantic Richfield for a number of years?

THE WITNESS: Fifteen.

MR. STAMETS: Fifteen years. And you will be testifying in your expert capacity as a land man?

MR. HINKLE: No, I don't think it is necessary that he qualify as an expert. He's just in the land department of Atlantic Richfield. His duties have been in connection with this unit to get signed up.

MR. STAMETS: Okay. In that limited area then, we will accept his qualifications.

Q Refer to Exhibit 1 and explain what this is and what it shows.

A Exhibit 1 is a plat showing the outline of the unit area. It's the same plat that is Exhibit A attached to the Unit Agreement. The plat shows all the tracts in the unit. It shows the tract number, all the Abo wells. The federal acreage is cross-hatched and the state is white.

That's all federal and state acreage. The total acres in the unit are 11,339.15. The federal lands comprised 36.91 per cent of the unit area being 4,184 acres. The state lands are 63 per cent of the unit area and comprised 7,154 acres.

Q Does this exhibit show all the wells which have been completed in the Empire-Abo pool?

A Yes, sir.

Q It also shows the acreage ownership?

A Yes, sir. It shows the lease ownership.

Q Lease ownership. Now, refer to Exhibit 2 and explain what this is and what it shows.

A Exhibit 2 is a letter from the United States Department of Interior Geological Survey from Washington signed by the acting director which designates the area shown on Exhibit 1 as logically suitable for a unitization.

Q Does this also indicate that they approved a form of Unit Agreement?

A Yes, sir. It does.

Q And also concur in the supervisor's recommendation as to the basis of allocating the unitized production?

A Yes, sir.

Q That's provided for in the Unit Agreement; is it not?

A Yes, sir.

Q Now, refer to Exhibit 3 and explain what this is.

A Exhibit 3 is a letter from the office of the Commissioner of Public Lands wherein as stated the commissioner approved the unit as to form and content.

Q And this is dated August 30, 1972?

A Yes, sir.

Q Are you familiar with the proposed Unit Agreement?

A Yes, sir.

Q Is Atlantic Richfield designated as the unit operator?

A Atlantic Richfield is the operator.

Q Does the Unit Agreement cover all formations or is it just limited to a particular formation?

A The Unit Agreement is limited to the Abo formation as

defined in Section 2-H of the Unit Agreement.

Q You might refer to that and state briefly what that formation consists of, how it's defined.

A The unitized formation refers to the Abo formation which is a continuous stratigraphic interval occurring between the base of the Drinkard formation and the top of the Wolfcamp formation and which is the same formation that was encountered between the logged depths of 5,325 feet and 6,533 feet in Amoco Production Company's State of New Mexico AU Number 1 Well.

Q Now, is this agreement in substantially the same form as heretofore approved by the Commission where Federal and State lands are involved?

A Yes, sir.

Q And where it's for secondary recovery or pressure maintenance purposes?

A Yes, sir. It is.

Q Now, have you invited or have Atlantic Richfield invited all the owners of working-interests and overriding royalty and other interests to commit their interest to the Unit Agreement?

A Yes, sir. We have.

Q What is the preference status of the unit with respect to commitment of acreage? You can refer to Exhibit Number 1.

A On Exhibit 1 we show in green 21 tracts the owners of which

have indicated to us that they probably won't join this unit. Now, this area comprises of approximately 840 acres and would be 7 per cent of the unit area.

Q When you refer to 21 tracts, you mean 21 40 acre tracts?

A Right. Actually 16 unit tracts.

Q 16 unit tracts but 21 40 acre tracts?

A Right.

Q These are the only ones who have definitely refused so far to commit their interests to the unit?

A To the best of my knowledge.

Q What do you anticipate with respect to all of the other owners?

A We expect all of the other tracts in the unit area to come in sooner or later. They are expected.

Q What percentage would that constitute?

A That would be 93 per cent.

MR. HINKLE: I'd like to offer into evidence exhibits 1 through 3.

MR. STAMETS: Are there any objections to the introduction of these exhibits? They will be admitted into evidence.

MR. HINKLE: That's all the direct of this witness.

MR. STAMETS: Are there questions of this witness?

MR. MORRIS: Mr. Examiner.

MR. STAMETS: Mr. Morris?

MR. MORRIS: Mr. Hinkle, would it be appropriate for me to ask questions of this witness concerning the formula?

MR. HINKLE: No. I should have stated there that our next witness will go into the formula and the operating aspects of it.

MR. MORRIS: I have no questions.

MR. KELLAHIN: Mr. Examiner, I just have one question.

CROSS-EXAMINATION

BY MR. KELLAHIN:

Q How much of the unit has presently been signed up?

A 85.4 per cent.

Q Is that an acreage figure?

A It's a unit Phase 1 figure, working-interest figure.

Q 85.40, did you say?

A 85.4.

Q And of that what percentage is owned by Arco?

MR. HINKLE: By who?

Q Atlantic Richfield?

A Our interest in the unit.

Q Of 85.4 per cent or your interest in the unit?

A Well, it would be our interest in the unit, 31 per cent.

Q What is the interest of the Amoco?

A Let me look. I better get exact. Amoco's interest is 30.38392. Atlantic's interest is 33.143.

MR. KELLAHIN: Thank you.

CROSS-EXAMINATION

BY MR. STAMETS:

Q Mr. Embry, on the second page of Exhibit number 2 there seems to be some indication by U. S. G. S. that they thought at that time you did not have sufficient commitment. Let's see. "However, the right is reserved to deny approval of any executed agreement that, in our opinion, does not have full commitment of sufficient lands to afford effective control of operations in the unit area." Do you know if 85.4 per cent will be sufficient in the eyes of the U. S. G. S.?

A Well, that's a determination that will have to be made by the U. S. G. S., that my personal opinion if you want that--

Q So to your knowledge it's not been made at this time?

A I beg your pardon?

Q That decision has not been made at this time?

A No.

MR. HINKLE: I might say in that connection, this is the way that all of these letters are written by the U. S. G. S., because the regulations provide that they will only approve the Unit Agreement where sufficient acreage has been committed to give effective control. So this is a determination which has to be made by the U. S. G. S. and also by the Commission of Public Lands when the unit is filed for final approval.

Now, the fact that they only have 84.4 per cent signed at the present time doesn't mean that's all they are going to get

before they submit it for approval. It's not necessary, as we see it, to have any particular percentage signed up before the Oil Conservation Commission can approve it or approve the injection of gas.

MR. STAMETS: Are there any other questions of the witness? He may be excused.

S. U. CHRISTIANSON

having been previously sworn testified as follows:

DIRECT EXAMINATION

BY MR. HINKLE:

Q State your name and your residence and by whom you are employed.

A S. U. Christianson. I reside in Midland, Texas; and I am employed at Atlantic Richfield Company.

Q Are you a petroleum engineer?

A Yes, sir. I am. A particular title at the present time is Senior Analytical Engineer.

Q Have you previously testified before the Commission?

A No, sir. I have not.

Q State briefly your educational background and experience as a petroleum engineer.

A 1954 I received a degree, Bachelor of Science in Petroleum Engineering with the Reservoir Engineering Option from the University of Houston. The previous year in 1953 I had received a Bachelor's Degree in Geology from the University

of Houston.

In 1954 I was employed at Atlantic Refining Company, predecessor to Arco in Midland, Texas, as a junior reservoir engineer working with the Permean Basin Fields and Reservoirs. In 1958 I moved to Tulsa, Oklahoma where I was working with Midcontinent Fields and Reservoirs primarily in Oklahoma, Kansas, and Texas during this period of time, and the next few years in Oklahoma City and Amarillo and partially in Denver later.

I was working primarily with Colorado, Kansas, Oklahoma, Texas Panhandle. My duties were primarily, well, you name it. Development, drilling, gas and oil wells, reservoir studies of all types for all types of secondary and primarily projects. During this period of time I testified before the Commissions of Kansas, Oklahoma, and the Railroad Commission of Texas.

In '65 I moved to Denver, was there for two years. 1967 I was transferred to Roswell, New Mexico, specifically for the purpose of beginning a reservoir study on the Empire-Abo Reservoir which would lead to eventual unitization of this reservoir.

Q Have you continued your studies since 1967?

A That is correct.

MR. HINKLE: Are the qualifications of the witness acceptable?

MR. STAMETS: They are.

Q Now, have you prepared or has there been prepared under your direction certain exhibits for introduction in this case?

A Yes, sir. There has.

Q And they have been marked Exhibits 4 through 12?

A That's correct.

Q Refer to Exhibit 4 and explain what this is and what it shows.

A Exhibit 4 happens to be a map of the Empire-Abo pool contoured on the top of the Abo porous reef. The subsea contours are shown. You can readily see by looking off to the southwest that probably the structurally highest well in the field is the Malco Federal Number 8 which happens t. be located in the northwest quarter of the southeast quarter of 9, 18 South, 27 East, at the top of the Abo reef at minus 1621 feet subsea, as you can see there.

From this point, the crest of the reef can be followed around dipping at about 1 degree. Approximately miles east of that point, the crest of the reef dips below water-oil contact in the Abo formation which was determined by the engineering committee to minus 2665 feet subsea. The heavy dashed line is the unit area which was approved by USGS as being a proper area for unitization of the Abo formation.

The dashed line most easily seen on the north side is the engineering committee's determination of the zero net pay in the Abo reefs.

Q Now, refer to exhibit 5 and explain what this is.

A Exhibit 5 is a plat of the various production variables normally plotted for any reservoir versus with the variables themselves plotted on the vertical scale and time encountered being on the horizontal scale with the production increments. Actually the most, as you can see by looking at the example, the most important figure to the income as related to it is the daily oil rate. And this is the heavy curve down here which happens to be labeled "Daily Oil" strangely enough.

And as you can see, back during the low allowables in the middle '60's that rate for the entire, this is for the entire Abo, Empire-Abo pool as it says on the top, this rate was kicking along at 15 to 16,000 barrels a day.

Q The numbers are in the thousands, are they?

A Right. I'm sorry. The vertical scale on the left is in thousands per day. So you can see that, for example, this 15 over here on the left means 15 thousand barrels per day. And the 20 means 20 thousands. And there by each individual line division between 15 and 20 would represent a thousand barrels a day of production. So as I was saying, you kick along here; and, of course, this field has been a

field that has had a great deal more capacity than the allowables. And as you can see in the middle '60's 15 to 16 thousand barrels a day and the market demand began to pick up.

The Commission upped the New Mexico Allowables. You can see the Empire-Abo's rate going right up. If you plot an allowable curve to the state of New Mexico, it will be parallel to this thing right here. Moving on out to current times, I might say that just happened at the time we plotted this curve. We didn't have January's data. The curve shows that we are, I'm still on the oil rate curve. It shows that we are producing at the end of the year 1972 approximately 25,500 barrels per day from the pool as a whole.

Moving up one curve, you find that cumulative oil curve. This is the increased oil production in the original first production back in November, 1957, to 1-1-72. And you see that as, I mean, 1-1-73. And you see as of 1-1-73 approximately 89.5 million barrels of oil had been produced from the reservoir.

Q Do you have any later figures on that?

A Well, we do have January which, you might imagine, is about the same as December. Allowable stayed the same. It's 25,625 barrels of oil per day. I might mention the water at this time is plotted on the low slide line down toward

bottom, field water production, so labeled.

And in January that production is 23,236 barrels of water per day which amounts to about 9 per cent of the water-oil combined production. That amount of production to 9-1-73 represents 23.4 per cent of the original oil in place.

Moving up to the next curve of cumulative gas, you see that along with this oil production we have had gas production, of course. And our cumulative gas production as of the end of '73 is 113 billion cubic feet. The curve on the right is an, well, it's again, it's in millions of barrels of oil for the cumulative. And it is in billions of cubic feet for the gas cumulative. So we have produced almost 90 million barrels in this curve of oil and the 113 billion cubic feet of gas through the year of 1972.

If we move on up to the curve that is plotted across the top, this is as indicated on the left margin, this is your reservoir pressures, points per square inch on the vertical scale. Plotted it is the heavy line as indicated by words "Reservoir Pressure." 2355 is the point back here in November of 1957 at the beginning of production.

The last pressure survey taken in July of 1972 was 1,410 PSI, again plotted for over here to right from the middle of 1972. The other curve which we haven't yet discussed is the gas-oil ratio curve which again is shown

on up here with the Reservoir Pressure curve. The gas-oil ratio curve is read over here in the right margin. Gas-oil ratio is cubic feet per barrel of oil. I think you can see that in that early days it was average perhaps, 1,100 cubic feet per barrel. That had been a gradual increase in the pool to the gas-oil ratio. However, it's been holding pretty steadily in the last few years and currently is averaging 1,300 cubic feet per barrel and 1,500 cubic feet per barrel.

Q Now, have the working interest owners formed an engineering committee in connection with the study of unitization in this area?

A Yes, sir. They certainly have.

Q When was that formed?

A That was formed at a working interest owner's meeting in October of 1967.

Q What was the purpose of the formation of this committee?

A The primary purpose charged to the engineering subcommittee. Actually there were two primary purposes. First, to determine the proper area to be unitized. And second, to work up a number of parameters which would be suitable as a basis for the working interest owners and to negotiate possible participation in a possible future unit.

Q Over what period of time did the engineering committee meet?

A It met in work sessions virtually continuously for anyone

who wanted to go from about November of '67 until just before a report, just before July of, August of '68.

Q Was the engineering--

A Nine or ten months.

Q Did they formulate a report by that time for the working-interest owners?

A That's right, which included a recommended unit area and, of course, a number of parameters.

Q What procedure did you follow then in getting the working-interest owner's representatives together?

A A meeting was called, of course. We had the address list as complete as--. Of course, Amoco, I'm saying, was ramrodding at this point, although Arco was working closely with them. But there was a complete address list of all working-interest owners that we could find in any way, shape or fashion; and they were notified as a matter of routine of all engineering meetings and all working-interest owners meetings.

Q What was the purpose of these meetings between the engineering committee or subcommittee and working-interest representatives?

A Well, it was to simply present the work that the engineering subcommittee had completed and then to stand back out of the way and let the working-interest owners work with them.

Q Did they approve at one meeting or did it take a number of

meetings?

A No. I think, well, actually the negotiations -- are you leading up to this point?

Q Yes.

A Real negotiations didn't begin until both major operators here had completed their reservoir feasibilities studies which actually was sometime around early December of 1971, I believe. No, December of 1970, I'm sorry. Then awhile back, December of '70 was when actually various negotiations began to the working interest owners.

Q What was the combination of the negotiations?

A Combination after a vote on some 56 different formulas were a favorable vote of about 87 percent of the Phase 2 ownership on a formula which at that time was called Formula 47, because it happened to be Number 47 in the sequence that we looked at. So at this point it was a decision of the group, at least the majority, that it was time to move ahead then in the direction of seeking USGS and State Land Commission approval.

Q In other words after numerous meetings and proposals of about 56 different formulas 87 percent of the working interest owners did approve the formula which was finally adopted?

A That's correct. And that is the formula which we are offering for the basis for unitization here today.

Q Now, what was your next step that was taken by the working-interest owners or the engineering committee?

A Well, of course, this meeting now was in July of '71, I believe; and we had the vote at the meeting; but this needed to be ratified by signed ballots. And this always takes a while so --

Q And you circulated this?

A We circulated the ballots, and we got back 6 from those who had voted yes, you know. I forget, a couple of months, maybe two or three months. At this point then we were ready to go to the U.S.G.S., and then we did with our application.

Q Did you have numerous conferences with the U.S.G.S. officials?

A Beginning some time there in the mid-fall of 1971 and continuing until August of 1972, we had numerous conferences with the engineering staff and other personnel of the U.S.G.S. in Roswell, with their supervisory personnel in Washington, D.C., also.

Q Then you did file an application with the U.S.G.S. for designation of the area as proper and suitable for unitization and for approval of the form of Unit Agreement and also the participation formula?

A That's correct. And after, I might say, very exhaustive studies by the U.S.G.S., they did send us in August of

'72 the approval you have that has previously been entered into evidence by Mr. Embry?

Q Exhibit Number 2?

A Exhibit Number 2, right.

Q How long did it take the USGS in their study before they approved the participation formula?

A Well, it was approved by the letter of August of '72.

Q Approximately how many months after it was submitted?

A After the first application.

Q Yes.

A I believe we officially submitted the application in November of '71, although we had talked to them informally about it before then. So it's from November, I'll say, November 21; but I don't guess it makes any difference. I think that's what it was, though.

Q Approximately ten months?

A Oh, it was sometime early in August when we actually got the letter.

Q Was the form of the Unit Agreement and the formula also submitted to the Commission of Public Lands for approval?

A Yes, it was.

Q Now, during all of this period of time were the working interest owners kept informed of what was going on and the steps that were being taken?

A Yes. They were. There was correspondence any time we felt

that some significant event had occurred. We informed the working interest owners.

Q Now, the tract participation formula is set forth in Section 13 of the Unit Agreement. Would you refer to that and explain it briefly?

A That's on Page 10. Okay. If you are looking at it, it looks like -- Page 10, Dick.

MR. STAMETS: Okay.

A Okay. Page 10. Now, this looks like as I was going to say, this looks a little bit complicated; but it really isn't. Phase 1 covers the first 11,000,000 barrels produced after the unit effective date. And it's simply 75 percent current production and 25 percent future primary as predicted by the Numeric Models Studies. That's Phase 1.

MR. STAMETS: Now, would you repeat that for me so I can get it down here?

THE WITNESS: 75 percent current production and 25 percent future primary as predicted by Reservoir Numeric Model Studies.

MR. STAMETS: Okay. Thank you.

Q (By Mr. Hinkle) Okay. Phase 2 which looks like it's got a lot of stuff in there can really be summarized as being 33 1/3 percent original oil-in-place and the rest which is 66 2/3 percent is future reserves as predicted by Reservoir Numeric Model Studies.

MR. STAMETS: Future reserves under any particular tract?

WITNESS: Each tract.

MR. STAMETS: Under each tract?

WITNESS: Of course, yes. That's it.

Q Now, in your opinion is the formula fair and equitable in the interest of conservation, prevention of waste, and will tend to protect correlative rights.

A Yes, sir. It certainly is.

Q Now, Section 11 of the Unit Agreement provides for a plan of operation which is to be approved by the working-interest owners and the supervisor of the U. S. G. S. and Commissioner of Public Lands and this Commission. Refer to Exhibit 6 which is the plan of operation and explain briefly.

A Page 1 is simply letter directed to the people who have to approve this plan of operation which happen to be the district supervisor of the U. S. G. S. over in Roswell, Mr. Armijo, who is the Commissioner of Public Lands, Mr. Ray Graham, Director of Oil and Gas Department of the Commission of Public Lands, and then the State of New Mexico Oil Conversation Commission, Mr. Al Porter, and then the working-interest owners.

And the letter is a cover letter stating that this is the "Initial plan of operation, Empire-Abo unit, Eddy County, New Mexico," And, "in compliance with Section 11

of the Unit Agreement, Empire-Abo Unit, Eddy County, New Mexico, Atlantic Richfield Company as unit operator on behalf of itself and the other participating working interest owners, hereby submit for your approval a Plan of Operations to cover the period beginning with the effective date of the Unit Agreement and extending through the remainder of Calendar Year 1973."

The next page which would be the third page starts with the Initial Plan of Operation, Empire-Abo Unit. The first paragraph here is history in background to the project area. And I might call your attention to the attached plat, Exhibit 1; and we will flip back here, if you will, flip back to that exhibit. Now, these are just strictly exhibits on the Plan of Operation. They don't have any relationship to the overall series of exhibits here for the hearing. Other than that, they are a part of Exhibit 6 here.

I will state what this is, and this is and this is as I stated over here in the legend in the lower right-hand corner, it is the unit boundary and all the individual tracts within the full unit as approved by the USGS. It shows each tract in its boundary and its tract number corresponding to the exhibit in the Unit Operating Agreement.

The little added features here are location of the Empire-Abo Gasoline Plant which is in the south half,

northeast quarter of Section 3, Township 17, I mean 18 South, 27 East, Section 3. That's the Empire Gasoline Plant.

The Phillips Gasoline Plant is shown located down in the southeast corner of Section 7, 18 South, 28 East. Then also shown in this map are, by the shaded triangles, the specific wells into which we plan to inject gas into the gas cap of the Empire-Abo Reservoir. And there happens to be 8 of those wells shown on this map.

Okay. Moving on down to Page 3 of the Plan of Operation, we see dropping on down its discussion about the general characteristics of the Abo Zone geologically and structurally speaking. We might point out Exhibit 2 which happens to be the type log which Mr. Embry referred to earlier which is in the Unit Agreement.

Let's flip over here back behind the map and we find Exhibit 2 which is the Amoco Production Company State AU Number 1 Well. This is a gamma ray neutron radio activity line log, and there you see up near the top log the base of the Drinkard at 5,325 minus 1,784. And on down here at the bottom, we find of the Wolfcamp at 6,533 or minus 2,992 subsea. That is Exhibit 2.

Moving on to Paragraph 2 of the Initial Plan of Operation, this covers current production, future recovery. We have discussed that pretty much already. Doesn't seem

to be any point in repeating it. There is a little more information in there. Paragraph 3 now is the basic concepts. Now, I'm over on page 4. Paragraph 3 is the basic concepts. "A. Field production history and Reservoir Numeric Models Studies have demonstrated that reservoir recovery is governed by a gravity drainage mechanism. With unitization, the operator will be able to maximize beneficial effects of this most efficient recovery mechanism by careful observation of well performance and shutting in or curtailing production from inefficient wells.

Paragraph B. Injection of plant residue gas will act toward pressure maintenance and orderly control of expansion of the secondary gas cap."

These are the concepts by which we will do our best to operate this reservoir, this unit area. Paragraph 4 covers the special rules that we are going to request.

Q Go ahead and explain what the special rules are that you are proposing.

A Paragraph 4 "Special Rules. A. Unit Allowable. Starting on the effective date of the unit, the unit will receive a unit allowable, calculated so that Unit Area reservoir voidage will not exceed average daily reservoir voidage rate for 1972." Let me see. Where am I? "This will result in an increase from current 23,600 BOPD to about 30,000 BOPD for the Unit Area."

Then --

MR. MORRIS: Excuse me, Mr. Examiner. Are there copies of this Plan of Operation available? We don't have one. We haven't seen one of these. It's hard for us to follow the testimony.

MR. HINKLE: We have got one other one here. Here is one, Dick.

MR. MORRIS: Thank you.

A The second step, then, to the allowable would be effective with the start of gas injection. At this point we would, the unit area allowable would be 40,192 barrels of oil per day. Reservoir Numeric Model Studies demonstrate added recovery and no reservoir waste at this rate.

We would then have a provision to produce the unit allowable. This is under B. This would be for B. "To produce the unit allowable from the most efficient wells without restriction. The only exception will be where a unit producing well directly offsets a non-unit well."

Paragraph C would be a "Provision that if any unit well is located within 660 feet of a non-participating tract on which is located an Empire-Abo producing well, such unit well will be allowed to produce no more than two times normal unit allowable for the Empire-Abo Pool."

Section 4-D then would be "Provision for administrative approval of additional injection wells, or changes in

injection well locations."

Moving ahead to part 5 which covers our operating Plans for 1973, "Initially gas injection will be into the Abo Gas Cap," in the same 8 wells that we just looked at over on Exhibit 1. And they are enumerated here. Okay. Attached Exhibit 3, flipping back to our exhibits here to the plan of operation again, Exhibit 3. If you have got it, there happens to be a Gamma Ray Neutron Log of the Atlantic Richfield M. Yates "B" (ARC) Well No. 8 which is one of the injection wells shown in Exhibit 1.

This shows reef top and reef base, and we would intend to inject gas into this well building in the upper part of the section. Exhibit 4 now right behind Exhibit 3 is generally the same well, and this a schematic diagram of the mechanical system in the wellbore itself that we would have to inject this gas. This is typical of all injectors as far as the mechanical set up is concerned.

Moving back over to page 5 to the last paragraph, we would expect or we anticipate maximum gas injection volume into all these 8 wells we just saw on Exhibit 1 to be no more than 7 million cubic feet a day. In terms of reservoir space fill up, this is equilvalent to over 60,000 barrels of water injection per day.

Plans are to pick up the residue gas from the outlet side of the two gasoline plants at about 700 pounds per square inch and compress it to 2,000 pounds per square inch for injection. The gas will contain hydrogen sulfide. And super-hydration facilities are planned in order to minimize possible corrosion.

Q How did you arrive at this first step and the second step in the project allowable?

A The first step allowable of about 30,000 barrels of oil per day is based on the fact there will be no more voidage at that rate than there was from the unit area as an average in 1972 on our primary operation.

Q In other words, that was the same voidage as in 1972?

A That's correct. The same voidage though more barrels of oil are being produced.

Q Now, what about your second step of 40,192 barrels?

A This is based on the numeric model studies which show not only no waste at this kind of rate, but increased recovery.

Q Now, how do you propose to allocate the project allowable? In that connection, you can refer to Exhibit no. 7. Okay. Refer to Exhibit 7 and explain what this is and what it shows.

A Exhibit 7 is our method of well-by-well allocation and credit for net reservoir voidage in determination of the allowable. The heading and the first six columns on the

first page, and by six columns I mean the columns with the little numbers up here at the top, 1 through 6, they actually include a number of subcolumns within most of them, numbered columns, but at any rate those columns to the left of column 7, I'll say, and that's the easiest way to look at it, are exactly like other pressure maintenance project forms that are presently in operation under this Commission's rulings now, such as the Vacuum Abo, for example, Phillips Vacuum Abo.

So it's simply a statement of well tests in the month we are basing the thing on, which happens to be a hypothetical month of the future, after we are injecting gas, March, 1974. Then we have in Cclumn 5 average production, and then column 6 gas injection. So these, as I say, are very much the same as others.

Now, the voidage calculations begin on column 7 through 11, and they simply reflect voidage in allowable values. This is true of both pages one and two. Now, you get through over here to the well count on page 2 and you will see twenty wells and wonder about that. And, of course, the reason for that is that we are dealing with a hypothetical sample here, a 20 well sample of that will be hopefully a 210 to 220 well unit area.

Every attempt was made to scale this sample in scale with the reservoir; but, of course, it had to approximate

by necessity. Nevertheless, the attempt was to reflect the types of wells that are in the reservoir at the present time, but I want to emphasize that these are not real tests. This is a hypothetical production, because we haven't got through March, 1974 yet. We will get there, we hope.

Okay. And then you move on over. That's the first two pages, and then you move over to the last three pages, 1, 2, 3. And some of you, I'm sorry, will not have the very last page which is a table of fluid properties versus reservior pressure, but we will get them to. That's just a foul up on our part, but any way those last three pages are simply, they simply show how we arrived at the voidage values that are over here on pages 1 and 2.

So under this allowable plan, the project area reservoir voidage I want to emphasize will be reduced to less than half of the current primary reservoir voidages.

Q Now, refer to Exhibit 8 and explain what this is and what it shows.

A Well, Exhibit 8 would try to throw a little more color into the proceedings here. Christmas red and green. This is the same map that we looked at back over here on one of the earlier, well, I guess it was Exhibit 4, the very same structure map, the same unit outlined and so forth; but it does now have the 8 injection wells as the red triangles, the same 8 wells we looked at in

[illegible] the plan of operation on, I believe, Exhibit [illegible] ago.

Q Why are the injection wells located as you have shown them on this presentation?

A Well, of course, there are a number of factors you have got to consider. Of course, our intent here in what we are going to do is put this down in the Gas Cap. So that was number 1. We want to distribute it as equally as possible to maintain pressure as much as we can throughout the reservoir.

So the attempt is to distribute the wells volumetrically over the reservoir.

Q And the Gas Cap is toward the north border of the reservoir?

A Well, the Gas Cap is over the whole structure virtually and along the whole rest of the reef and and back to the back reef. And these wells are located, of course, in the Gas Cap. This was a primary consideration. You have got to consider permeability, injectivity, are you going to be able to get gas in the wells, and then naturally, and this is why the green tracts are on here.

These green tracts are the same tracts that Mr. Embry had on his map being those tracts that we have now reason to believe likely will be in the unit. Naturally, we do not want to damage in any way these tracts; and, therefore, we are locating our injection wells as you can see by looking at Exhibit A at least two locations away.

which will not participate in any unit, and in some cases three locations away.

Q Do you have anything else with respect to this exhibit?

A No, that's all I have on that.

Q I refer to Exhibit Number 9. I might state that Exhibit Number 9 is a diagramatic sketch of each of the 8 injection wells, and we have just numbered it as 1 exhibit. Refer to Exhibit 9 and explain what it shows.

A Exhibit Number 9. What you are looking at there at the first, this is a packet which has the mechanical diagram of each of the wells, each of the injectors. This shows how we will complete these wells, the equipment we will have in the hole, the mechanics of completing them here. On all these wells, they are all the same on. So unless someone wants to, I'll not go into detail on each of these.

Q The only reason for having a separate diagram is that perforations are at different depths, the cementing and so forth is different in each well?

A That's correct.

Q Now, refer to Exhibit 10 and explain it.

A Exhibit 10 again is a packet which includes the Gamma Ray Neutron Log on each of the injection wells that we just had in the packet of diagrams in the mechanical setup. And it's pretty well self-explanatory so I'll say no more about that.

Q In your opinion is completing these injection wells in the places that have been indicated, will it confine the injection of gas to the Blo reef formation?

A Yes, sir. We intend to make every effort to see that gas stays in the Blo reef.

Q Now, refer to Exhibit 11 and explain what this is and what it shows.

A On Exhibit 11 the heading states that it's Empire-Blo Pool, future recovery projections as they affect State of New Mexico Leases. There are several vertical columns, several horizontal lines on the left. For example, starting with the very first line, we see what variable we are dealing with. In this case, it's pool ultimate oil recovery as a per cent of the original oil in place.

Moving to the first column immediately to the right of the definition there, we find a 45.0, and that is the per cent of the original oil in place which the pool will recover or the total unit area will recover under competitive natural depletion, non-unitized.

Then the second operational method one step to the right, residue gas injection unitized which is what we are proposing. We are under this method of operation. The increase for the pool will go from 45 per cent of original oil in place to 52.9.

Looking over in column 3 which is labeled Advantage Of

Unitized Case over non-unitized case, we find a plus 7.9; and that's simply the difference or the incremental increase in terms of percent of the original oil-in-place some are 45.0 in primary to 52.9 in residue gas injection.

The next column deals with pool total reserves after 7-1-73. And there is barrels of oil. And you see that there are numbers here that indicate under competitive natural depletion future recovery would be 79 million barrels of oil. This is from the pool as a whole. Under residue gas injection, that recovery goes up to 109 million barrels. This, of course, corresponds to this 52.9 percent of original oil-in-place or this increased recovery due to residue gas injection shown in Column 3 of approximately 30 million barrels of oil.

Now, we move from the pool to the figures in the first two horizontal lines down in the State Leases Gross Reserves after 7-1-73, barrels of oil. So the first column which is 60 million 700 plus thousand barrels, this states the gross share of that 79 million figure directly above it. This is what the State would recover after 7-1-73 under primary continued competitive operation.

And moving 1 Column over to the right we see that if the State, if we form a unit here, State Leases gross reserves increase from 60.7 million to 77.7 million. Now, this is an increase as shown in Column 3 of almost

17 million barrels gross reserves in increase to the State.

Moving down to the next line then, this is simply a figuring calculation of what the State's 12 1/2 percent net royalty share of that gross figure up there on the line above would be under each of these same conditions. And we see then that under competitive natural depletion, the State's net royalty oil would be about 7.6 million barrels after 7-1-73. If we unitize and go ahead their share of net with our gas injection case, their share of the net, their net royalty share, is 9.7 million or an increase of in excess of 2.1 million barrels of oil net to the State royalty from unitized residue gas injection.

All right, the next line down then simply gives the dollar value to the State of these net royalty reserves after 7-1-73 at a price set over here of $3.81 a barrel. We see that moving to the column to the right under primary that 7.6 million barrels of oil that the State would net is worth 28.9 million dollars. Under secondary, that 9.7 million barrels net royalty oil to the State is worth 37 million dollars.

In other words, in the last column to the right you see a gain in dollars to the State of approximately 8.1 million dollars from the residue gas injection over continuation of primary operation. The last line merely

shows that the future life after 7-1-73 under competitive natural depletion is expected to be 26 years. Under our residue gas injection operation, it would be predicted to be 24 years.

The note below simply shows what interest, what state interest in the unit formula the reserves above were based on. Phase 1, the state's gross interest will be about 69.6 per cent that covers the first 11 million barrels after unitization. Then in Phase 2 the state's interest builds up to 71.5 per cent and continues at that point until depletion.

The bottom note states that the calculated oil loss for each year's delay due to starting unit operation and gas injection at a lower reservoir pressure is in excess of 2 million barrels of oil loss, forever, I might add, per year delay. The State of New Mexico's share of this loss interest, I want to emphasize that's deferred income, that's loss. The State of New Mexico's share of this loss is 2 million barrels times their weighted average interest times royalty interest is 183,000 barrels of oil reserves lost net to the state royalty for every year's delay in formation of this unit.

The last line simply multiplies that 183,000 barrel number by the price of oil per barrel of $3.81 to come out with approximately 695,000 dollars loss to the state

for every year's delay in unitization of this reservoir.

Q Now, refer to Exhibit 12 and explain this.

A This is, Exhibit 12 again, we are talking about the State. We are talking there about the potential rate benefits to New Mexico State Lands Leases by unitization as we are proposing here today. Under the pool total requested top allowable, the unitized State rate Phase 1 under the Phase 1 participation, 29,253 barrels per day.

The non-unitized primary, in other words, State rate at the current rates, 25,600 barrels per day times the current State share of that rate, 17,615 barrels per day. And the next line down simply subtracts 17,615 from 29,253, and we find that the State Lease rate gained by unitization from continued primary into Phase 1 is 11,638 barrels of oil per day net gain. Well, that's gross gain to the State.

Okay. Now, to get the net royalty gain, we multiply that 11,638 figure by .125; and we find a net royalty gain to the State as shown here of 1,455 barrels of oil per day.

And the next and final column we simply multiply that 3.81 dollars a barrel and we find that the net gain moving from primary into Phase 1 of the Unit Agreement to the State is 5,544 dollars per day. And I might emphasize, as we saw in Exhibit 11, that the State's interest increases in Phase 2 so that we would expect the State's gain

primarily to be somewhat greater than $5,544 per day. And after those first 11,000,000 barrels are produced, then we move into Phase 2.

Q So every day that is lost in putting this into effect, they are going to lose over $5,000 a day as far as the State is concerned?

A That's right. They defer that. They lose $182,000 a year as Exhibit 11 said, per year's delay.

Q Now, Exhibits 11 and 12 relate to the State's interests. Have you made a study as to the overall gain that will be effected by reason of unitization?

A Well, yes, of course.

Q All right. What do you anticipate will be the total ultimate recovery they will gain over the primary?

A Thirty million barrels of oil approximately.

Q Over what period of time will this be produced?

A Over the next twenty-four years as was mentioned in one of the previous exhibits.

Q Now, in the event the Unit Agreement is approved and the participation formula is approved and the project allowable, in your opinion will this be in the interest of conservation, the prevention of waste, and tend to protect correlative rights?

A Yes, sir. It certainly will.

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

A No, sir. I do not.

MR. HINKLE: We'd like to offer into evidence Exhibits 4 through 12.

MR. STAMETS: Are there objections to the entrance of these exhibits? They will be admitted into evidence.

MR. HINKLE: That's all of the Direct.

MR. STAMETS: There will be a 15-minute coffee break at this time.

(Whereupon, the hearing was held in recess from 2:40 P.M. until 2:50 P.M.)

MR. STAMETS: The hearing will come to order, please. Are there questions of this witness?

CROSS-EXAMINATION

BY MR. MORRIS:

Q Mr. Christianson, concerning your Exhibits 11 and 12 where you made a projection of future recovery for the State Lands involved in this unit --

A Yes, sir.

Q -- did you make any similar studies with respect to individual tracts or tracts owned collectively by the various companies that are participating in the, excuse me, not participating necessarily but have acreage within the unit?

A Some studies, yes, sir, of various tracts. Right.

Q And have you made studies of this sort with respect to

those tracts and companies that at this point are non-consenting interests in the unit?

A Yes, some of them, right.

Q Did you make a study of this sort with respect to the tracts that are owned by Signal Oil and Gas Company?

A Yes. I've got, of course, we looked at two or three different things with them, right. Sure did.

Q Now, on your Exhibit 11 and 12 where you show the future recovery projections for the State, if you made a similar study with respect to the Signal Oil and Gas Company tracts, would it show a gain or a loss?

A Relative to what?

Q Well, the same relative considerations that you made on your Exhibits 11 and 12.

A Well, let me, as a matter of fact, of course, we do have a study. Now, let me see. I guess I'm not clear on your question. Relative --

Q My question is this: You have made a rather detailed study here of future recovery projections as they affect the combined State of New Mexico leases.

A Right.

Q And obviously you have presented this to show the State's relative position, as you interpret it here, as where you compare the non-unitized production against what the recovery would be under the Unit Plan of Operation. And

I'm simply asking you if you had made a similar study with respect to the two leases that are owned by Signal Oil and Gas Company?

A Yes. Let me give you a few answers from that, if you will. Okay.

Q That's what I want.

A All right. First of all, Signal State E-1 and State M-1 combined, that's the total Signal interest; am I correct?

Q Yes, sir.

A Now, the original oil-in-place on that twin forty-acre tract that has two wells on it is 892,082 barrels from the Engineering Committee study. The cumulative oil actually produced from that tract from those two wells on that tract from the beginning to February 1st, 1973, happens to be 870,688 barrels of oil. This is actually oil measured in the tanks.

Q Mr. Christianson, excuse me. Let me interrupt you a moment.

A That happens to be 97.6 percent of Signal's original oil-in-place that you have produced up to February 1, 1973. That's the first thing in our study. You want me to go ahead with the rest of it?

Q Mr. Christianson, you are not answering my question, sir. I am asking you the question, please. Have you made a similar determination as shown on Exhibit 11 with respect

to the Signal tracts? The first consideration shown on Exhibit 11 was what the State tracts would produce under competitive natural depletion, that is, non-unitized production.

A Yes, I am getting to the answer of your question in fullness of the whole consideration. I think the Commission needs to hear the whole thing, not just your specific question which I will answer as I move on down this study. It will come. You'll hear it, but first of all --

MR. STAMETS: Mr. Christianson, in the interest of time here, I think it would be better if you would answer the attorney's specific questions; and then if your counsel has something on Redirect, you can cover those points at that time.

THE WITNESS: I see. Okay.

Q (By Mr. Morris) All I'm asking, Mr. Christianson, is if you have made a study that would produce for the Signal Oil and Gas Company the same type of figures that you have shown here in your three columns on Exhibit 11. The first consideration being what recovery Signal would expect to get under your studies under non-unitized operation. And then make a comparison from that to what Signal would receive under the Unit Plan of Operation.

A Okay. Let's see now. Your total ultimate primary recovery or your primary recovery, let me get my numbers

straight here. Let me say your total ultimate recovery, I'll state it this way. Your total ultimate recovery from primary to wells, from primary all the way through including your ultimate recovery as predicted by our Numeric Models --

Q Yes, sir.

A -- that happens to be, you want me to give you that number?

Q Yes, sir.

A It is 273.2 percent of your original oil-in-place. Now, in barrels if you want that, your total ultimate primary recovery is 2,429,300 barrels. After subtracting, let's see, well, let's take your cumulative to February 1st, '73, or let's take it to 7-1-73, which I believe was the way the State was figured.

Okay. Your predicted primary recovery, I think this is after two Numeric Model Studies, your recovery after 7-1-73, and that's comparable to what we talked about for the State, and this is your gross working interest recovery, is 174.5 percent of your original oil-in-place. Now, in terms of barrels, now, this is under primary production with your tract located advantageously as it is on one of the two wells or two of the lowest structural wells in a gravity drainage reservoir which means as these recovery numbers I've already shown in

terms of percent original oil-in-place which means that you, under competitive depletion, will continue to drain oil from all the tracts up.

Q Mr. Christianson, if you will please answer my very simple question. All I have asked you is to please give me in terms of barrels what according to your study would be the remaining production of Signal Oil and Gas Company tracts if the field is not unitized.

A Well, that 174.5 percent of your original oil-in-place which you will produce if the field is not unitized from 7-1-73 to abandonment under primary is equivalent to approximately 1,559,000 barrels of oil.

Q Okay. We finally got there. One million five hundred and fifty-nine thousand barrels?

A Right.

Q All right. Now, if the field is unitized effective 7-1-73, what would Signal's production in barrels be under both Phases 1 and 2 of the proposed Unit Agreement?

A Well now, keep in mind these are estimated numbers, because we don't know exactly how much oil is going to be produced to 7-1-73; and, of course, the engineering predictions are subject to some degree of inaccuracy. Okay. Let's see. We are saying now, what was the question? I'm sorry. What was the question?

Q The question was simply, Mr. Christianson: Under the

proposed Unit Participation both Phases 1 and 2 according to your calculations, what would be Signal Oil and Gas Company's production in barrels?

A If they joined the unit?

Q Yes, sir, if we joined the unit.

A Your total recovery now, see, my problem, I'll have to subtract. Your total ultimate recovery would be, if you join the unit, would be 2,147,000. Now, this is under the formula. So if we subtract from that, take that number, your production to 7-1-73 which is 914, is estimated to be 914,000 barrels approximately, we get, what do we get? We get that you would get under unitized operation, now I want to, okay. You'd get 2,233,000 barrels of oil after 7-1-73 if you joined the unit.

And I want to amend, I'm sorry; but I made a wrong calculation when I said you would get 1,559,000 after 7-1-73. That's after 2-1-73. I should have subtracted your estimated cumulative to get these two numbers on an equal basis.

I should have subtracted 914,000 barrels instead of the 870 that I did in fact subtract. So your previous number that I gave you is in error, and I'm sorry. Okay. That's 1,514,000 barrels.

MR. STAMETS: Mr. Christianson, I've heard so many numbers here that I'm fully lost. Let me get a couple here I

can hang the hat on. You predicted under primary conditions Signal's ultimate recovery of 2,429,300 barrels of oil.

THE WITNESS: That's right. If this unit is ever formed, their recovery to 7-1-73 plus their recovery after 7-1-73 under primary operation would be this total number.

MR. STAMETS: Their share of the unit production plus what they had before unitization would come to 2,147,000 barrels?

THE WITNESS: Right. A total ultimate recovery primary to 7-1-73 plus unit recovery is 2,147,000 barrels.

MR. STAMETS: You are talking about a loss there of around 300,000 barrels?

THE WITNESS: I don't define that as a loss.

MR. STAMETS: Difference in numbers of a minus 300,000 barrels?

THE WITNESS: If the reservoir is no longer going to be produced under the conditions under which Signal has had this advantageous drainage position, then you can't really talk about that as being a loss.

MR. STAMETS: Okay. I'm clear on this.

Mr. Morris, do you have some more questions?

MR. MORRIS: Yes, sir.

Q (By Mr. Morris) Without characterizing it one way or another, Mr. Christianson, there is a difference between the two figures of approximately 300,000 barrels? That

is the difference of 7-1-73 into the future being the difference in what Signal would produce if no unit is formed compared to what they would produce if a unit is formed and Signal joined it. Is that a fair statement?

A Yes, sir. If the reservoir were to continue under primary operations, competitive operations as they now exist and the rules were to continue as they are now, in other words, the rules that have been in operation designed as they are for a general-type reservoir situation, simply don't quite cover a gravity drainage type recovery situation.

Q Now, the rules have been --

A Therefore, if you continued to enjoy your advantageous drainage position, you would recover this amount of oil.

MR. STAMETS: Mr. Christianson, if you could make your answers somewhat shorter, I certainly would appreciate it. Like I say, these things can be brought out in Redirect.

THE WITNESS: I see. Okay.

Q (By Mr. Morris) Mr. Christianson, this pool has been produced under the General Rules and Regulations of the Commission governing oil production?

A Yes, sir.

Q And under the form unit allowables for this department. Now, your Unit Plan of Operation actually would accomplish a complete change of Proration Formula, would

it not?

A We are applying it only to the Unit Area, the Project Unit Area.

Q But that is your intent by unitizing the field as a whole would be to change the allocation method as to all wells in the unit based upon this Participation Formula that is proposed in the Unit Agreement?

A Yes. You mean each operator or working interest owner would participate on that basis of what's in the Unit Formula as far as this Phase 1 and Phase 2 procedure?

Q Yes. In other words, your Unit Participation Formula would supersede the allocation formula that is presently provided by the General Rules and Regulations of the Commission?

A No, I don't think. The unitization doesn't. It merely sets out whatever one's interest is in the total oil provided from the unitized or project area.

Q Is each working interest owner being asked to contribute a certain amount of capital to the unit operation based upon its equity ownership in the unit?

A Yes, sir.

Q What is the total unit capital requirement?

A Well, for the overall project, now keep in mind that this is just, I'm not a, I'm a Reservoir Engineer, not a Production Engineer. I'm no expert on costs.

Q Approximately?

A But it amounts to about a 3.3 million dollar additional cost of unitized operation over primary operations, in that range.

Q It's about three and a half million?

A Well, when it boils down at the end, it may be different from either one of those numbers, but that's approximately right.

Q And each operator would be expected to contribute its share of capital to the unit?

A Yes, sir.

Q So in other words, Signal in addition to the difference in oil production that we were discussing a minute ago comparing continued primary and unit operations, in addition to that difference that Signal would suffer it would also be expected if it joined the unit to contribute capital to the unit; is that correct?

A That's correct. They would be expected to contribute capital, but let me point out that their share, their immediate share of right in the unit would be greater than their current primary rate. So that in terms of pay out that capital, I'm certain, would be paid out because your rate could go up.

You got, I don't know the exact figure. I've got it here someplace, but it would go up. Your rate goes up

from its current amount of barrels a day to something greater than that. For example, if you want to figure it out, you can figure it out.

Q I didn't ask you that question.

A Well, your rate will go up and you will pay out your increased investment relative to time.

Q Mr. Christianson, in all the 56 formulas that were considered by your operating group, was any formula ever considered that would in effect hold harmless some of the edge tracts such as the Signal tract that would allow them to at least participate in the unit on a basis that would return to them the amount of oil that they would otherwise expect to receive on continued primary conditions plus something in addition to cover their capital contribution to the unit?

A Well, 56 formulas were considered. Signal voted yes on a few. I don't remember which ones. I think they were the ones that had 100 percent remaining primary in them or roughly that, but I'm not going to, I don't want to answer that question in the sense that the way you stated it.

You said was any formula considered that would hold harmless. What is your definition of harmless? Harmless relative to what? In my opinion, the Unit Formula holds Signal harmless relative to their fair equity in the

reservoir.

Q Even though they would lose some 300,000 barrels of oil?

A They would be unable to continue to drain the other tracts as they are now draining them, or let's say, their drainage would be reduced, I'm afraid, if not limited.

Q I'd like to talk about your Plan of Operations a minute, Mr. Christianson.

A Yes, sir.

Q Do you have a provision in your Plan of Operations that would restrict the production from any well in the unit that is a direct offset to a well located outside of the unit?

A Yes, sir.

Q Now, what was the purpose of restricting those wells?

A Restricted wells that are direct offsets to non-participants?

Q Yes. What was the purpose of that?

A Well, really it is in line with what the Commission has done in other partial-pressure maintenance or pressure maintenance projects.

Q All right. But what is the purpose of restricting? As I understand your Plan of Operations, the wells would be able to produce unrestricted within the unit, but the wells that would be located as direct offsets, the non-

unit wells, would be restricted to twice a top unit allowable. What is the purpose of restricting those wells?

A Really, it was in line with what other pressure maintenance units had done, and we didn't mind it or object to it. So we said, "Okay. We will restrict the direct offsets to twice normal allowable."

Q Obviously, Mr. Christianson, it's a protection to the well outside the unit so that you won't be creating a big pressure sink or coning water or damaging the non-unit well; isn't that the obvious purpose for such a restriction?

A Let me point out that we will be reinjecting 70 percent of our produced gas in the unit, and I don't know if you have run any voidage calculations, but our 284-barrel-a-day offset, you won't be avoiding as much net reservoir space as your 142-barrel-a-day will be. And the pressure drop goes in the direction of the well that's voiding space.

Q As far as you know, there is no reason for that restriction other than this is what has been in other Unit Agreements? You don't have any engineering basis for it?

A That's right.

Q Would excessive production from any well cause the

prospect of water cone in this area?

A I honestly don't know. Our Model Studies didn't really indicate that, no.

Q You ran those studies to observe the effects of production and the rate of production on water coning because there is a water problem here; is there not?

A Well, there is in some edge wells, yes. That's right. As a matter of fact, I might add that under unitized operation not having to worry about maintaining a competitive position with offsets as the operator in the primary has to do, the unit would be able to control the situation.

That is, if a well that belonged to the unit was producing at a rather high rate and began to give indications that water was coning in, we would be of no necessity to compete particularly with any offset tracts. Therefore, we would be able to reduce that oil rate and produce it from a well which had no water coning problem, was in the thick oil column away from the water-oil contact.

So this is the whole purpose for unitizing this reservoir to gain the flexibility. If we see a well that is inefficient, we can shut that rascal in and transfer its voidage. This is the whole purpose of forming the units, that we are not going to be forced to

produce a well coning water at a higher rate in order to compete with our neighbor.

We have got flexibility. We can move that oil production around in the place where the oil column is the thickest maximized recovery from this reservoir.

MR. MORRIS: I have no further questions.

MR. STAMETS: Are there other questions of this witness?

CROSS-EXAMINATION

BY MR. KELLAHIN:

Q Mr. Christianson, you have set out the Participation Formula in the Unit Agreement. Is it the policy to admit all tracts solely on the basis of this formula?

A Is it the policy to what?

Q Admit the various tracts. Do they have to come in under this Participation Formula or do you make any adjustment in the participation from one tract to another?

A Not at this very meeting. Now, I don't know if someone perhaps at some date could.

Q I'm talking about in the tracts joining the unit as of today. They come in under this formula; is that correct?

A That's right.

Q And you don't make any adjustment from one tract to another in order to induce somebody to come in?

A Not today.

Q How about tomorrow?
A Maybe not ever, but we don't know, but our position is no.
Q That would call for an amendment of your Unit Agreement, wouldn't it?
A I think so, yes. I mean, the participations are set. They have been approved by the USGS. I didn't really understand your question, I'm sorry. The USGS has approved these participation factors and so have the working interest owners.
Q In your Phase 2, you have 33 1/3 percent original oil-in-place and 66 2/3 future reserves. How were these figures arrived at for each tract?
A Yes, sir.
Q How did you arrive at those figures? I don't mean the percentage. I mean, how did you arrive at the amount of oil that would be attributed to each tract?
A To each tract? Well, basically the Engineering Committee as a group studied the reservoir and determined this oil-in-place. That is, representatives from all operators who were interested and asked to participate. We had a great volume of various types of data. We analyzed it and came up with these values.
Q Now, you did use a Reservoir Model Study, did you not?
A Not to determine the original oil-in-place, no, sir.

That was entirely independent.

Q How about your future reserves, your 66 2/3 figure?

A Oh, yes. Oh, yes.

Q Who made that study?

A Amoco made a study and Arco made a study.

Q They are the owners of some 60 percent of the unit?

A Correct. Right.

Q Now, do you have the reserve figures on each individual tract available here?

A Yes.

Q Would it come under Phase 2?

A You mean, what reserve? I've got the fraction which I can multiply. I have some. Go ahead. Which tract?

Q Well, I would like to have the figures on Amoco's Number 71 and Arco Number 37-D. Do you have that?

A Amoco's Number Tract 71?

Q Yes, sir.

A You mean the remaining reserves that they would --

Q Well, their participation on the Phase 2, whatever it might be.

A I don't really have that number as such. I suppose I could take Phase 1 and Phase 2 participations for those tracts and multiply by the recovery.

Q Well, you did give them a participation, did you not, those two tracts?

A Of course, yes. They got a participation, and it's shown in Exhibit C of the Unit Operating Report or Unit Operating --

Q Neither one of them has a well on it, does it?

A I don't know. Let's look. You are probably right, but I don't understand. Let me see. Let's see what tracts you are talking about. Okay. Can you give me the location?

Q I don't have any plats, Mr. Christianson.

A You don't have a copy of the Unit Operating Agreement?

MR. STAMETS: I believe 71 is in Section 31. They are both in 31, in the south half of the northeast quarter of 31.

THE WITNESS: South half of the northeast quarter of what?

MR. STAMETS: Thirty-one. Eighteen, twenty-seven. It looks like 18, 28.

THE WITNESS: Yes, Amoco C. Okay. There is 71. Now, 37-D. Where is that rascal? There is 37-C and D. Well, let me look in the report here. I know what these are. I mean, it's just a question of finding it right there. They are edge tracts that had a little original oil-in-place.

MR. STAMETS: They are both in the south half of that northeast quarter. One is the southwest and the other is the southeast.

THE WITNESS: Thirty-seven?

MR. STAMETS: Of 31.

THE WITNESS: That's 57 from the southwest quarter, northwest quarter. Are you talking about 37 or 57?

Q (By Mr. Kellahin) Thirty-seven D is the one I was talking about.

A That happens to be located in the southeast of the northeast of Section 31. So, well, we can go back to the first, very first exhibit and see why those tracts were given some participation.

Q Could you tell me this? Wasn't there a well drilled on each of those tracts plugged and abandoned?

A Yes, sir. That's right. They are shown on the map.

Q Dry holes?

A Right, but let's look at, I mean, we want to find out where the exhibit --

Q Well, you can come to that later when your attorney asks you the questions. I'd like to go on to another.

MR. STAMETS: I'd like to get to whatever point Mr. Kellahin is trying to make.

A They were given original oil-in-place and original oil-in-place is in the Phase 2 Formula; and therefore, they got participation because there is a little bit of oil-in-place under a corner of each one of these tracts.

Q Do you know whether or not they actually got more credit

under Phase 2 than Penroc's Tract 56 did?

A No, I don't. You mean individually or the two tracts together or what?

Q Each tract individually.

A No. I don't know whether they did or not.

Q Well, your exhibit would show it, would it not?

A Oh, yes. Exhibit C of the report, we can look and see. I presume you have got the numbers or you wouldn't be asking. Are you referring to Tract 56 for Penroc?

Q Yes. The well on that tract according to my figures is making 135 barrels a day.

A That's correct. You mean, are you referring to that well that is deviated down into the corner of the Section B 130 feet from the south line and 150 feet from the east line?

Q I haven't any idea.

A I think that's the well you are referring to.

Q I don't know what that has to do with the question. It is making 135 barrels a day, right?

A That's right. I just wanted to make sure we were talking about the same well.

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

(Whereupon, a discussion was held off the record.)

MR. KELLAHIN: If the Examiner please, I think the witness has said his exhibit will show the allocations to each

one of these tracts; and I'll refer to that and make no further questions.

A Okay. The allocation of Tract 56. You want me to put that in --

Q I'm through asking questions, Mr. Christianson. I am through. You don't need to answer anymore questions.

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

CROSS-EXAMINATION

BY MR. STAMETS:

Q Mr. Christianson, a wide variety of engineering problems and results have been described here; and many times they refer to Numeric Models.

A Yes, sir.

Q And of course, these covered and number these exhibits. Let me qualify here one point. You as a Professional Reservoir Engineer, are you in agreement basically with the various calculations associated with the Numeric Model?

A I certainly am, yes, sir.

Q And you are in agreement with the estimates of additional recovery and so on?

A Yes, sir.

Q Okay. You are familiar with the Numeric Model calculated allowable of 40,192 barrels a day from the Unit Area will

not be harmful to the reservoir and will in fact be less harmful than the current allowable; is that correct?

A Yes, sir. It will. In fact -- You want me to be responsive to that at all?

Q No. I think that that's a sufficient answer there. I'm somewhat concerned about wells located higher on the structure here and whether or not these tracts will be drained. I'm talking about non-participating tracts now, whether these tracts will be drained earlier and will actually lose production by the plan that you have proposed here with injecting gas high to the structure and withdrawing oil lower to the structure.

A Let me say first that we are locating our injection wells subsea. Let's see. You have the exhibit that has the injection wells in green tracts on it. So you can see, I think we are locating the wells well away from any tracts that we feel will be outside the unit. We are also --

Q You don't think the higher rates of withdrawal will have any effect on these non-participating tracts?

A The higher rates of withdrawal will not, no, because we are not, well --

Q Referring to Exhibit Number 8 again in Section 6, Township 18 South, Range 26 East, in the northwest quarter of the northeast quarter there is a well

identified on this exhibit as Shelton, et al.

A You are on which exhibit? I'm sorry.

Q Well, Exhibit Number 8. I think practically any of the pool exhibits will catch that well.

A Now, will you lead me back to that well?

Q It's in the northwest quarter of the northeast quarter of Section 6, 18 South, 28 East.

A The northeast quarter of the northeast quarter.

Q Northwest of the northeast.

A Oh, yes. All right. Mr. Shelton's.

Q Right.

A That's right. Yes, sir.

Q And according to this Exhibit Number 8, that is one of the non-participating tracts?

A We believe that's probably true, yes, sir.

Q That's surrounded by edge participating tracts?

A Yes.

Q Okay. Conceivably each one of these tracts could have a well on it providing twice the current top allowable?

A That's right.

Q Under that situation, will oil be drained from Mr. Shelton's tract and he be deprived of producing, or his chance to produce the oil-in-place under this tract?

A No.

Q This is based on the --

A Not, there will be no deprivation due to producing 284 barrels a day from these wells. Would you like me to answer why or would you rather I not?

Q Well, yes, in just a second. Let me ask one more question first. Have you made an analysis such as -- Never mind. Tell me why.

A You have to get your orientation away from, you know, we look, most of what we look at are solution gas drive reservoirs, right? And I will agree with you that the recovery there is very sensitive to rate, and this is the way our rules have been set up; but what we are talking about here is a gas-oil contact which moves down structure. And this is what determines the recovery from a well.

First, the movement of the cap down structure is what finishes off a well, because what we have got here is a reservoir that is well communicated both vertically and horizontally. Okay. Now, as a further corollary of this in terms of just simply voidage straight out, voidage per well, because the unit is reinjected 70 percent of its produced gas.

On the average, it's voiding much less sputtage per well at 284 barrels a day than is an offsetting well producing at 142, because essentially we are reducing net voidage from unit wells by this reinjection of 70-odd

percent of the produced gas. Of course, the people that stay out of the unit are not participating in this, and they are not sharing in the expenditures, anything like this; but it will be the gas-oil contact which will gas out Mr. Shelton's well, not what we produce immediately offsetting him.

Q Now, you have shown on one of these exhibits twenty-six year life under primary production, twenty-four life under this unitized program.

A Yes, sir.

Q You think it will be practical to operate this unit for twenty-four years?

A This is actually, well, I don't know. This is a twenty-four year total life. We assumed operation throughout. In other words, we ceased operating when we no longer could pay operating expenses in our projects. There was abandonment conditions.

Q I just wondered how much this might affect the ultimate recovery and the ultimate additional recovery in here if after ten years the economics of the situation deteriorated and you ceased to produce it this way. How much of this extra 30,000,000 barrels of oil would still be in the ground on recovery?

I didn't make myself clear on that. Let me describe what I mean. In order for you to recover the

full 30,000,000 barrels that you foresee here, you have made this calculation based on operating the unit to depletion, the twenty-four year life of the field. How much of this extra 30,000,000 barrels is produced in those last years where it might reasonably shut down because of economics. It might get too expensive to operate.

A Actually very little. One or two percent, but the fact is we didn't shut it down till it became uneconomical. Can I discuss a little bit how this thing will go, I mean, how our model projections and our reservoir studies--

Q Yes. I'd like to have that information.

A Well, essentially what you do, you start replacing, well, you reduce voidage by 60 percent or so because you are reinjecting 70 percent of your produced gas, you see. That gas reduces the voidage from the reservoir. The effect of the reduction in voidage is to flatten the pressure decline.

In other words, the pressure is declining with time, as one of our earlier curves showed it. This curve will flatten in slope after you start injecting this gas and in fact it will happen virtually immediately to some extent. Okay. You go along and you continue to produce under unitized operation from the most efficient wells, the wells located where the oil column is the thickest.

You continue to do this throughout the life. You

allow the gas cap then to move uniformly down structure displacing this oil that is draining down to the low structure wells continually. At some point, and it's very near the end of the whole project, your gas-oil ratios get so high that it's uneconomic to continue injecting gas.

You are just producing too much gas because you have gradually moved your gas cap down until it's gassing out the very lowest structural wells. At this point, you have swept with your gas injection. You have allowed to drain down structure oil. You are at blow-down. That's what Reservoir Engineers call it.

And so you blow the reservoir down to a pressure as low as you can get it. And as long as gas is coming out, you are selling that gas. And so you continue to produce it right on down to a very low pressure. You deplete the reservoir in other words. But by this time your relative permeability situation is such that you are producing virtually all gas, you see, and very little oil continues to drain at this time.

Anyway, of course, the 30,000,000 barrels is a result of a calculation which projected this type of performance; and we would never abandon the reservoir until we were probably down to an extremely low pressure, because we would still be making money.

Q I believe that answers the question I had in mind.
A Okay.
Q I believe you indicated you did not use the model for calculations of oil-in-place; is that right?
A That's right. That's strictly determined from log analysis, core data, everything we could lay our hands on by the Engineering Committee as a group with all companies who wish to participate being represented by engineers and geologists working together to come up with this.

MR. STAMETS: Are there other questions of this witness? He may be excused. Mr. Hinkle, does that conclude your testimony?

MR. HINKLE: I believe it does. That's all we have to present.

MR. STAMETS: I believe we had another witness sworn. You are not going to put him on?

MR. MORRIS: No.

MR. STAMETS: Are there any other appearances in this case? Does anybody wish to put on testimony? We will call then for statements.

We have got a whole flock of telegrams. Let us read those first and then everybody can get organized while we are doing that.

MR. CARR: The text of all of these are virtually

the same. I will read one and read the names of those who sent us the various wires. It reads, "As a working interest owner on State-owned lands in the Empire-Abo Field, I object to the formation of the unit under the present participation factors. My interest and the State's royalty would be reduced approximately one-half under the proposed factors." It is signed Edward Egbert.

We have also received them from Hanover Planning, Incorporated; Hanagan & Hanagan; Penroc Oil Corporation; Monroe Roberts; W. V. Roberts; B. W. Broaddus; J. F. Pritchett; Clarence H. Albaugh; John C. Ryan; Jean Blanc and James Blanc; Bruce Clampton; Joe D. Denton; and F. M. Late Oil Company.

And also, Walter Crockett, Bill J. Rogers, and Cactus Drilling Corporation.

MR. STAMETS: Mr. Kellahin, I believe you stood for a statement.

MR. KELLAHIN: If the Examiner please, Jason Kellahin, Kellahin & Fox, Santa Fe. I entered my appearance. I'm representing Cities Service Oil Company, Samedan Oil Corporation, Penroc, C & K, Fred Turner, and V. P. Shelton. Needless to say my clients are less enchanted with the Participation Formula than are Arco and Amoco. And while we do not object to the formation of the unit and we eventually feel that such a procedure is necessary, we do object to the Participation Formula.

Cities Service Oil Company operates 11 wells on seven leases in the proposed Empire-Abo unit.

Cities Service is not opposed to unitization nor to the proposed pressure maintenance project. As of this date, Cities has not committed any of its operated leases to the unit but believe certain safeguard rules should be included in an order to protect the non-unitized leases.

Cities feels that it is the duty of the Oil Conservation Commission to protect correlative rights of the non-unitized leases and offers the following: Number 1. No producing wells direct or diagonal offsets to non-unit wells should produce more than a normal forty-acre allowable for the field unless the operator of the non-unit well signifies no objection by waiver and the transfer of additional allowable be approved by the New Mexico Oil Conservation Commission.

Number 2. Injection wells should be located at least two regular locations from a non-unit lease unless the operator of the non-unit lease indicates no objection by waiver and the injection location is approved by the New Mexico Oil Conservation Commission.

I believe there is one of Arco's witnesses who testified that this is the procedure that they propose to follow, but we would ask that it be included in the order.

Samedan Oil Corporation signed by the other operators whom I am representing feel that they would suffer a

serious loss by joining this unit.

If Samedan Oil Corporation were to join the proposed Empire Abo Unit, it would suffer both loss of ultimate and current income. Samedan's interest in the proposed Unit is in Tracts 49 and 79 as shown on Exhibit "B" of the Unit Agreement (1-1-72). Atlantic Richfield's study indicates the following: Tract 49, Samedan-Walker State No. 1, Royalty Owner - State of New Mexico, had primary oil reserves on 1-1-73 of 400,379. Tract 79, Chambers & Kennedy-Abo No. 1, Royalty Owner - State of New Mexico, had primary Oil Reserves in 1-1-73 of 404,385. These are Atlantic Richfield's remaining primary oil reserves (1-1-71) less 1971 and 1972 oil production.

Samedan's share of this forecasted reserve is 347,652 barrels of oil.

Samedan's share of the unitized reserve under the proposed participation is 335,946 barrels of oil which includes the company's share of the predicted 30.1 million barrels of incremental secondary oil.

Samedan would be required to invest $20,615.00 in the unit operation to recover 11,706 less barrels of oil.

Phase I is defined as the first eleven (11) million barrels of oil produced after the effective date of the Unit. According to the updated Engineering Report furnished by Atlantic Richfield on November 21, 1972, Phase I will have a duration of 9.5 months. We estimate our two (2) wells to be

top allowable for another 3.75 years before commencing decline. During this 3.75 year period Samedan will lose 47,882 barrels of oil by joining the Unit.

Therefore, Samedan has no incentive to join this Unit and wishes to register opposition to its formation under the formula that has been adopted.

The quality of the reef pay varies widely across the length of the reservoir as depicted by the thirteen (13) bands that were used in the model studies. Permeability, or the capacity to produce, ranges from 12 to 195 millidarcies from west to east. It is noted that forty-seven percent (47%) of the total tracts and thirty-eight percent (38%) of the productive tracts inside the Unit outline are not capable of producing top allowable as set out in the annual "Report of the New Mexico Oil and Gas Engineering Committee" for the Calendar Year of 1971. The majority of the future productivity must come from an area between the west edge of Section 2, Township 18 South, Range 27 East and the Center of Section 25, Township 17 South, Range 29 East. Allowable transfers will hasten the recovery from this area as migration of oil continues. Anyone owning an interest in a well in this area not receiving sufficient incentive to join the proposed Unit could not protect their correlative rights with the increased withdrawals due to allowable transfer. Likewise, normal migration of oil would be severely altered resulting in loss of ultimate oil

recovery by a non-unit well.

Further damage would be experienced if gas injection were permitted in the vicinity of a non-unit well due to gas coning. This gas coning concept was developed in the Engineering Report in arriving at maximum safe oil producing rates as well as predicted future oil reserves.

We ask that this Commission give due consideration to approving the items of recommendation set out below as protection to those Royalty and Working Interest Owners not having sufficient incentive to join the proposed Unit.

We make the following recommendations:

1. All unit wells which directly or diagonally offset any non-unit well, all of which are producing from the same common source of supply, be restricted to produce an amount of oil equal to the top well allowable.

2. Top unit allowable shall be equal to the sum of the individual unit well allowables providing the allowable assigned to any well which is shut-in, which allowable is to be transferred to any well or wells in the unitized project area for production, shall in no event be greater than its ability to produce during the final 24-hour period of a 72-hour test, or greater than the current top well allowable for the pool during the month of transfer, whichever is less.

3. The injection of gas into any unit well not be permitted within 2,640 feet in any direction from the boundary

of any non-unit tract.

4. The following be made a provision and included as part of the Commission Order: If it is apparent, as pointed out by any non-joining party, that correlative rights are not being protected, that the Commission agree to consider what other measures are necessary for such protection.

I think that states the position of a number of non-participating operators in this pool; and as read off by Mr. Carr, I believe there were some 18 that have seen fit to file telegrams on this. And I ask that the Examiner give consideration to these objections.

MR. MORRIS: If the Examiner please, Signal Oil and Gas Company also recognizes the desirability of unitizing this pool. We find ourselves in the position of being opposed to unitization in its present form and under the Unit Participation Formula as proposed in the presently proposed Unit Agreement as presented here today by Atlantic Richfield. For this reason, we are opposed to the Commission's approval of the unit or of the pressure maintenance project at this time.

We think it apparent that the correlative rights of all operators in this pool have not adequately been considered in the proposed Allocation Formula. We believe this is very obvious through the admission finally of Atlantic's witness that the interests of Signal Oil and Gas Company under the proposed Participation Form a would be 300,000 barrels of

oil less than what Signal could expect to receive from primary production continued ununitized.

We think as a minimum, we should be allowed to join a unit under a Participation Formula that would allow us to at least produce that which we would be entitled to produce under continued primary operations. We would observe that Atlantic has not provided the Commission with any evidence concerning the extent of the correlative rights of the various operators involved in this proceeding, and we submit that the Commission does not have sufficient evidence in the record before it upon which it can approve the proposed Unit Agreement and pressure maintenance project, because it is the Commission's duty to protect correlative rights. And there is no evidence in the record to define what the correlative rights of the parties are.

Should the Commission determine to approve the Unit Agreement, we concur with the recommendations that were read by Mr. Kellahin on behalf of Samedan Oil Corporation, his recommendations 1, 2, 3, and 4. Thank you.

MR. LOSEE: Mr. Examiner, I earlier appeared for Yates Petroleum Corporation and its related interests. At this time, they have not ratified the Unit Agreement; and they hold approximately 5 percent of the Participation Formula under Phase 1 and Phase 2. Yates does not oppose the unitization in principal, but at this point in time a problem remains unsolved

to which we would like to call the Commission's attention.

Arco conducted a study which found that it would be more economic for the working interest owners to unitize the field without gas injection than it would be with gas injection. The requirement or the proposal here to inject gas into the reservoir through seven or eight wells is a requirement of the United States.

The problem arises by virtue of the fact that the two gas plants in the area, one, the Abo Plant, owned 50 percent by Arco and 50 percent by Amoco, who are 64 percent interest owners in the unit; and they take two-thirds of the gas presently from the unit; and the Phillips Plant takes the balance.

Under existing contracts each of these plants are only required to deliver residue gas for repressuring at somewhere between 15 and 25 pounds, although these plants do operate at and can deliver the residue gas at 700 pounds without any further compression. Now, although Yates has brought this matter to the attention of the Unit Operator in an effort to find a solution to get a satisfactory contract or a proposal whereby the unit takes over the Abo Plant, at this point in time, no solution has been offered. There is no protection for the other working interest owners who have committed their interest that gas for repressuring can be furnished at a reasonable price.

Until this protection is offered or a solution is found for this problem, Yates will not be in a position to ratify the unit.

MR. STAMETS: Are there other statements? Mr. Landis?

MR. LANDIS: If it please the Examiner, the working interest owners of the Empire-Abo Field have worked together now voluntarily and diligently for a period of five and one half years to provide a depletion program for this reservoir of highest order of conservation. The Amoco Production Company supports Atlantic Richfield Company's application in these efforts and urges this Commission to speedily approve the project as presented here today in the interest of preventing waste of the reservoir and increasing ultimate recovery. Thank you very much.

MR. STAMETS: Are there other statements?

MR. HINKLE: I think that all of the telegrams that were read and all of the protests that have been here represent the owners of the 7 percent which are shown on Exhibit A in green which is 21 forty-acre tracts and consists of 840 acres.

Now, as Mr. Landis has pointed out, this has taken a long time to get this unit together. And the evidence shows that there were some 56 formulas considered, and every opportunity was given to the representatives of the working interest owners to participate in these meetings and to reach an agreement. This is a large unit, contains 11,339 acres and

it would be a miracle really if you could get all of the owners to agree 100 percent.

I think they have done real well to get the owners to agree as far as they have. As the evidence shows, it's anticipated that as a final result there will be approximately 93 percent of all of the acreage committed to the unit. It clearly shows that by unitization there will be an additional recovery of some 30,000,000 barrels.

Now, as I see it, the prerogative of the Commission is only to approve the Unit Agreement as a conservation measure and to find that the application for the injection of gas and pressure maintenance is fair and reasonable and will not violate correlative rights. It's not grounds for this approval that some of the parties did not want to join in the unit. That's a privilege which is open in connection with any unit so long as we do not have forced unitization in the State.

So this is something they can do or not do. They have an opportunity to join. They have been invited to join and given every opportunity to participate; but if they want to stay out, of course, that's their privilege; but I do not believe that this small percentage of 7 percent should cause the Commission to turn down their approval of the unit and of the pressure maintenance which would in effect commit the waste of 30,000,000 barrels of oil. That's all.

MR. STAMETS: Okay. Are there no other statements?

We will take the case under advisement.

REPORTER'S CERTIFICATE

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

Janet Russell
COURT REPORTER

I N D E X

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 4952-4953 heard by me on April 25, 1973.

Richard L. Stamets, Examiner
New Mexico Oil Conservation Commission

United States Department of the Interior

GEOLOGICAL SURVEY
WASHINGTON, D.C. 20242

AUG 10 1972

Atlantic Richfield Company
P.O. Box 1610
Midland, Texas 79701

Attention: Mr. R. E. Howard

Gentlemen:

Your application of November 18, 1971, revised by letters of January 14, 1972, and July 7, 1972, filed with the Area Oil and Gas Supervisor, Roswell, New Mexico, requests the designation of the Empire Abo unit area embracing 11,339.15 acres, more or less, Eddy County, New Mexico, as logically subject to operation under the unitization provisions of the Mineral Leasing Act, as amended.

Unitization is for the purpose of conducting more efficient operation with partial pressure maintenance by the injection of residue gas and will be limited to the Abo formation as defined by Section 2(h) of the unit agreement. You estimate that such operations will result in the recovery of approximately 30,000,000 barrels of additional oil.

The land requested, as outlined on your plat marked "Exhibit A, Empire Abo unit, Eddy County, New Mexico," is hereby designated as a logical unit area. In order that the land now included in the Chalf Bluff unit area may be incorporated into the Empire Abo unit agreement, the Chalf Bluff unit agreement should be terminated.

Your proposed form of unit agreement will be acceptable if modified as indicated. One marked copy of the form is returned herewith, one copy is being retained, and one copy is being sent to the Oil and Gas Supervisor, Roswell, New Mexico. We hereby concur in the Supervisor's recommendation that the proposed basis for allocating unitized production be accepted.

The format of the sample exhibits attached to the 1968 reprint of the Form of Unit Agreement for Unproved Areas should be followed closely, including the latest status of all acreage, in the preparation of Exhibits A and B.

In the absence of any objection not now apparent, a duly executed agreement conformed to the returned copy and approved by the appropriate officials of the State of New Mexico will be approved if submitted in approvable status within a reasonable period of time. However, the right is reserved to deny approval of any executed agreement that, in our opinion, does not have full commitment of sufficient lands to afford effective control of operations in the unit area.

As the unit area contains State of New Mexico lands, we are sending a copy of this letter to the Commissioner of Public Lands of the State of New Mexico in Santa Fe. Please contact the State of New Mexico before soliciting joinders, regardless of prior contacts with or clearance from the State.

Sincerely yours,

Acting Director

State of New Mexico

Commissioner of Public Lands

August 30, 1972

ALEX J. ARMIJO
COMMISSIONER

P. O. BOX 1148
SANTA FE, NEW MEXICO

Atlantic Richfield Company
P. O. Box 1610
Midland, Texas 79701

Re: Proposed Empire Abo Unit
Eddy County, New Mexico

ATTENTION: Mr. W. L. Embry

Gentlemen:

We have reviewed the proposed unexecuted copy, as well as the modified copy by the USGS and exhibits for the captioned unit and find that it meets with the requirements of the Commissioner of Public Lands, therefore, the Commissioner approves the proposed agreement for the Empire Abo Unit as to form and content.

Your Exhibit "B" requires the following changes.

TRACT NO.	CHANGE TO BE MADE
48	Sec. 31-17S-27E(should be 28E)
56	Sec. 28-27S-28E(should be 17S)
57	Sec. 31-17S-27E(should be 28E)
64	Sec. 31-17S-27E(should be 28E)

Upon submitting this unit for final approval the following are required by this office:

1. Two executed copies of Unit Agreement-one must be an original
2. One copy of Operating Agreement
3. Two sets of all Ratifications from Lessees of Record and Working Interest Owners-one copy must be an original
4. Order of the Oil Conservation Commission
5. Initial Plan of Operation

6. Filing Fee in the amount of Three-Hundred ($300.00) Dollars.
7. Re-designation of wells

In your final application we would also like for you to state all tracts qualified and verification that the Working Interest in the qualified tracts have been contacted and requested to join. Also, state all tracts committed and not committed to the unit.

If we may be of further service please do not hesitate to call on us.

Very truly yours,

Ray D. Graham

RAY D. GRAHAM, Director
Oil and Gas Department

AJA/RDG/s

AtlantichfieldCompany
North American Producing Division
Permian District
Post Office Box 1610
Midland, Texas 79701
Telephone 915 682 8631

Ex. 6

BEFORE EXAMINER STAMETS
OIL CONSERVATION COMMISSION
App. Exhibit No. 6
CASE NO. 4952 & 4953
Submitted by ARCO
Hearing Date 25 April 1973

April 25, 1973

United States Department
of the Interior
Geological Survey
P. O. Drawer 1857
Roswell, New Mexico 88201

Attention: Mr. N. O. Frederick (6)
Oil and Gas Supervisor

State of New Mexico
Mr. Alex J. Armijo
Commissioner of Public Lands
P. O. Box 1148
Santa Fe, New Mexico

Attention: Mr. Ray D. Graham, Director (3)
Oil and Gas Department

State of New Mexico
Oil Conservation Commission
P. O. Box 2088
Santa Fe, New Mexico

Attention: Mr. A. L. Porter, Jr. (3)
Secretary Director

Working Interest Owners
Empire Abo Unit
(see attached address list)

Re: Initial Plan of Operation
Empire Abo Unit
Eddy County, New Mexico

Gentlemen:

In compliance with Section 11 of the Unit Agreement, Empire Abo Unit, Eddy County, New Mexico, Atlantic Richfield Company, as

Unit Operator on behalf of itself and the other participating working interest owners, hereby submits for your approval a Plan of Operation to cover the period beginning with the effective date of the Unit Agreement and extending through the remainder of calendar year 1973.

Yours very truly,

ATLANTIC RICHFIELD COMPANY
OPERATOR

P. E. Fletcher
Operations Manager

PEF/SHC/jrb

INITIAL PLAN OF OPERATION
EMPIRE ABO UNIT

1. Project Area

History and Background

The Empire Abo Unit area consists of some 11,339.15 acres in Eddy County, New Mexico (see attached plat, Exhibit 1). The area is located in portions of sections 34, 35, 36 Township 17 South, Range 27 East; sections 1, 2, 3, 4, 8, 9, 10, 11, 12, 15, 16, 17 Township 18 South, Range 27 East; sections 25, 26, 27, 28, 31, 32, 33, 34, 35, 36 Township 17 South, Range 28 East; sections 4, 5, 6 Township 18 South, Range 28 East; sections 29, 30 Township 17 South, Range 29 East. Within the Unit Area, owners of the following tracts have chosen not to participate in the unit: 2,6,42,46,49,55,56,69,73C,77,79,84,91. These non-participating tracts total ~~684.84~~ 840 acres. The remaining ~~10,654.31~~ acres is to be developed as a project area for pressure maintenance by injection of plant residue gas from Abo production back into the Abo formation.

The Abo producing zone is found at an average depth of about 5800 feet (see attached type log, Exhibit 2). The Abo is a lower Leonard (Permian) carbonate reef which has undergone complete dolomitization. Vugs, fractures and fissures have been observed in cores throughout the main reef, with local anhydrite infilling sometimes restricting flow. Reef development is long (12 1/2 miles) and narrow (1 1/2 miles). The reef crest dips about 1° from southwest to northeast. Average gross reef thickness is about 300 feet, ranging to the maximum of 732 feet on the Amoco State AT No. 1 (L2-18S-27E).

On the up-dip west and southwest end of the reservoir productive limits are the result of anhydrite deposition, while on the back-reef north side there is a facies change to an impermeable carbonate "mud" interspersed with green shale. Limits to the south, east and northeast result as the top of the reef dips below the oil-water contact.

2. Current Production, Future Recovery

The original discovery well was the Amoco Malco Federal A No. 1, located in the NE NW Section 11, T-18-S - R-27-E, completed in November 1957.

At the present time the Pool has 235 producing wells. Of these, 153 are capable of producing more than the current top allowable of 142 BOPD/well. There are 183 flowing wells. Field performance and detailed study of cores indicate excellent vertical permeability. The principal producing mechanism is gravity drainage with an expanding secondary gas cap. There are 22 operators in the field and 112 separate working interest owners.

In January 1973, Abo Pool total oil production averaged 25,625 BOPD with 9% water production and gas oil ratio 1,366 cu. ft./BO. Cumulative oil production from the pool is 90 MMBO to February 1, 1973. Remaining primary after February 1, 1973, based on ARCO numeric model studies, is estimated to be 83 MMBO. Unitized residue gas injection for pressure maintenance is calculated to increase future recovery by about 30 MMBO compared to continued primary operations.

3. Basic Concepts Governing Future Unit Operations

a) Field production history and reservoir numeric model studies have demonstrated that reservoir recovery is governed by a gravity drainage mechanism. With unitization, the operator will be able to maximize beneficial effects of this most efficient recovery mechanism by careful observation of well performance and shutting in or curtailing production from inefficient wells.

b) Injection of plant residue gas will act toward pressure maintenance and orderly control of expansion of the secondary gas cap.

4. Special Rules

a) Unit Allowable

1st Step - Starting on the effective date of the unit, the unit will receive a unit allowable, calculated so that Unit Area reservoir voidage will not exceed average daily reservoir voidage rate for 1972. This will result in an increase from current 23,600 BOPD to about 30,000 BOPD for the Unit Area.

2nd Step - to be effective with the start of gas injection. Unit Area allowable to be 40,192 BOPD. Reservoir numeric model studies demonstrate added recovery and no reservoir waste at this rate.

b) Provision to produce the unit allowable from the most efficient wells without restriction. The only exception will be where a Unit producing well offsets a non-unit well.

c) Provision that if any unit well is located within 660' of a non-participating tract on which is located an Empire Abo producing well, such unit well will be allowed to produce no more than two times normal unit allowable for the Empire Abo Pool.

d) Provision for administrative approval of additional injection wells, or changes in injection well locations.

5. Operating Plans for 1973

Initially gas injection will be into the Abo gas cap in the following eight wells (see plat Exhibit 1):

Current Operator	Lease & Well	Location
Exxon	Chalk Bluff Draw Unit "A" No. 4	NE/4 NW/4 Sec.9-T18S-R27E
Amoco	Windfohr Federal No. 4	NW/4 SE/4 Sec.4-T18S-R27E
Amoco	Malco "H" Federal No. 2	SE/4 NE/4 Sec.3-T18S-R27E
M.YatesIII	Dooley Abo State No. 2	NW/4 SE/4 Sec.36-T17S-R27E
Amoco	State "BM" No. 1	NE/4 SW/4 Sec.31-T17S-R28E
Amoco	State "BV" No. 1	SW/4 NW/4 Sec.32-T17S-R28E
Arco	M. Yates B (ARC) No. 8	SW/4 NE/4 Sec.33-T17S-R28E
Hondo	State "A" No. 21	NE/4 SW/4 Sec.26-T17S-R28E

Attached Exhibit 3 is an example of an injection well log, while Exhibit 4 is a schematic diagram of a typical mechanical setup for an injection well.

Maximum gas injection volume into all wells is estimated at 37,000 MCF/Day. In terms of reservoir space fill-up, this is equivalent to over 60,000 barrels of water injection per day. Plans are to pick up residue gas at about 700 psi and compress it to 2000 psi for injection. The gas will contain hydrogen sulfide. Superdehydration facilities are planned in order to minimize possible corrosion.

A rigorous corrosion checking procedure will be maintained.

A regular and comprehensive well-testing program will be followed to maintain reservoir control and aid in determining optimum operating conditions.

Workovers: Wherever well production data and reservoir conditions so indicate, workovers will be performed to lower gas-oil or water-oil ratios and maximize producing well efficiencies.

Facilities for produced water gathering and reinjection will be constructed.

Atlantic Richfield Company, as unit operator, will act prudently to preserve all rights of the mineral owners and to effectively and efficiently recover the unit area reserves. This Company will meet all economical offset obligations and act to prevent undue waste.

Modifications - It is understood that to meet changing conditions, this Plan of Operation may be modified from time to time, with the approval of the Supervisor, the Commissioner of Public Lands of the State of New Mexico and the New Mexico Oil Conservation Commission.

Effective Date:

This Plan of Operation shall be effective July 1, 1973.

If this Plan of Operation meets with your approval, please indicate in the space below and return one copy for our files.

Yours very truly,

ATLANTIC RICHFIELD COMPANY
OPERATOR

P. E. Fletcher
Operations Manager

PEF/SHC/jrb

APPROVED BY: _____ Date: _____
Supervisor of United
States Geological Survey

APPROVED BY: _____ Date: _____
Commissioner of Public
Lands, State of New Mexico

APPROVED BY: _____ Date: _____
Secretary-Director
New Mexico Oil Conservation
Commission


R27E
T 17 S
T 18 S
EMPIRE GASOLINE PLANT
MALCO - FEDERAL
MALCO-FED
EMPIRE ABO
MARTIN YATES DOOLEY ABO
CITIES SERVICE RUSSELL
CITIES SERVICE HUDSON
AMOCO
HUMBLE
GULF
ARCo
FRANKLIN ASTON & FAIR
SIGNAL
SUN
YATES
KERSEY
RAMAPO
TURNER
WILBANKS
R G COX
MAGRUDER
HARBOLD TRIGG
FEDERAL
STATE
MALCO
SHELDON
TENNECO
EDDY
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18

R 28 E

R 29 E

T 17 S

T 18 S

28 | 27 | 26 | 25 | 30 | 29 | 28

33 | 34 | 35 | 36 | 31 | 32 | 33

4 | 3 | 2 | 1 | 6 | 5 | 4

9 | 10 | 11 | 12

16 | 15 | 14 | 13

UNIT OUTLINE

KNOX | YATES | AMOCO "BZ" | A.R.Co | A.R.Co. | CONTINENTAL | GEN AMER | GEN AMER

PENROC | AMOCO "BW" | CHAMBERS KENNEDY | HUMBLE "BK" | LEPCO | CONTINENTAL

A.R.Co "B" | A.R.Co EDDY | AMOCO "BT" | AMOCO "BY" | SUN "V" | A R Co

AMOCO "BU" | AMOCO "BS" | AMOCO "BX"

AMOCO "BG" | A.R.Co "A" | CHAMBERS & KENNEDY "H"

HUMBLE "BE" | SER

LEGEND

- UNIT BOUNDARY
- ⑦ TRACT BOUNDARY / TRACT NUMBER
- PT PARTIAL TRACTS
- RESIDUE GAS LINES
- PROPOSED GAS INJECTION WELLS

EMPIRE ABO UNIT

EDDY COUNTY, NEW MEXICO

PROPOSED GAS
INJECTION WELLS AND LINES
UNITIZED RESIDUE GAS INJECTION

DATE: 3-27-73

0' 1320' 2640' 5280'

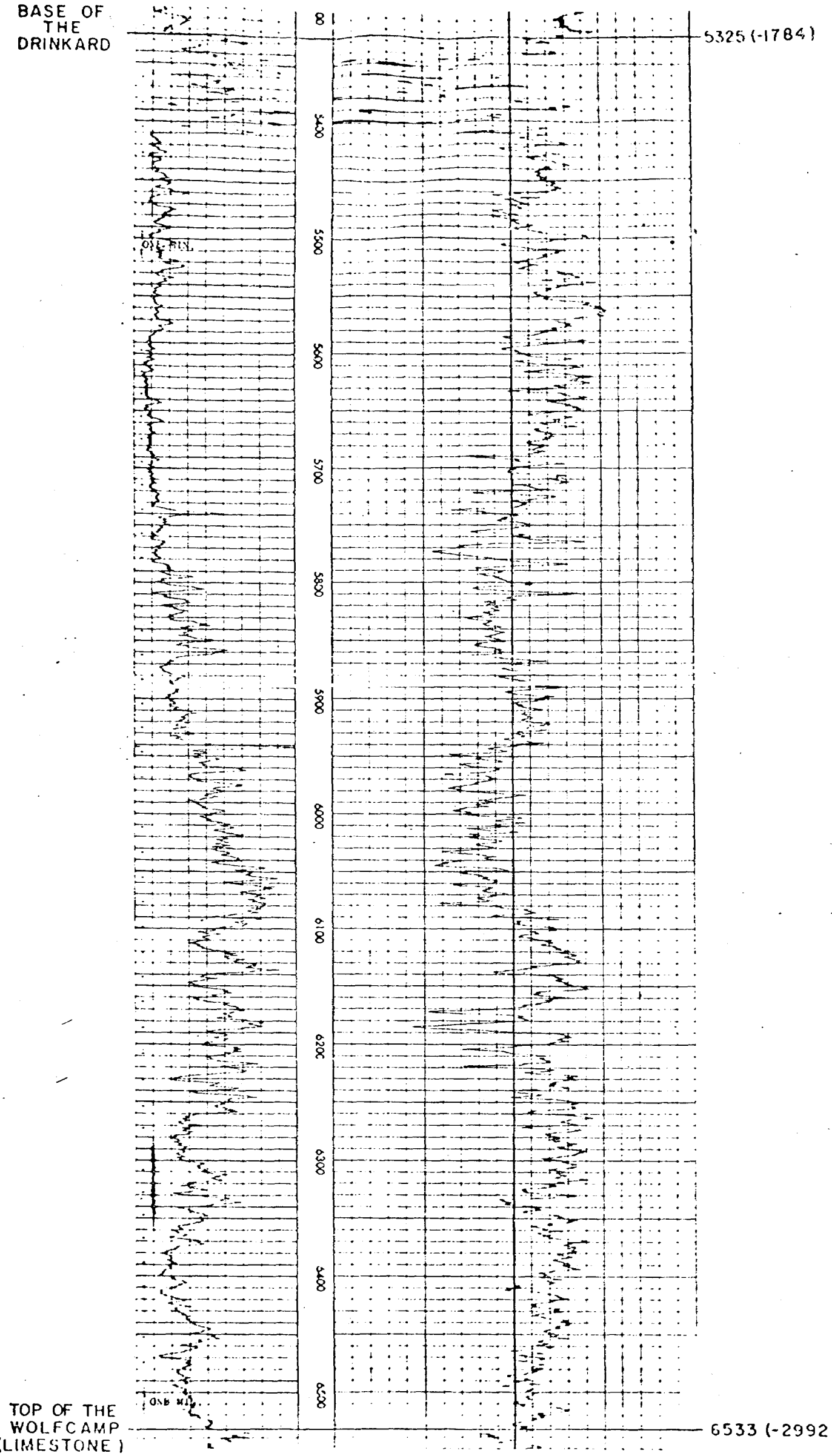
AMOCO PRODUCTION COMPANY

State AU No. 1

1980' FSL & 1830' FWL SEC. 2, T-18-S, R-27-E

EDDY COUNTY, NEW MEXICO

RADIOACTIVITY LOG



ATLANTIC RICHFIELD COMPANY

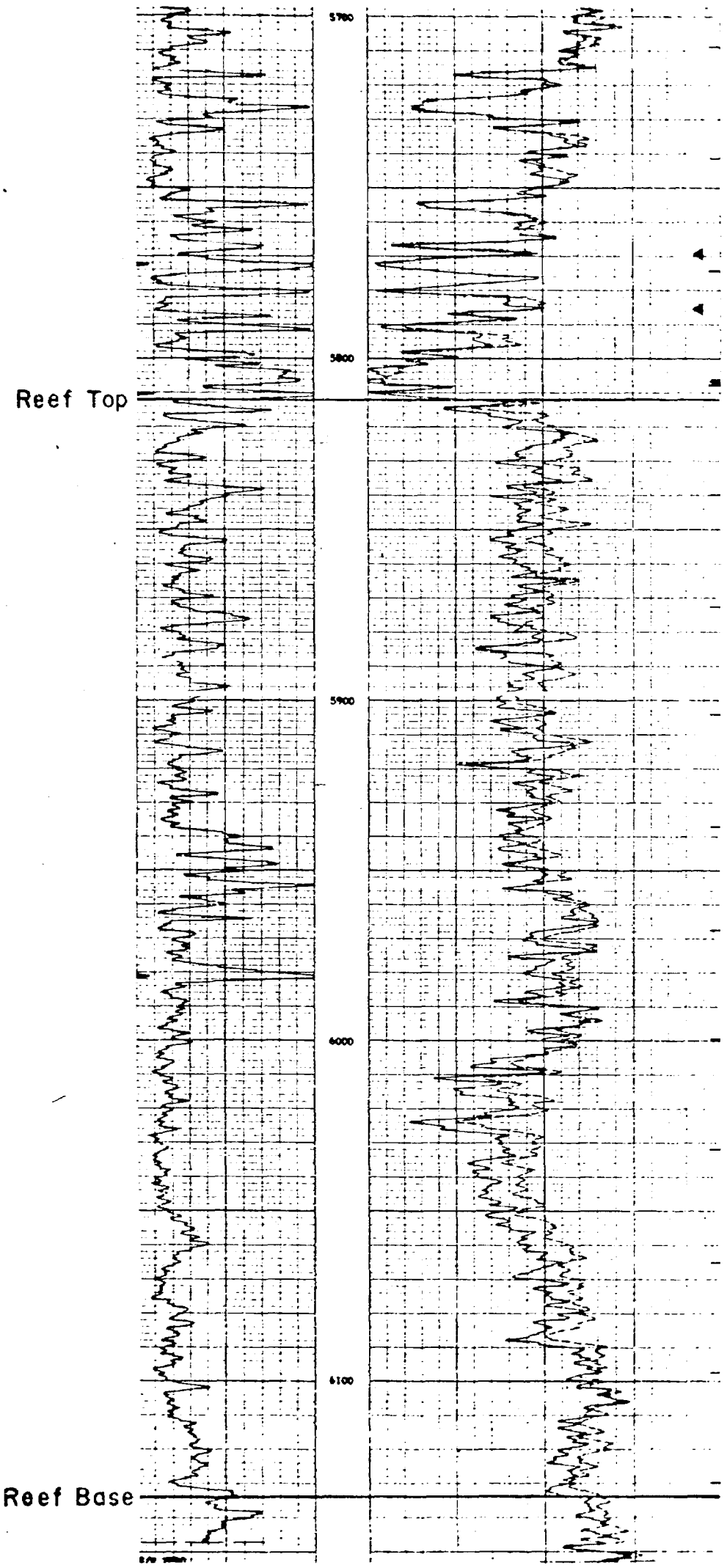
M. Yates "B" (ARC) Well No. 8

1980' FNL & 2130' FEL SEC. 33, T-17-S, R-28-E

EDDY COUNTY, NEW MEXICO

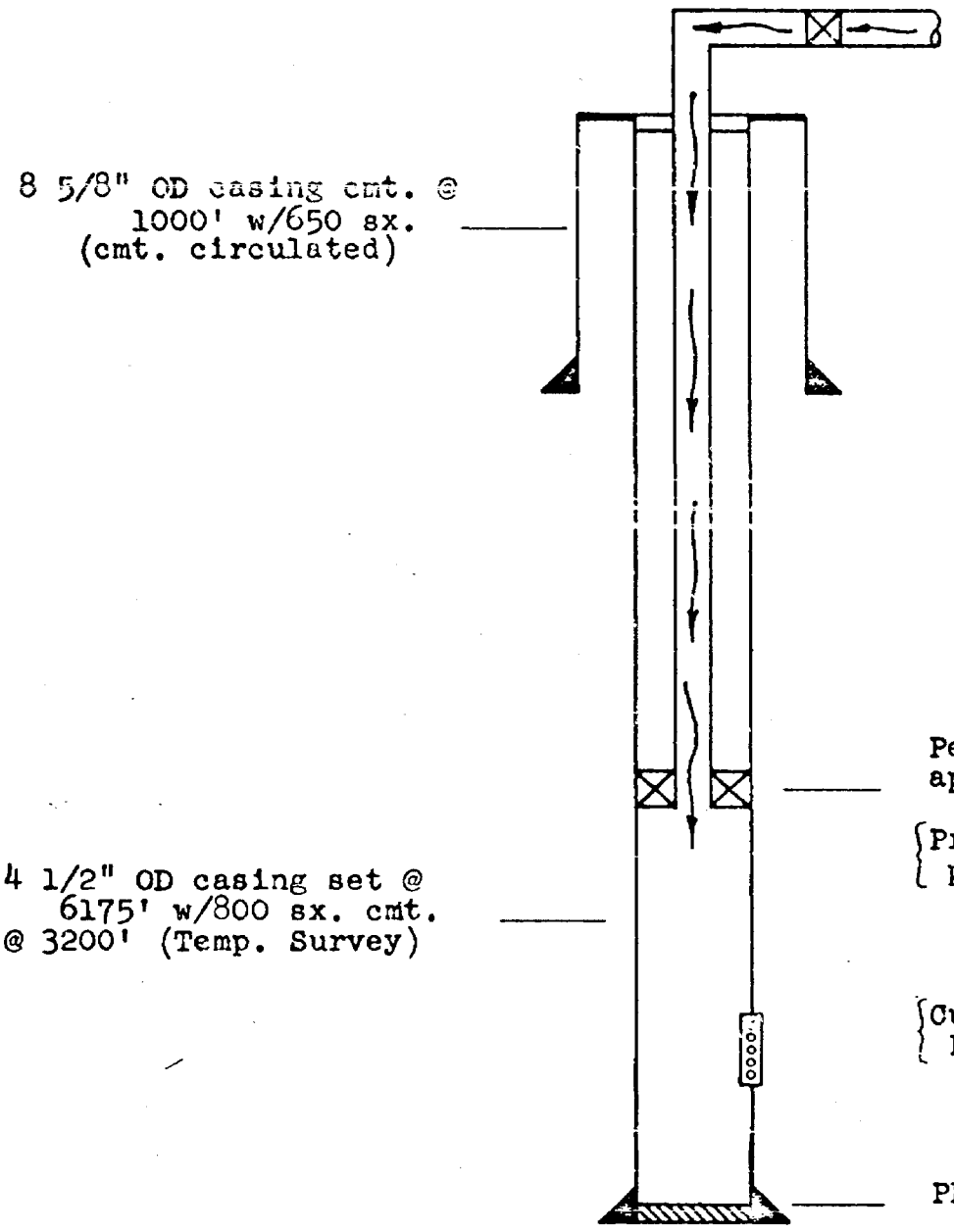
GAMMA RAY – ISOTRON

LEA ABC UNIT
PLAN OF OPERATION
EXHIBIT 3



EMPIRE ABO UNIT
PLAN OF OPERATION
EXHIBIT 4

ATLANTIC RICHFIELD COMPANY
M. Yates "B" (ARC) Well No. 8
1980' FNL & 2130' FEL SEC. 33, T-17-S, R-28-E
EDDY COUNTY, NEW MEXICO
INJECTION WELL DIAGRAM



Case 4953

EXHIBIT NO. _____

EX. 7

To: N.M.O.C.C. Dist. II (3)
P. O. Drawer DD
Artesia, New Mexico 88210
Attn: Mr. W. A. Gressett

EMPIRE ABO PRESSURE MAINTENANCE PROJECT

(N.M.O.C.C. ORDERS , .)

ATLANTIC RICHFIELD COMPANY - OPERATOR

MONTHLY REPORT FOR March, 19 74

PROJECT AREA: EMPIRE ABO UNIT

Total Requested Allowable for June 1974 is 3700 BOPD.

Sheet A

(1)	(2)	(3)	(4)					(5)				(6)			(7)	(8)	(9)	(10)	(11)
Empire Abo Unit			Well Test Data - Latest 24-hr.					Production-Average March 1974 Top Well Allow. BO				Injection-Average March 1974			Voidage Avail. for Trnsfr.[1]	Requested Voidage Transfer	Net Void. @ Normal Unit Allow.[2]	Requested Net Void. ((8)+(9))	Requested Oil Allowable for 6, 19
Well No.	Location Un. Sec. T R	Well Sta.	Date M	Date Y	Oil Bbls.	Wtr Bbls.	Gas MCF	GOR CF/B	Oil BOPD	Wtr. BWPD	Gas MCF/D	GOR CF/B	Gas MCF/D	WHInj Press. PSI	Cum. Inj. MMCF	ResvB/D	ResvB/D	ResvB/Day	See I (9) ResvB/Day	BOPD
1	J 36 17 27	Inj.	3	74	---	---	---	---	---	---	---	---	2773	1800	250	484.6	---	---	---	---
2		F	3	74	350	0	245	700	300	0	210	700					56.5	58.9	115.4	300
3		F	3	74	400	0	320	800	300	0	240	800					64.7	66.2	130.9	300
4		F	3	74	365	0	329	900	300	0	270	900					72.7	73.4	146.1	300
5		F	3	74	382	0	382	1000	300	0	300	1000					80.9	80.8	161.7	300
6		F	3	74	424	0	466	1100	348	0	383	1100					118.7	88.0	206.7	348
7		F	3	74	372	0	446	1200	284x	0	341	1200					86.3	95.3	181.6	284
8		F	3	74	325	0	228	700	284x	0	199	700					49.9	58.9	108.8	284
9		F	3	74	310	0	248	800	284x	0	227	800					57.2	66.2	123.4	284
10		F	3	74	360	0	324	900	250	0	225	900					46.8	73.4	120.2	250
11		F	3	74	250	0	250	1000	250	0	250	1000					52.5	80.8	133.3	250
12		F	3	74	250	0	275	1100	210	0	231	1100					33.1	88.0	121.1	210
13		F	3	74	150	0	180	1200	150	0	180	1200					-3.6	95.3	91.7	150

([1]See Attachment I(b) Col. (9)).
([2]See Attachment I(a) Col. (10)).
([x] = Production limited to twice N.U.A.)
([y] = Limited capacity, see Attachment I(c) Col.'s (9) & (9c).).

To: N.M.O.C.C. Dist. II (3)
P. O. Drawer DD
Artesia, New Mexico 88210
Attn: Mr. W. A. Gressett

EMPIRE ABO PRESSURE MAINTENANCE PROJECT

(N.M.O.C.C. ORDERS , .)

ATLANTIC RICHFIELD COMPANY - OPERATOR

MONTHLY REPORT FOR March, 19 74

PROJECT AREA: EMPIRE ABO UNIT

Total Requested Allowable for June 1974 is 3700 BOPD.

Sheet A

(1)	(2)	(3)	(4)						(5)				(6)			(7)	(8)	(9)	(10)	(11)
Empire Abo Unit			Well Test Data - Latest 24-hr.						Production-Average March 1974 Top Well Allow. BO				Injection-Average March 1974			Voidage Avail. for Trnsfr.[1]	Requested Voidage Transfer	Net Void. @ Normal Unit Allow.[2]	Requested Net Void. ((8)+(9)) See I (9)	Requested Oil Allowable for 6, 1974
Well No.	Location Un. Sec. T R	Well Sta.	Date M	Date Y	Oil Bbls.	Wtr Bbls.	Gas MCF	GOR CF/B	Oil BOPD	Wtr. BWPD	Gas MCF/D	GOR CF/B	Gas MCF/D	WHInj Press. PSI	Cum. Inj. MMCF	ResvB/D	ResvB/D	ResvB/Day	ResvB/Day	BOPD
14		P	3	74	150	100	180	1200	150	100	180	1200					96.4	95.3	191.7	150
15		P	3	74	150	75	105	700	150	75	105	700					69.3	58.9	128.2	150
16		F	3	74	100	35	500	5000	100	35	500	5000					0	288.1y	288.1	100
17		F	3	74	40	0	120	3000	40	0	120	3000					0	54.8y	54.8	40
18		SI	3	74	14	2	42	3000	---	---	---	---				479.4				---
19		SI	3	74	5	1	70	14000	---	---	---	---				477.9				---
20		SI	3	74	158	0	553	3500	---	---	---	---				480.3				---
TOTALS:									3700	210	3961	1071	2773		250	1922.2	881.4	1422.3	2303.7	3700

([1] See Attachment I(b) Col. (9)).
([2] See Attachment I(a) Col. (10)).
([x] = Production limited to twice N.U.A.)
([y] = Limited capacity, see Attachment I(c) Col.'s (9) & (9c).)

EMPIRE ABO PRESSURE MAINTENANCE PROJECT
Monthly Report for March, 1974
Attachment I: Allowable Calculations Based on Net Reservoir Voidage.

pire Abo Unit	Tract No. (1)	Well No. (1)	Q_o = per well Allowbl. Prodctn. STBOPD (2)	$\frac{Gi}{Gp}=\frac{A-6}{A-5}$ (Fraction) (3)	$(1.000-\frac{Gi}{Gp})=(1.000-\beta)$ (Fraction) (4)	Rp, from Col. A-5 (GOR) 19 MCF/BO (5)	Rpn = Equation 1a (5)x(4) MCF/BO (6)	Vr(hc) (Equation 1) (ResBbls/Day) (7)	Vr(w) (Equation 2) ((A-4)-180/20) x 1.0 (ResBbls/Day) (8)	Vrt=(7)+(8) (Equation 3) Total Res. Voidage (ResBbls/Day) (9)	Vr(hc) for ea. well @ N.U.A. of 142 BOPD (Equation 1) (ResBbls/Day) (10)
Wells accepting transferred allowables:	1	2	300	0.700	0.300	0.700	0.210	124.4	-9	115.4	58.9
		3	300			0.800	0.240	139.9	-9	130.9	66.2
		4	300			0.900	0.270	155.1	-9	146.1	73.4
		5	300			1.000	0.300	170.7	-9	161.7	80.8
		6	348			1.100	0.330	215.7	-9	206.7	88.0
		7	284			1.200	0.360	190.6	-9	181.6	95.3
		8	284			0.700	0.210	117.8	-9	108.8	58.9
		9	284			0.800	0.240	132.4	-9	123.4	66.2
		10	250			0.900	0.270	129.2	-9	120.2	73.4
		11	250			1.000	0.300	142.3	-9	133.3	80.8
		12	210			1.100	0.330	130.1	-9	121.1	88.0
		13	150			1.200	0.360	100.7	-9	91.7	95.3
		14	150			1.200	0.360	100.7	91	191.7	95.3
		15	150			0.700	0.210	62.2	66	128.2	58.9
a)Totals:			3560	0.700	0.300			1911.8	49	1960.8	1079.4
Wells Transfering allowables:		1	142	0	1.000	2,000*	2.000	493.6	-9	484.6	
		18	14	0	1.000	20.286*	20.286	486.4	-7	479.4	
		19	5	0	1.000	56.800*	56.800	485.9	-8	477.9	
		20	81	0	1.000	3.500*	3.500	489.3	-9	480.3	
b) Totals			242					1955.2	-33	1922.2	

) Capacity wells, allowable calculations:	Tract No. (1)	Well No. (1)	Q_o = per well Allowbl. Prodctn. STBOPD (2)	$\frac{Gi}{Gp}=\frac{A-6}{A-5}$ (Fraction) (3)	$(1.000-\frac{Gi}{Gp})=(1.000-\beta)$ (Fraction) (4)	Rp, from Col. A-5 (GOR) 19 MCF/BO (5)	Rpn = Equation 1a (5)x(4) MCF/BO (6)	Vr(hc) (Equation 1) (ResBbls/Day) (7)	Vr(w) (Equation 2) ((A-4)-180/20) x 1.0 (ResBbls/Day) (8)	Vrt=(7)+(8) (Equation 3) Total Res. Voidage (ResBbls/Day) (9)	Vrt for top all. Max GOR well Ib(9), (ResB/D) (9a)	Ratio: Vrt(9a)/Vrt(9) (Frac)z (9b)	Req.Cap.All. Col(2),or(2)x (9b) BOPD (9c)
	1	16	100	0.700	0.300	5.000	1.500	262.1	26	288.1	484.6	1.682	100
		17	40	0.700	0.300	3.000	0.900	63.8	-9	54.8	484.6	8.843	40

(z Note: Capacity well allowed to produce at any rate as long as Vrt(9a)/Vrt(9) ≥ 1.0. When Vrt(9a)/Vrt(9) < 1.0, Daily Oil allowable of capacity well must be no greater than (2) x Vrt(9a)/Vrt(9) or (2) x (9b)).

Fluid Factors: (based on Previous Reservoir Pressure Survey, 1343 psi, July, 1973):
Bo, Oil Formation Volume Factor, Reservoir bbls./stock tank bbl=1.415
Bg, Gas Formation Volume Factor, Resv. bbls/thousand std cu ft =1.71
Rs, Solution gas-oil ratio, MCF/Stock tank bbl oil =0.795
Bw, Water formation volume Factor, Resv bbls/stock tank bbl =1.0

Established Constants: Qwe, Natural water encroachment stock tank bbls/day, based on Numeric model studies: = 180
Qo, Top per-well N.U.A., STBOPD = 142

Basic Voidage Equations: 1) Vr(hc) = Qo (Bo+(Rpn-Rs)Bg), Net hydrocarbon resv voidage, RvB/D; 1a.) Rpn = Rp (1.0-Gi/Gp); 2) Vrw = (Qwp-Qwe)Bw, Net resv space voided by wtr, RvB/D; 3) Vrt = Vrhc + Vrw, Total net reservoir space voided on daily basis.

* Rp = 284MCFPD/QoI(2), where 284 MCFPD is the daily gas limit, and QoI(2) is from Attach. I, Column (2).

Empire Abo Unit

Reservoir Voidage Formula:

Equation 1: $V_{rvb} = Q_o\ (B_o + (R_{pn} - R_s)\ B_g) + (Q_{wp} - Q_{we})B_w$

Where:

V_{rvb} = Reservoir voidage, bbls. per day
Q_o = Oil production rate, Stock tank bbls. per day
B_o = Oil formation volume factor(1), reservoir volumetric bbls/stock tank bbl.
R_{pn} = Net producing gas-oil ratio, MCF/S.T.B.O.

$$R_{pn} = R_p\left(1.0 - \frac{G_i}{G_p}\right)$$

Where: R_p = producing gas-oil ratio, MCF/BO
G_i = daily volume of gas injected, MCF/Day
G_p = daily volume of gas produced, MCF/Day

R_s = Solution gas-oil ratio(2), MCF/STBO
B_g = Gas formation volume factor (3), RVB/MCF
Q_{wp} = Water production rate, S.T.B.W./Day
Q_{we} = Aquifer water influx rate, S.T.B.W./Day, determined from reservoir numeric model runs to be 1950 BWPD
B_w = Water formation volume factor, RVBW/STBW, use 1.0

Solving Equation 1 for daily oil rate, Q_o,

Equation 2: $$Q_o = \frac{V_{rvb} - (Q_{wp} - Q_{we})\ B_w}{(B_o + (R_{pn} - R_s)\ B_g)}$$

(1), (2), (3): These values calculated from fluid analysis data.

EMPIRE ABO UNIT AREA

Table of Fluid Properties (P Base = 15.025 P_{bp} = 2231)

Tres. = 109°F (569° R)

P_r (PSIA)	BO (RVBO/STBO)	Bg RVB/MCF	Rs (MCF/BBL)	Z
15.025	1.000	194.696	0	1.0
100	1.125	28.229	.180	.965
200	1.163	13.749	.235	.940
300	1.193	8.970	.290	.920
400	1.218	6.692	.345	.915
500	1.244	5.236	.395	.895
600	1.263	4.276	.445	.877
700	1.285	3.644	.495	.872
800	1.304	3.108	.540	.850
900	1.325	2.746	.585	.845
1000	1.344	2.437	.625	.833
1100	1.364	2.178	.675	.819
1200	1.384	1.962	.725	.805
1300	1.404	1.790	.775	.795
1400	1.425	1.649	.825	.789
1500	1.445	1.516	.875	.777
1600	1.465	1.404	.925	.768
1700	1.485	1.304	.975	.758
1800	1.505	1.220	1.025	.751
1900	1.525	1.147	1.075	.745
2000	1.548	1.053	1.125	.720
2100	1.573	1.000	1.175	.718
2200	1.597	.953	1.225	.717
2231	1.606	.939	1.250	.716

P_r = Reservoir average pressure at datum -2264' subsea, lbs/in^2 absolute.

B_o = Oil formation volume factor, reservoir volumetric bbls/stock tank bbl.

B_g = Gas formation volume factor, reservoir volumetric bbls/thousand std. cu. ft.

R_s = Solution Gas/Oil Ratio, Thousand std. cu. ft./stock tank bbls. oil.

Z = Gas Compressibility Factor.

EXHIBIT _____

4-25-73

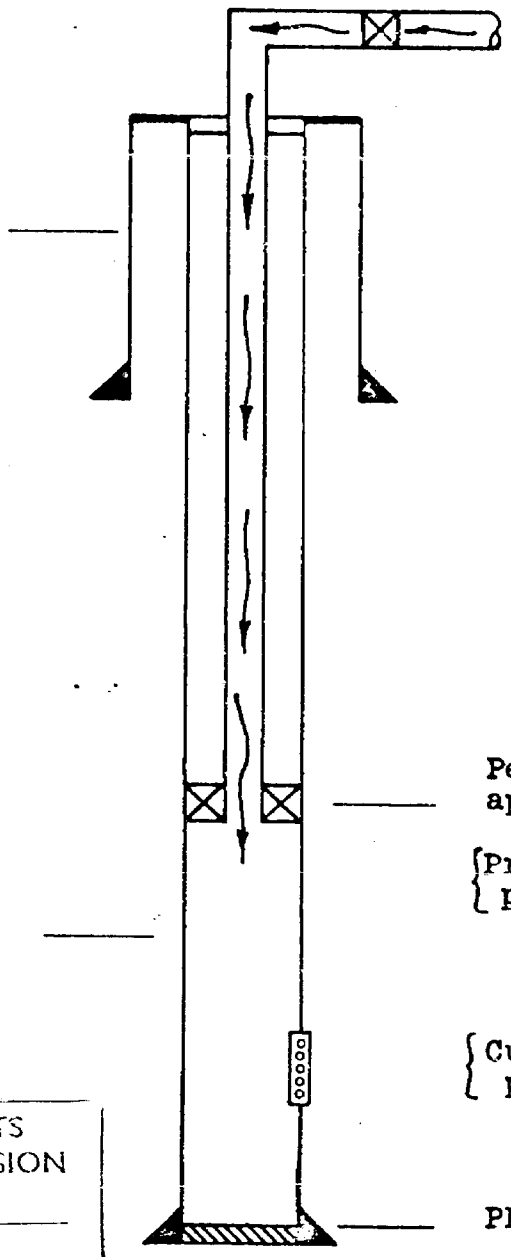
HUMBLE OIL AND REFINING COMPANY

Chalk Bluff Draw Unit A Well No. 4

990' FNL & 2310' FWL SEC. 9, T-18-S, R-27-E

EDDY COUNTY, NEW MEXICO

INJECTION WELL DIAGRAM



2 3/8" OD TUBING
(Internally Coated)

8 5/8" OD casing set @
1499' w/700 sx. cmt.
T @ surface (calculated)

Permanent packer @
approx. 5300' (proposed)

{Proposed perfs.} 5330-5430'

{Current perfs.} 5365-5564'

PBTD 5641'

4 1/2" OD casing set @
5670' w/350 sx. cmt.
T @ 4130' (calculated)

BEFORE EXAMINER STAMETS
OIL CONSERVATION COMMISSION
App EXHIBIT NO. 9
CASE NO. 4952 & 4953
Submitted by ARCO
Hearing Date 25 April 1983

EXHIBIT NO. 9

AMOCO PRODUCTION COMPANY

R.H. Windfohr Well No. 4

1582' FSL & 1645' FEL SEC.4, T-18-S, R-27-E

EDDY COUNTY, NEW MEXICO

INJECTION WELL DIAGRAM

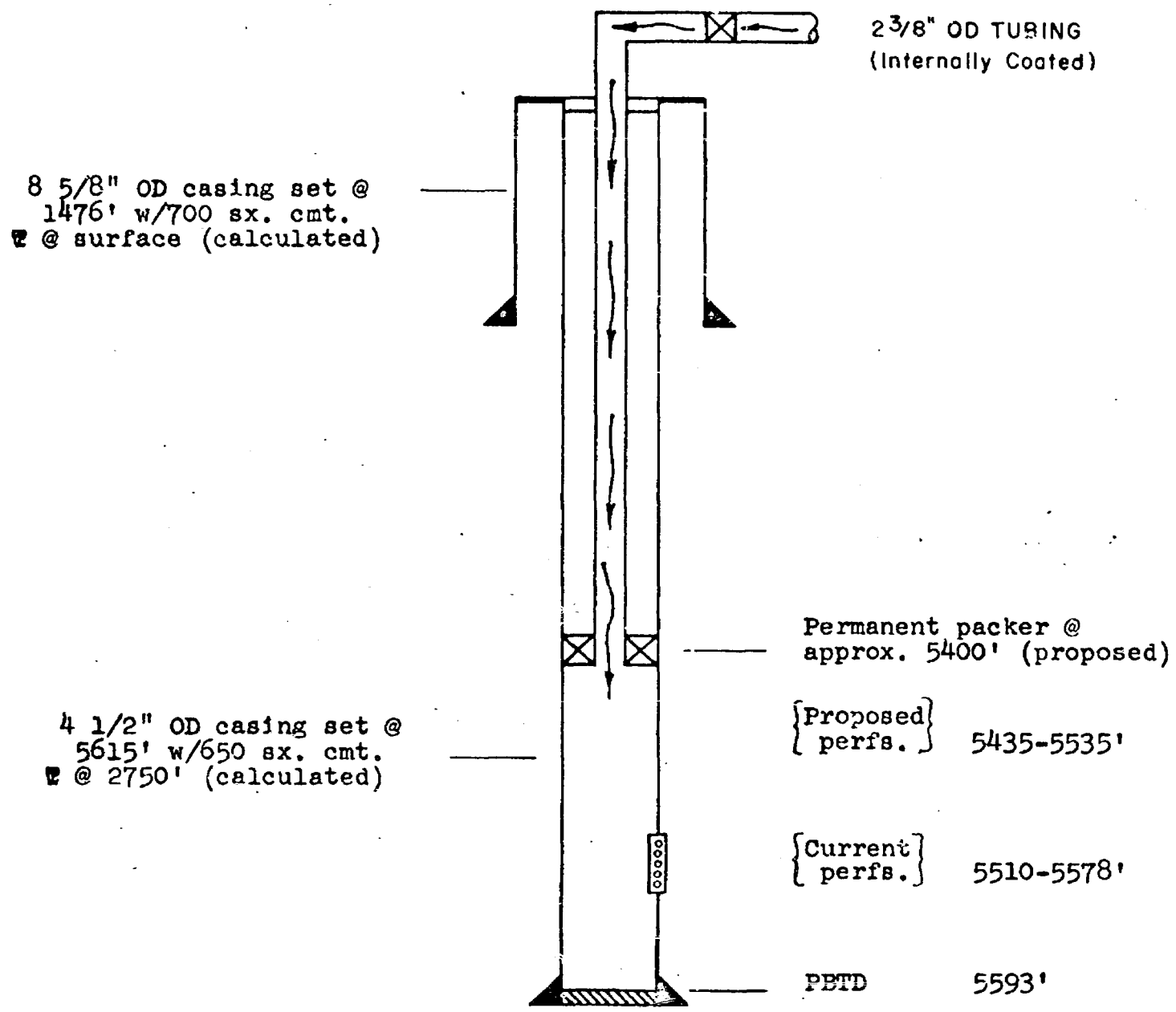


EXHIBIT NO. _____

AMOCO PRODUCTION COMPANY

Malco "H" Federal Well No. 2

1980' FNL & 660' FEL SEC. 3, T-18-S, R-27-E

EDDY COUNTY, NEW MEXICO

INJECTION WELL DIAGRAM

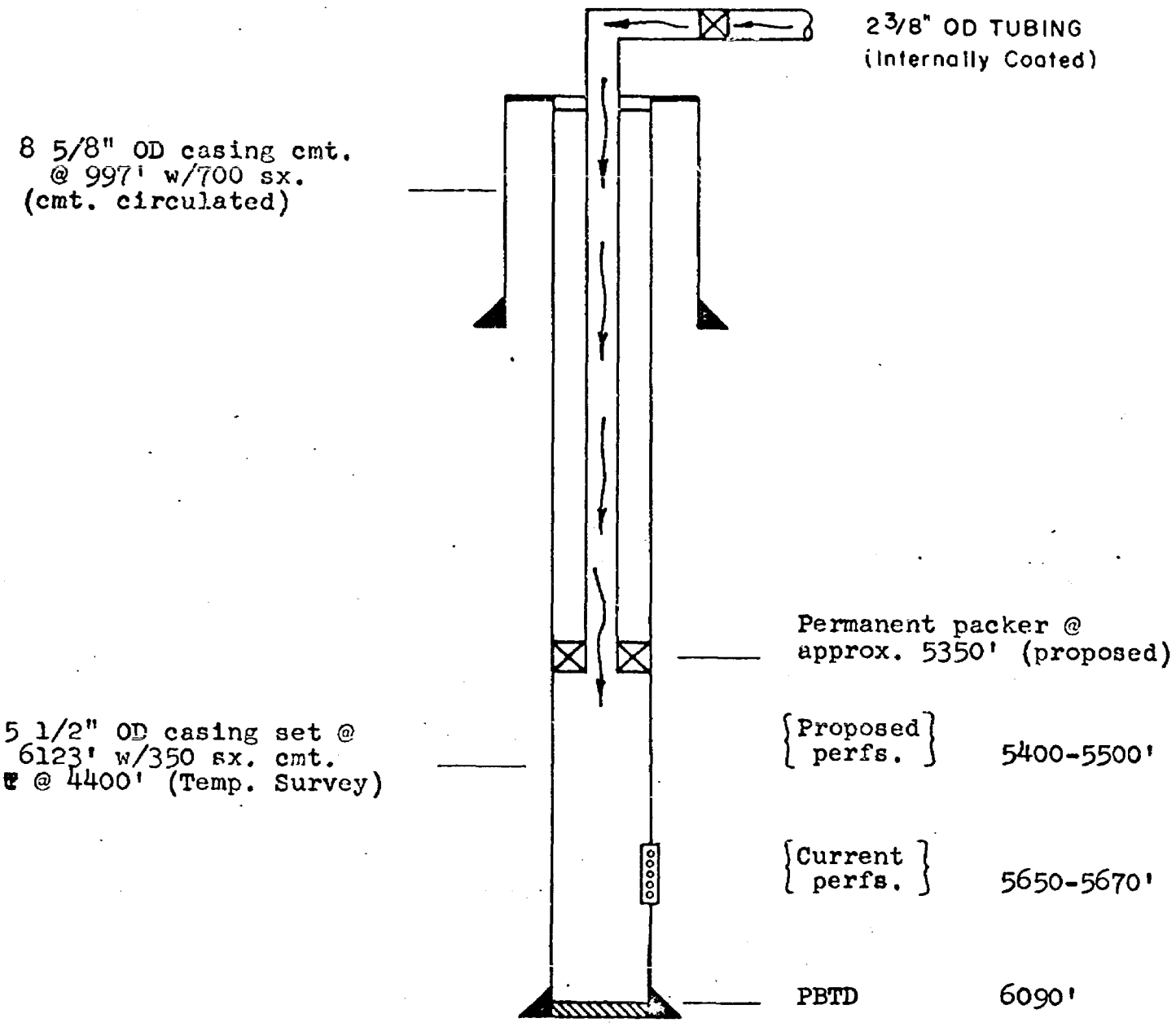


EXHIBIT NO. _____

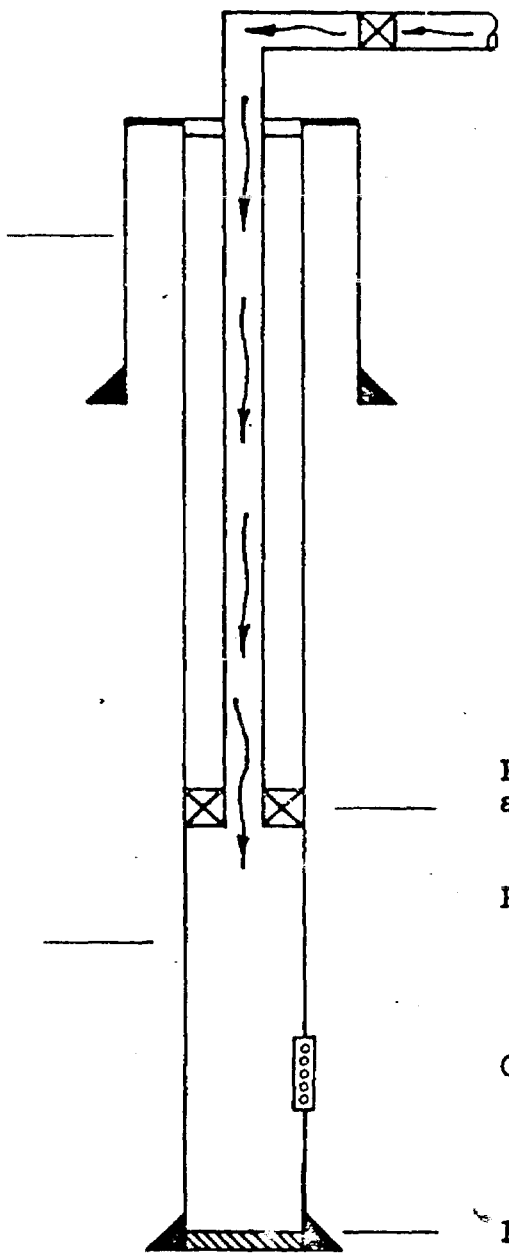
MARTIN YATES, III

Dooley State ABO No. 2

1650' FSL & 1650' FEL SEC. 36, T-17-S, R-27-E

EDDY COUNTY, NEW MEXICO

INJECTION WELL DIAGRAM



8 5/8" OD casing cmt. @ 950' w/400 sx. cmt. @ surface (calculated)

5 1/2" OD casing cmt. @ 5970' w/650 sx. @ 2227' (calculated)

2 3/8" OD TUBING (Internally Coated)

Permanent packer @ approx. 5700' (proposed)

Proposed perfs.	5740-5850'
Current perfs.	5749-5766' 5776-5781' 5788-5793'
PBTD	5929'

EXHIBIT NO. _____

AMOCO PRODUCTION COMPANY

State "BM" Well No. 1

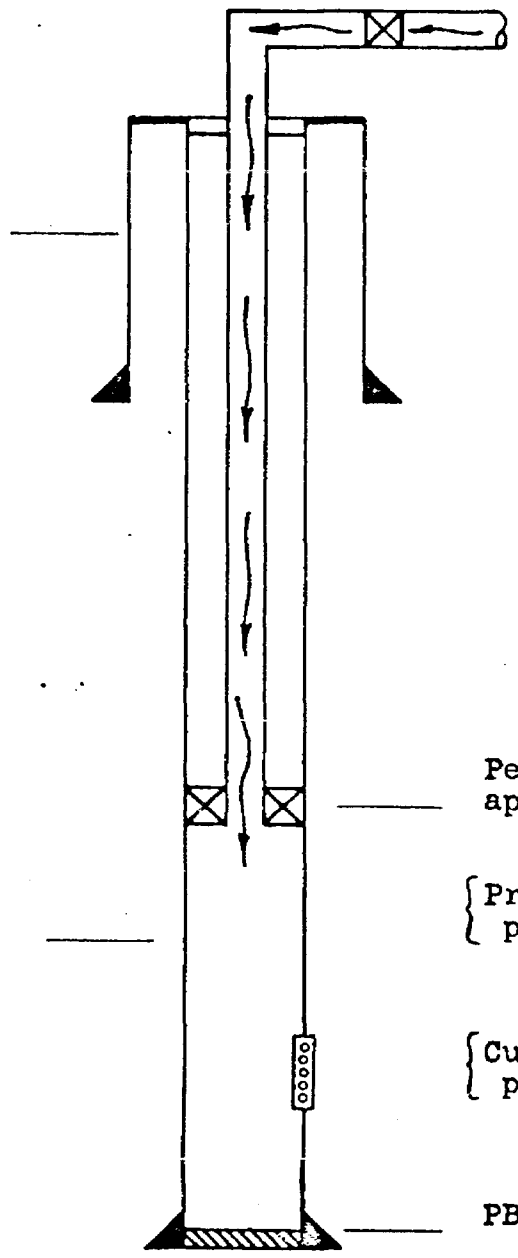
1650' FSL & 2387' FWL SEC. 31, T-17-S, R-28-E

EDDY COUNTY, NEW MEXICO

INJECTION WELL DIAGRAM

8 5/8" OD casing set @
1275' w/650 sx. cmt.
@ surface (calculated)

4 1/2" OD casing set @
6046' w/750 sx. cmt.
@ 2750' (calculated)



2 3/8" OD TUBING
(Internally Coated)

Permanent packer @
approx. 5750' (proposed)

{Proposed perfs.}	5800-5900'
{Current perfs.}	5998-6032'
PBTD	6040'

EXHIBIT NO. _____

AMOCO PRODUCTION COMPANY

State "BV" Well No. 1

2280' FNL & 978' FEL SEC. 32, T-17-S, R-28-E

EDDY COUNTY, NEW MEXICO

INJECTION WELL DIAGRAM

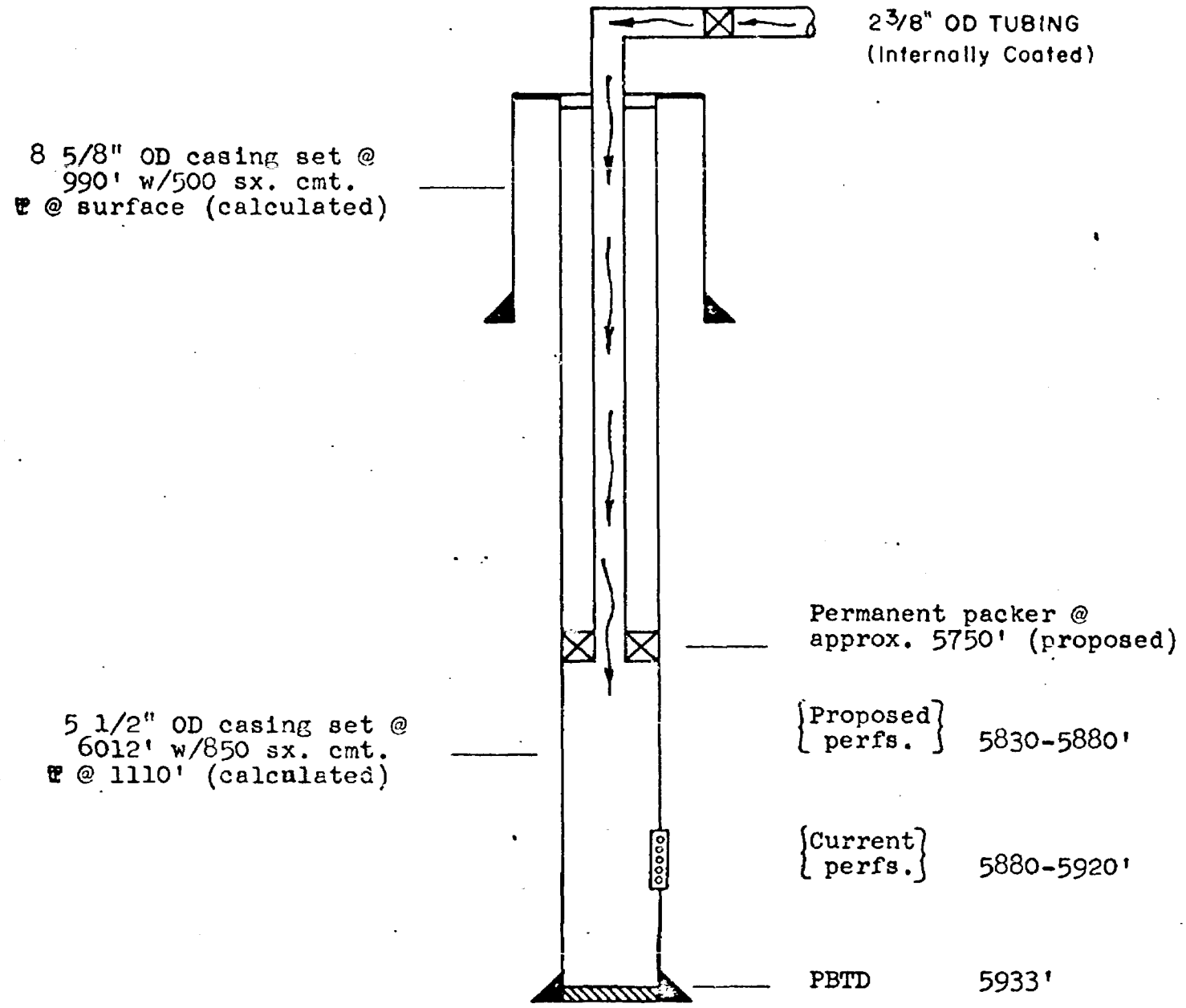


EXHIBIT NO. _____

ATLANTIC RICHFIELD COMPANY

M. Yates "B" (ARC) Well No. 8

1980' FNL & 2130' FEL SEC. 33, T-17-S, R-28-E

EDDY COUNTY, NEW MEXICO

INJECTION WELL DIAGRAM

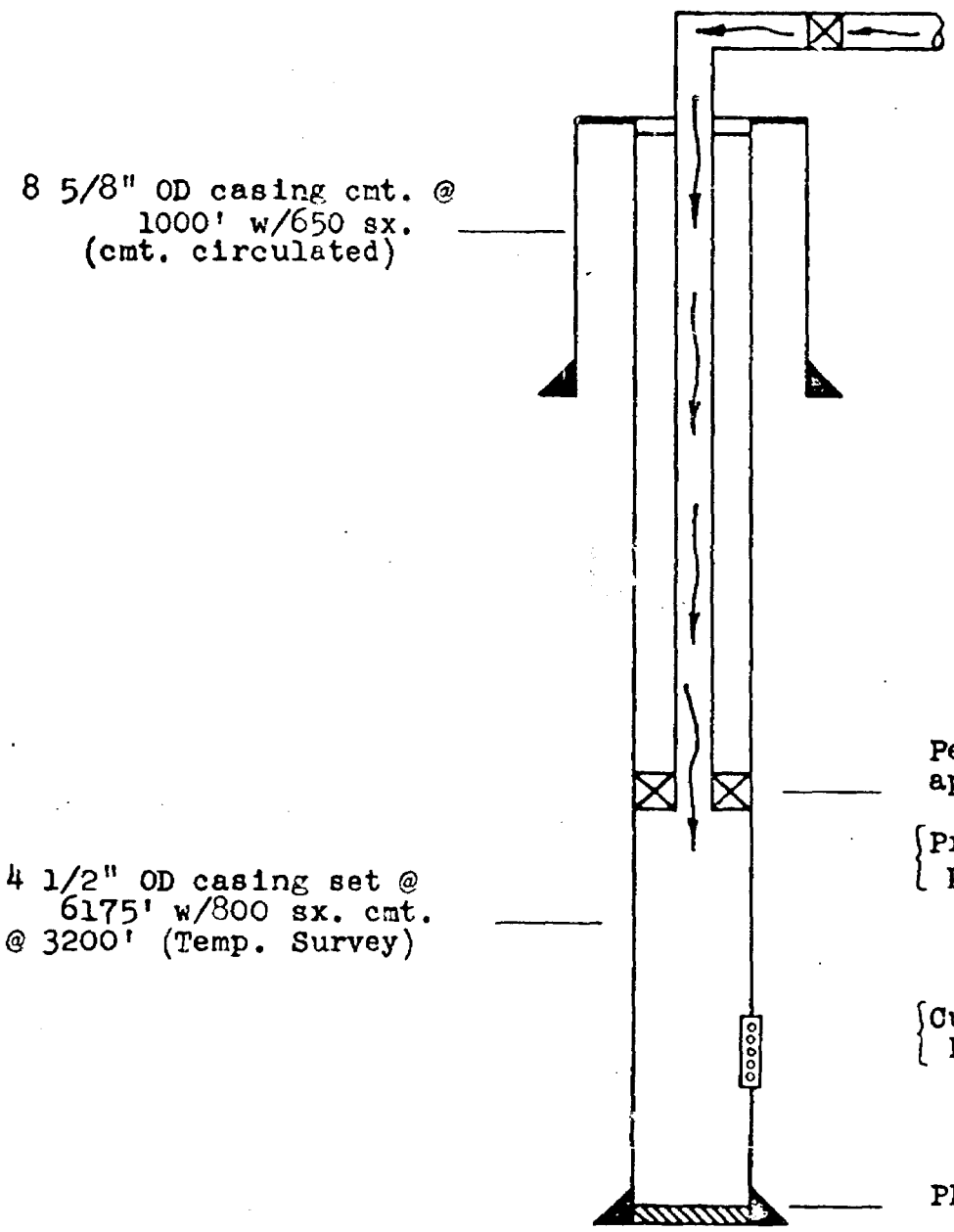


EXHIBIT NO. _____

HONDO OIL AND GAS COMPANY
(ATLANTIC RICHFIELD COMPANY)
State "A" Well No. 21
1650' FSL & 1980'FWL SEC.26, T-17-S, R-28-E
EDDY COUNTY, NEW MEXICO
INJECTION WELL DIAGRAM

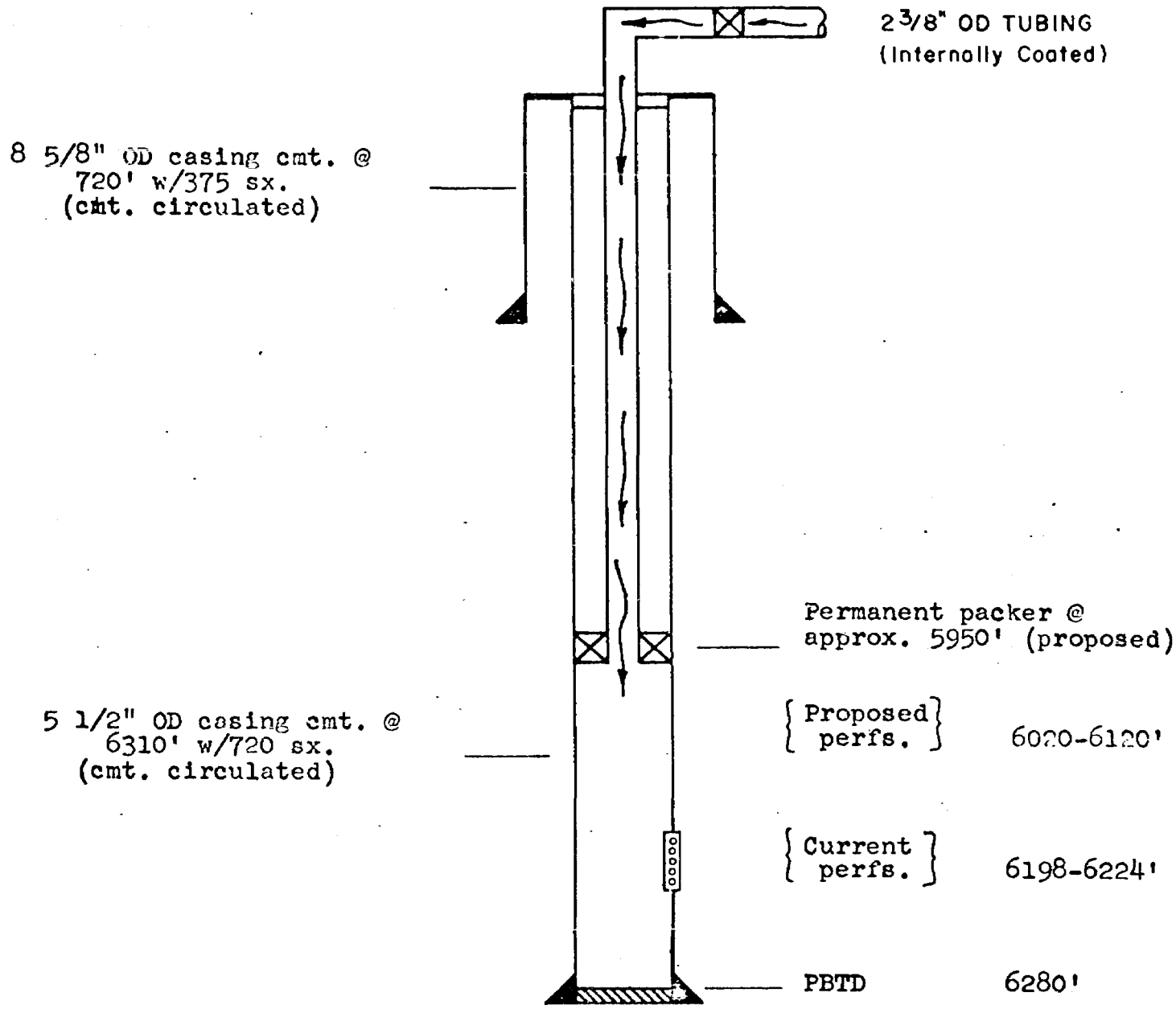


EXHIBIT NO. _____

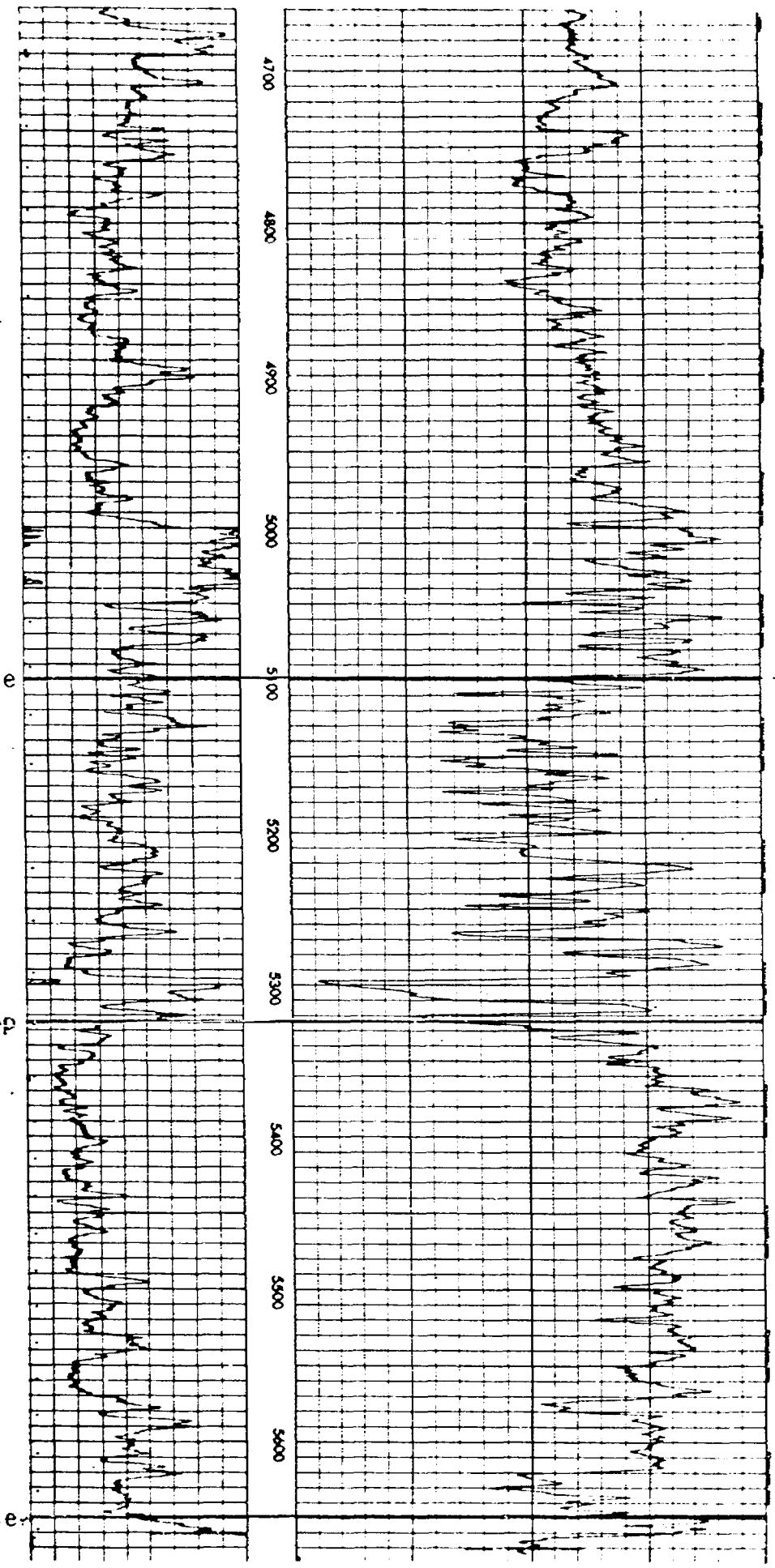
HUMBLE OIL AND REFINING COMPANY

Chalk Bluff Draw Unit A Well No. 4

990' FNL & 2310' FWL SEC. 9, T-18-S, R-27-E

EDDY COUNTY, NEW MEXICO

GAMMA RAY — NEUTRON



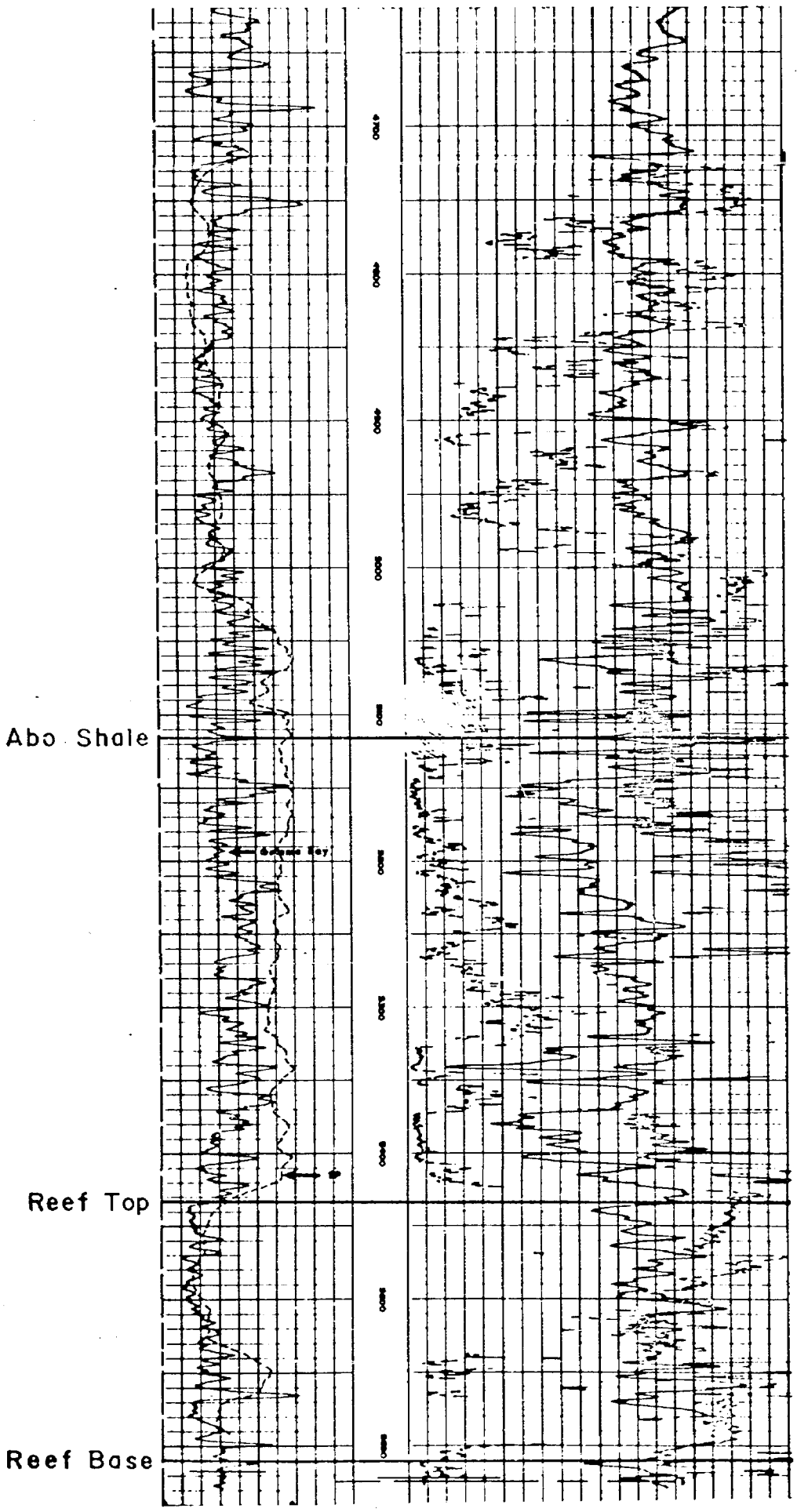
AMOCO PRODUCTION COMPANY

R.H. Windfohr Well No. 4

1582' FSL & 1645' FEL SEC. 4, T-18-S, R-27-E

EDDY COUNTY, NEW MEXICO

GAMMA RAY — NEUTRON — LATEROLOG



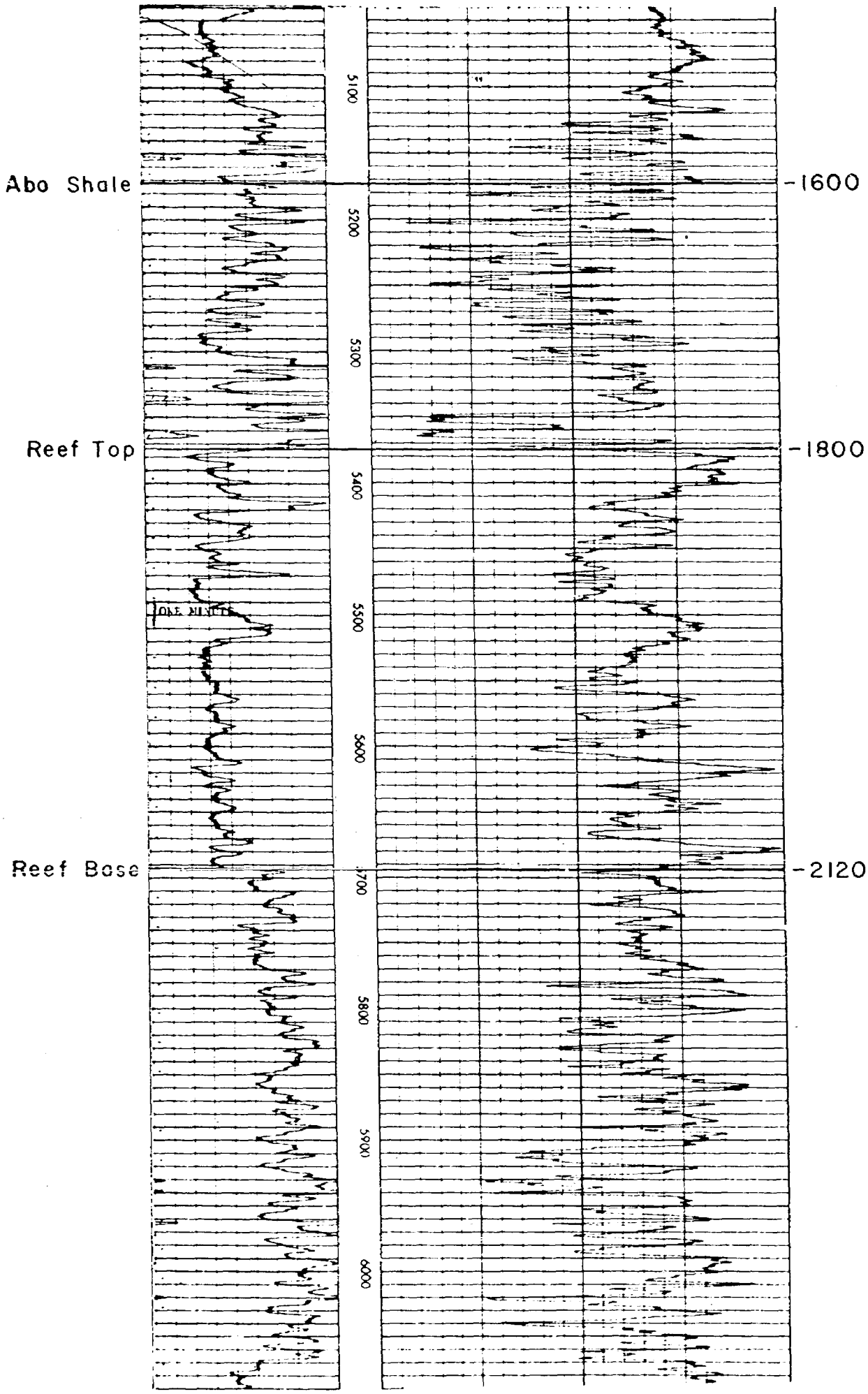
AMOCO PRODUCTION COMPANY

Malco "H" Federal Well No. 2

1980' FNL & 660' FEL SEC. 3, T-18-S, R-27-E

EDDY COUNTY, NEW MEXICO

GAMMA RAY – NEUTRON



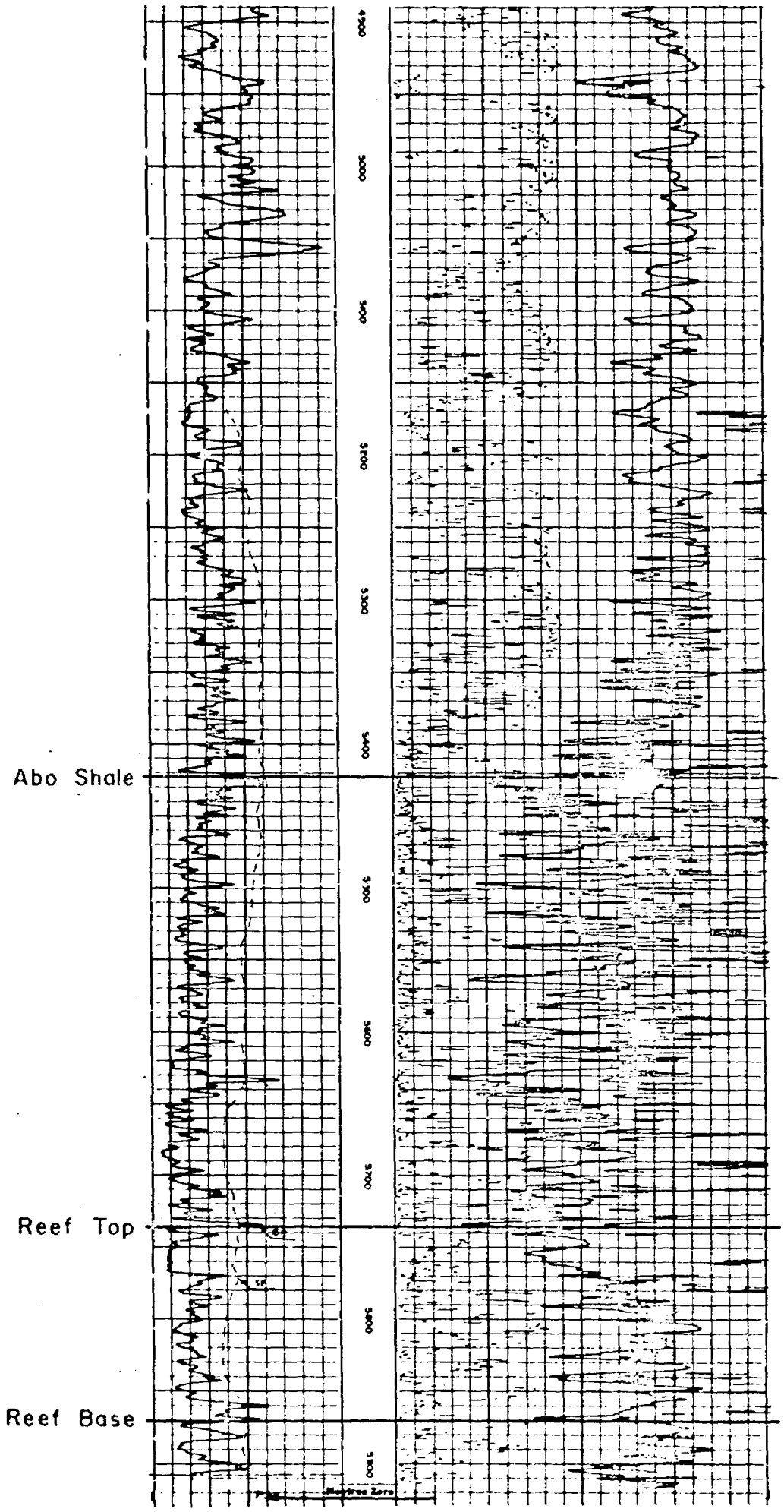
MARTIN YATES, III

Dooley State ABO No. 2

1650' FSL & 1650' FEL SEC. 36, T-17-S, R-27-E

EDDY COUNTY, NEW MEXICO

LATEROLOG-GAMMA RAY-NEUTRON



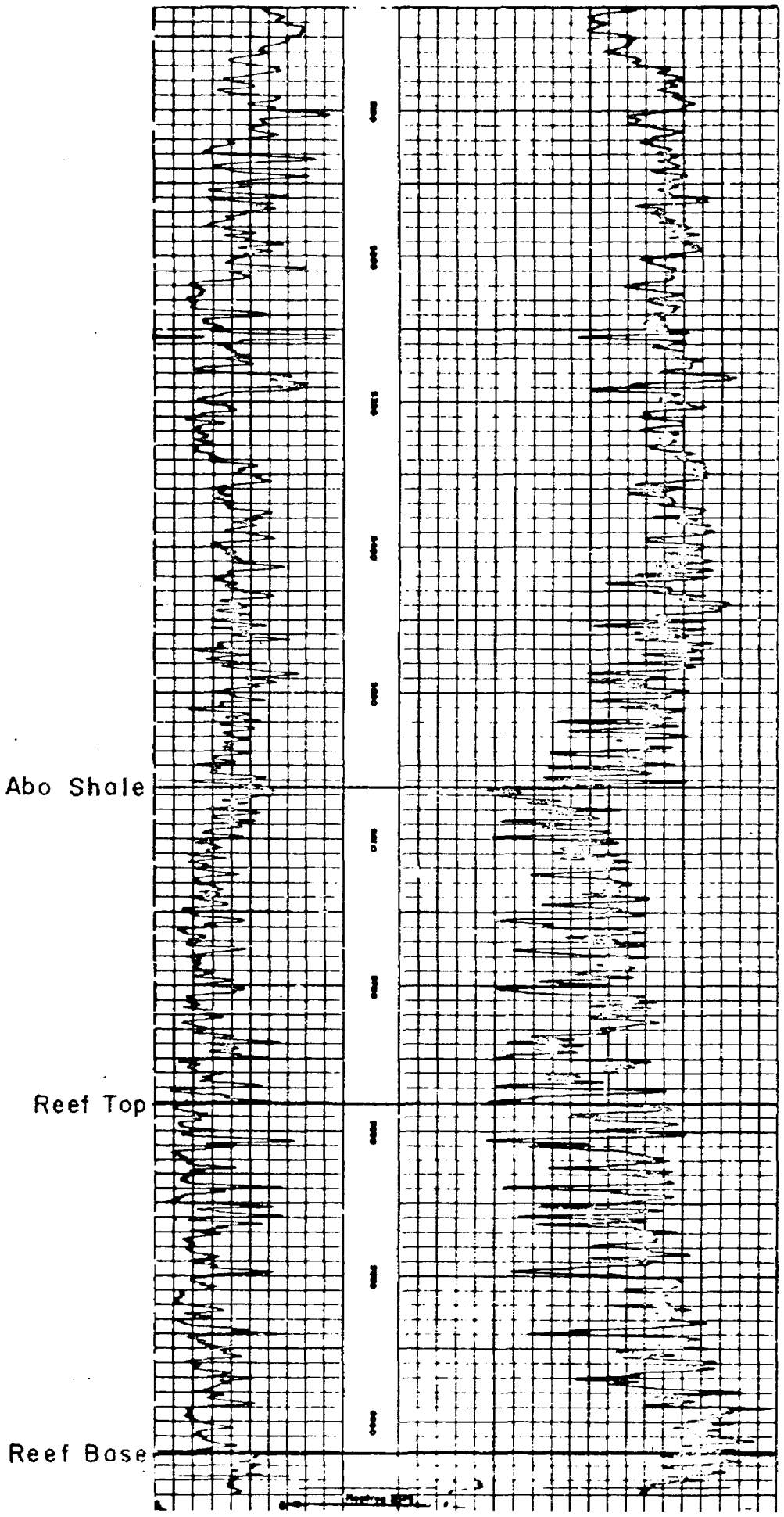
AMOCO PRODUCTION COMPANY

State "BM" Well No. 1

1650' FSL & 2387' FWL SEC. 31, T-17-S, R-28-E

EDDY COUNTY, NEW MEXICO

GAMMA RAY - NEUTRON



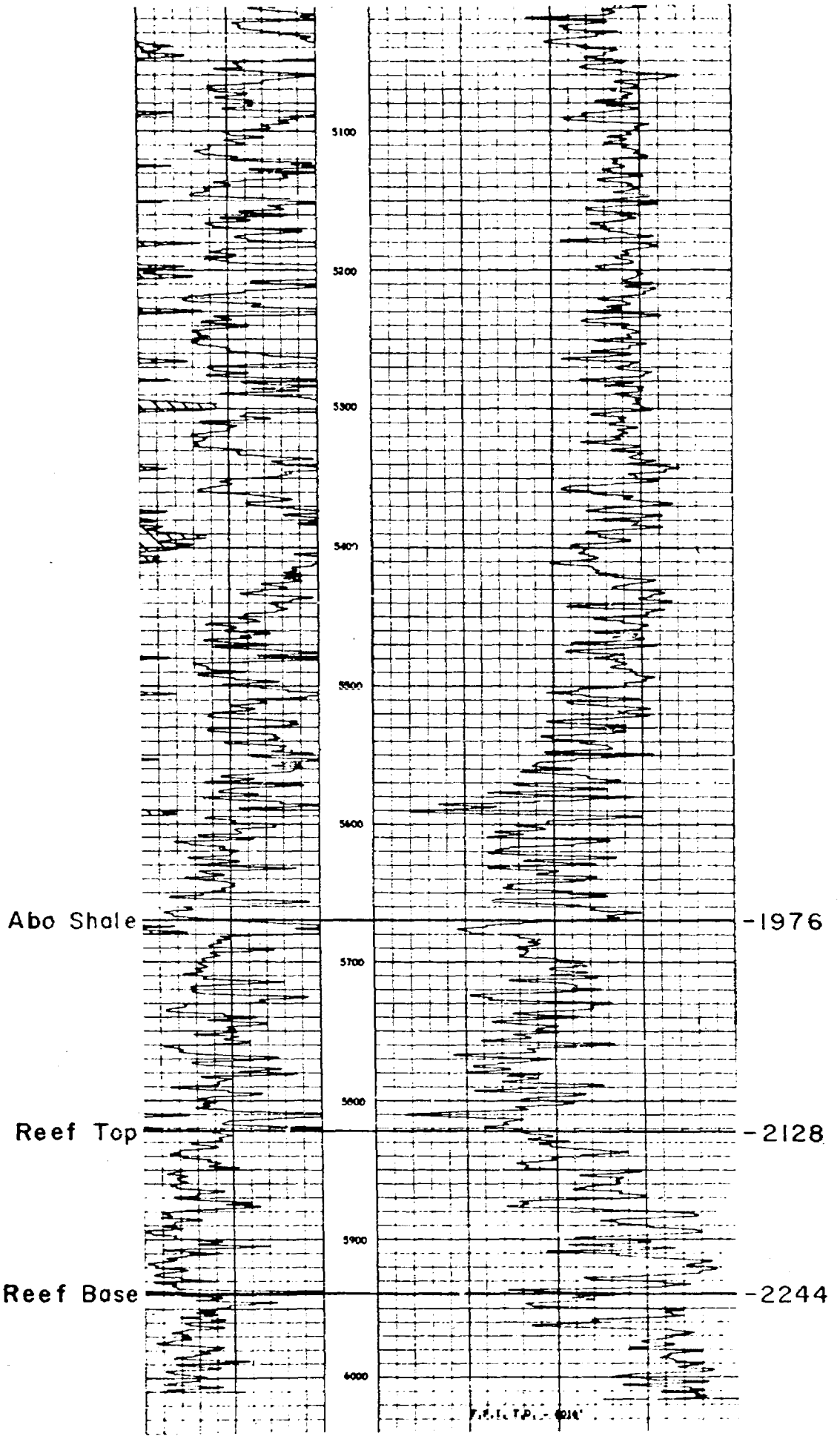
AMOCO PRODUCTION COMPANY

State "BV" Well No. 1

2280' FNL & 978' FEL SEC. 32, T-17-S, R-28 E

EDDY COUNTY, NEW MEXICO

GAMMA RAY – ISOTRON



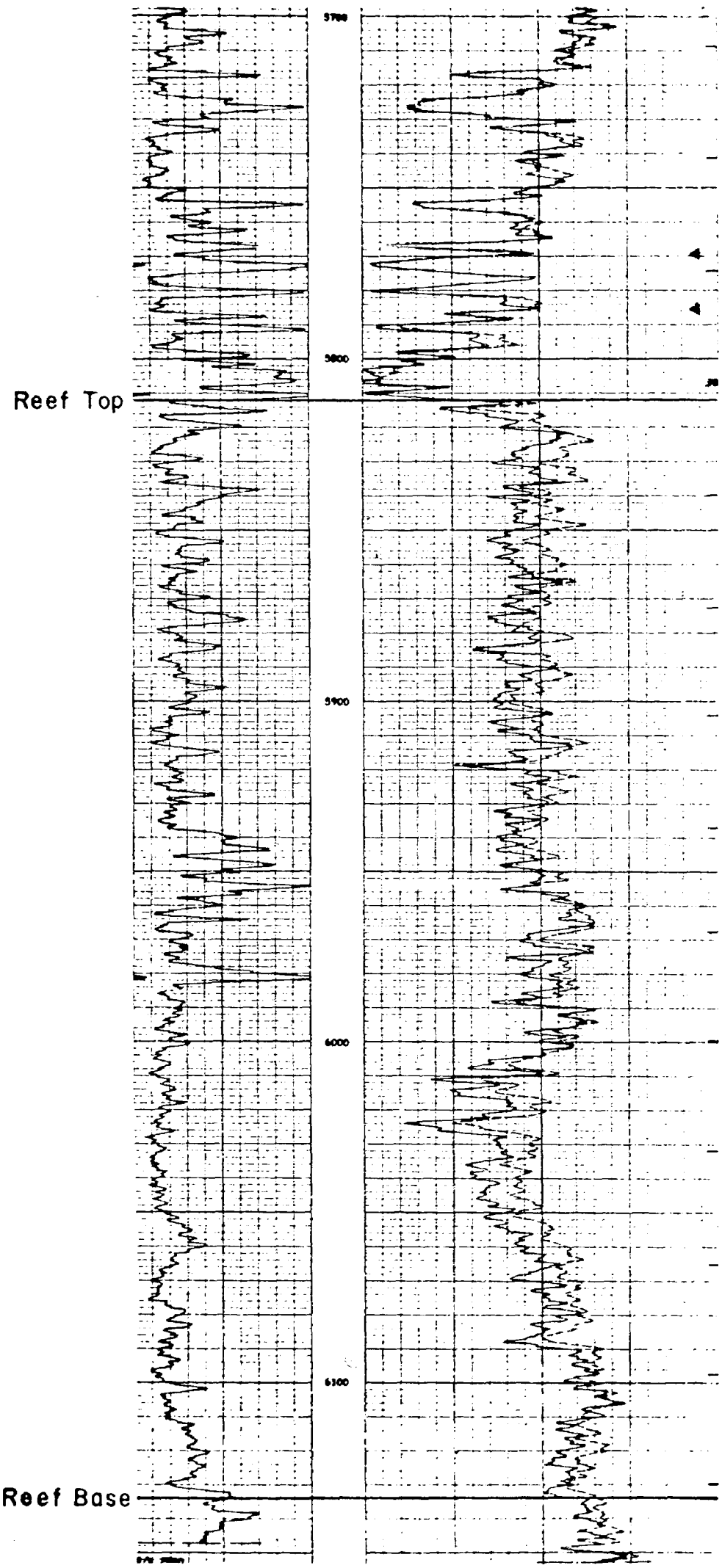
ATLANTIC RICHFIELD COMPANY

M. Yates "B" (ARC) Well No.8

1980' FNL & 2130' FEL SEC. 33, T-17-S, R-28-E

EDDY COUNTY, NEW MEXICO

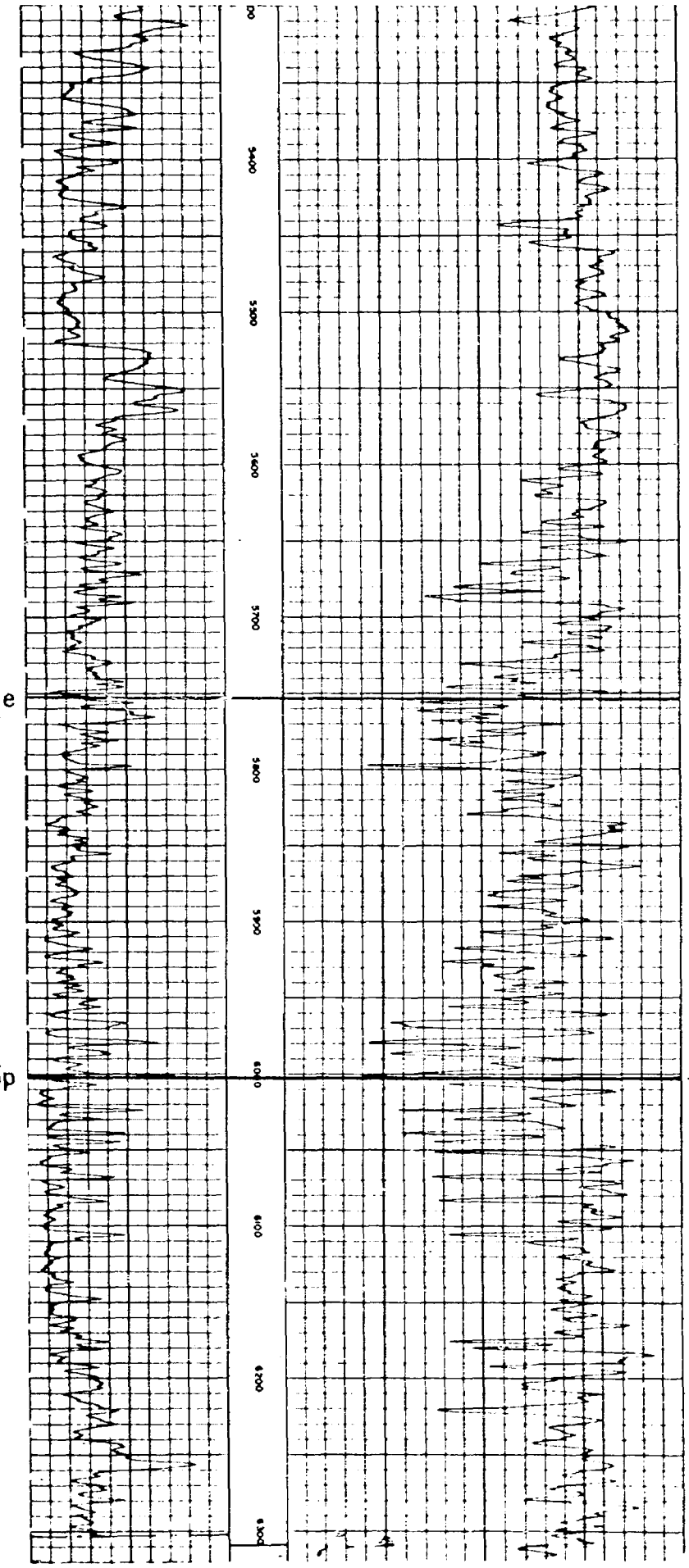
GAMMA RAY – ISOTRON



Reef Top -2144

Reef Base -2466

HONDO OIL AND GAS COMPANY
(ATLANTIC RICHFIELD COMPANY)
State "A" Well No. 21
1650' FSL & 1980' FWL SEC. 26, T-17-S, R-28-E
EDDY COUNTY, NEW MEXICO
GAMMA RAY – NEUTRON



EMPIRE ABO POOL

Potential Rate Benefits to New Mexico State Lands Leases by Unitization.

(Pool Total Requested Top Allowable: 42,000 BOPD*)

Unitized State Rate Phase I: (42,000)(.6965)	=	29,253 BOPD
Non-Unitized State Rate: (25,600)(.6881)	=	17,615 BOPD
State Lease Rate Gain by Unitization	=	+11,638 BOPD
State Leases Net Royalty Gain by Unitization: (.125)(11,638)	=	1,455 BOPD
Value of State Leases Net Royalty Gain by Unitization ($3.81)(1,455)	=	$ 5,544/Day

(*To be requested from N. M. O. C. C., supported by reservoir numeric model predictions.)

E-12

OIL CONSERVATION COMMISSION

STATE OF NEW MEXICO
P. O. BOX 2088 - SANTA FE
87501

GOVERNOR
BRUCE KING
CHAIRMAN

LAND COMMISSIONER
ALEX J. ARMIJO
MEMBER

STATE GEOLOGIST
A. L. PORTER, JR.
SECRETARY - DIRECTOR

June 15, 1973

Re: Case No. 4953
Order No. R-4549
Applicant:
Atlantic Richfield Co.

Mr. Clarence Hinkle
Hinkle, Bondurant, Cox & Eaton
Attorneys at Law
Post Office Box 10
Roswell, New Mexico 88201

Dear Sir:

Enclosed herewith are two copies of the above-referenced Commission order recently entered in the subject case.

Very truly yours,

A. L. PORTER, Jr.
Secretary-Director

ALP/ir

Copy of order also sent to:

Hobbs OCC x
Artesia OCC x
Aztec OCC

Other State Engineer Office
Mr. A. J. Losee, Mr. Jason Kellahin, Mr. Richard Morris, Mr. Bruce A. Landis

D. H. 11758
Exh

SAMEDAN OIL CORPORATION
PROPOSED [illegible] UNIT
[illegible] COUNTY, NEW MEXICO

In Samedan Oil Corporation's desire to join the proposed Maljamar Abo Unit, it would suffer a loss of substantial net present income. Samedan's interest in the proposed Unit is in Tracts 42 and 49 as shown on Exhibit "B" of the Unit Agreement (1-1-72). Atlantic Richfield's study indicates the following:

Tract	Operator and Lease	Royalty Owner	* Primary Oil Reserves 1-1-73
42	Samedan-Walker State No. 1	State of New Mexico	130,272
49	Chambers & Kennedy-Abo No. 1	State of New Mexico	104,385

* Atlantic Richfield's Remaining Primary Oil Reserves (1-1-71) less 1971 and 1972 oil production.

Samedan's share of this forecasted reserve is 347,692 barrels of oil.

Samedan's share of the unitized reserve under the proposed participation is 335,946 barrels of oil which includes the company's share of the predicted 30.1 million barrels of incremental secondary oil.

Samedan would be required to invest $20,615.00 in the unit operation to recover 11,706 less barrels of oil.

Phase I is defined as the first eleven (11) million barrels of oil produced after the effective date of the Unit. According to the updated Engineering Report furnished by Atlantic Richfield on November 21, 1972, Phase I will have a duration of 9.5 months. We estimate our two (2) wells to be top allowable for another 3.75 years before commencing decline. During this 3.75 year period Samedan will lose 47,882 barrels of oil by joining the Unit.

Therefore, Samedan has no incentive to join this Unit and wishes to register opposition to its formation under the formula that has been adopted.

The quality of the reef pay varies widely across the length of the reservoir as depicted by the thirteen (13) bands that were used in the model studies. Permeability, or the capacity to produce, ranges from 12 to 195 millidarcies from west to east. It is noted that forty-seven percent (47%) of the total tracts and thirty-eight percent (38%)

of the productive tracts inside the Unit outline are not capable of producing top allowable as set out in the annual "Report of the New Mexico Oil and Gas Engineering Committee" for the Calendar Year of 1971. The majority of the future productivity must come from an area between the west edge of Section 2, Township 18 South, Range 27 East and the Center of Section 25, Township 17 South, Range 29 East. Allowable transfers will hasten the recovery from this area as migration of oil continues. Anyone owning an interest in a well in this area not receiving sufficient incentive to join the proposed Unit could not protect their correlative rights with the increased withdrawals due to allowable transfer. Likewise, normal migration of oil would be severely altered resulting in loss of ultimate oil recovery by a non-unit well.

Further damage would be experienced if gas injection were permitted in the vicinity of a non-unit well due to gas coning. This gas coning concept was developed in the Engineering Report in arriving at maximum safe oil producing rates as well as predicted future oil reserves.

We ask that this Commission give due consideration to approving the items of recommendation set out below as protection to those Royalty and Working Interest Owners not having sufficient incentive to join the proposed Unit.

Recommendations

1. All unit wells which directly or diagonally offset any non-unit well, all of which are producing from the same common source of supply, be restricted to produce an amount of oil equal to the top well allowable.

2. Top unit allowable shall be equal to the sum of the individual unit well allowables providing the allowable assigned to any well which is shut-in, which allowable is to be transferred to any well or wells in the unitized project area for production, shall in no event be greater than its ability to produce during the final 24-hour period of a 72-hour test, or greater than the current top well allowable for the pool during the month of transfer, whichever is less.

3. The injection of gas into any unit well not be permitted within 2,640 feet in any direction from the boundary of any non-unit tract.

4. The following be made a provision and included as part of the Commission Order: If it is apparent, as pointed out by any non-joining party, that correlative rights are not being protected, that the Commission agree to consider what other measures are necessary for such protection.

EMPIRE ABO POOL, EDDY COUNTY, NEW MEXICO
FUTURE RECOVERY PROJECTIONS AS THEY AFFECT STATE OF NEW MEXICO LEASES

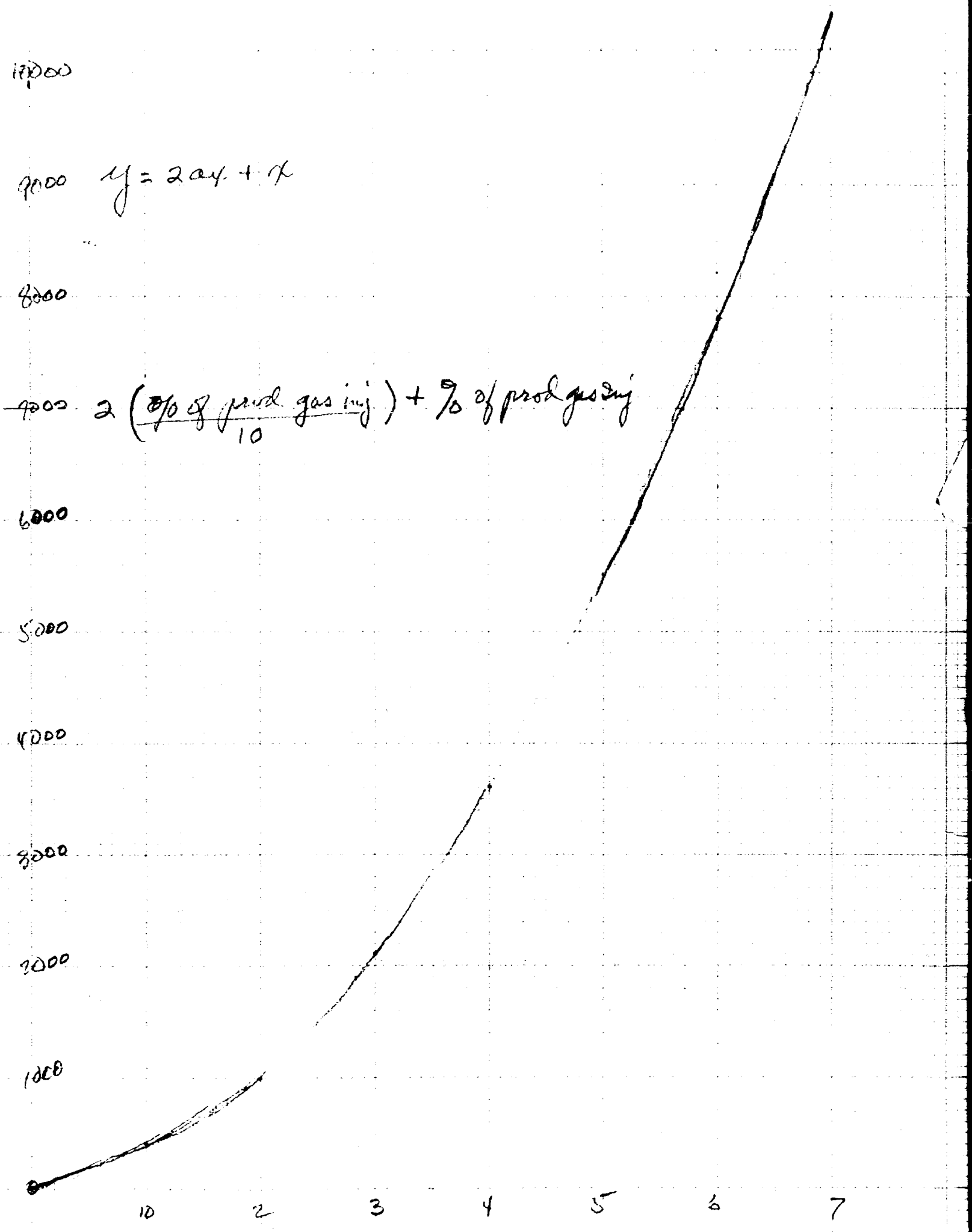
	Operational Method		
	Competitive Natural Depletion (Non-Unitized)	Residue Gas Injection (Unitized)	Advantage of Unitized Case Over Non-Unitized Case
Pool Ultimate Oil Recovery (Percent of original oil-in-place)	45.0	52.9	+7.9
Pool Total Reserves After 7-1-73 (Bbls. Oil)	79,023,854	108,956,651	+29,932,797 (Reserve Increase: 37.9%)
State Leases Gross Reserves After 7-1-73 (Bbls. Oil)	60,734,252	77,702,773*	+16,968,521
12.5% Net Royalty Reserves for State Leases after 7-1-73 (Bbls. Oil)	7,591,781	9,712,847*	+ 2,121,066
Value of State Net Royalty Reserves After 7-1-73 (@ $3.81/Bbl.)	$28,924,686	$37,005,947*	+$8,081,261
Future Life After 7-1-73 (Years)	26	24	

*Unitized Reserves are based on the proposed unit formula, which gives State leases the following share of a Field-wide Unit:

Phase I: 69.64897% (during first 11,000,000 BO after unitization)
Phase II: 71.50243% (Thereafter)

NOTE: Calculated oil lost for each year delay, due to starting unit operations and gas injection at a lower reservoir pressure: 2,050,000 Bbls. Oil lost per year delay.
State of New Mexico share of this loss:
(2,050,000)(.71315)(.125) = 182,834 Bbls. oil reserves lost per year delay.
Value of this lost oil = ($3.81)(182,834) = $694,883 lost to State per year delay.

11 x 17


110
14000
12000
10000
8000
6000
5000
4000
3000
2000
1000
$y = 2ax + x$
$2\left(\frac{\%\text{ of prod gas inj}}{10}\right) + \%\text{ of prod gas inj}$
10
2
3
4
5
6
7

BEFORE THE OIL CONSERVATION COMMISSION

STATE OF NEW MEXICO

Pressure Maintenance

Case 4953

APPLICATION OF ATLANTIC RICHFIELD COMPANY FOR APPROVAL OF A PRESSURE MAINTENANCE PROJECT FOR THE EMPIRE ABO POOL TO BE EMBRACED WITHIN THE EMPIRE ABO UNIT AREA CONSISTING OF 11,339.15 ACRES IN TOWNSHIPS 17 AND 18 SOUTH, RANGES 27, 28 AND 29 EAST, EDDY COUNTY, NEW MEXICO, INCLUDING EIGHT GAS INJECTION WELLS AND FOR APPROVAL OF SPECIAL POOL RULES INCLUDING A PROJECT ALLOWABLE

Oil Conservation Commission
Box 2088
Santa Fe, New Mexico 87501

Comes Atlantic Richfield Company, acting by and through the undersigned attorneys, and hereby makes application for approval of a pressure maintenance project for the Empire Abo Pool to be embraced within the Empire Abo Unit Area consisting of 11,339.15 acres in Townships 17 and 18 South, Ranges 27, 28 and 29 East, Eddy County, New Mexico, including eight injection wells and for the approval of special pool rules including a project allowable, and in support thereof respectfully shows:

1. That there is filed herewith a plat showing the location of the proposed injection wells and the location of all other wells within a radius of 2 miles from the proposed injection wells and the formation from which said wells are producing or have produced. The plat also shows the boundaries of the proposed unit area and shows the owners of the oil and gas leases within an area of 2 miles of the proposed unit area.

2. As indicated by Exhibit "A" filed herewith, there are 8 proposed injection wells. All of the injection wells consist of presently producing wells to be converted to injection wells. All of said wells will be completed in such a way as to provide for the injection of gas into the gas zone of the Empire Abo Pool which includes the Abo formation. There are filed herewith logs of all the wells. There are also filed herewith diagrammatic sketches of all the proposed injection wells, showing all casing strings, including diameters and

setting depths, quantities used and tops of cement, perforated or open hole intervals, tubing strings, including diameters and setting depths, and types and location of packers to be used.

3. The proposed pressure maintenance project is within the boundaries of the proposed Unit Agreement for the Empire Abo Unit Area and application has been filed for approval of the unit agreement by the Commission.

4. It is proposed to inject gas for increased recovery purposes into the Empire Abo Pool which includes the Abo formation only. The unit agreement identifies the top of the formation at 5325 feet on the Welex Radioactivity Log dated December 21, 1958 for the Amoco Production Company's State of New Mexico "AU" Well No. 1 located 1980 feet from the south line and 1830 feet from the west line of Section 2, Township 18 South, Range 27 East and the bottom of the formation at 6533 feet on the log.

5. That applicant proposes to inject Abo residue gas from the Amoco Empire Gasoline Plant and the Phillips Artesia Gasoline Plant and that it is anticipated that approximately 37,000 MCF per day will be injected after all wells which are to be converted to injection wells have been converted. Maximum wellhead injection pressiure is to be approximately 2,000 psig.

6. That applicant also desires a project allowable to be approved, in accordance with Rule 701 of the Commission rules.

7. Applicant also submits an Initial Plan of Operation as provided by Paragraph 11 of the Unit Agreement, said Plan of Operation to include details of special field rules requested.

8. That the special pool rules to be adopted include a project allowable as well as provision for the administrative approval of the conversion of additional wells for injection purposes.

9. In the opinion of applicant, said pressure maintenance project will be in the interest of conservation, prevention of waste, the protection of correlative rights and will tend to promote the greatest ultimate recovery of oil and gas from that portion of the Empire Abo Pool covered by the project.

10. Applicant requests that this matter be set down for hearing at the examiner's hearing to be held on April 25, 1973.

Respectfully submitted,

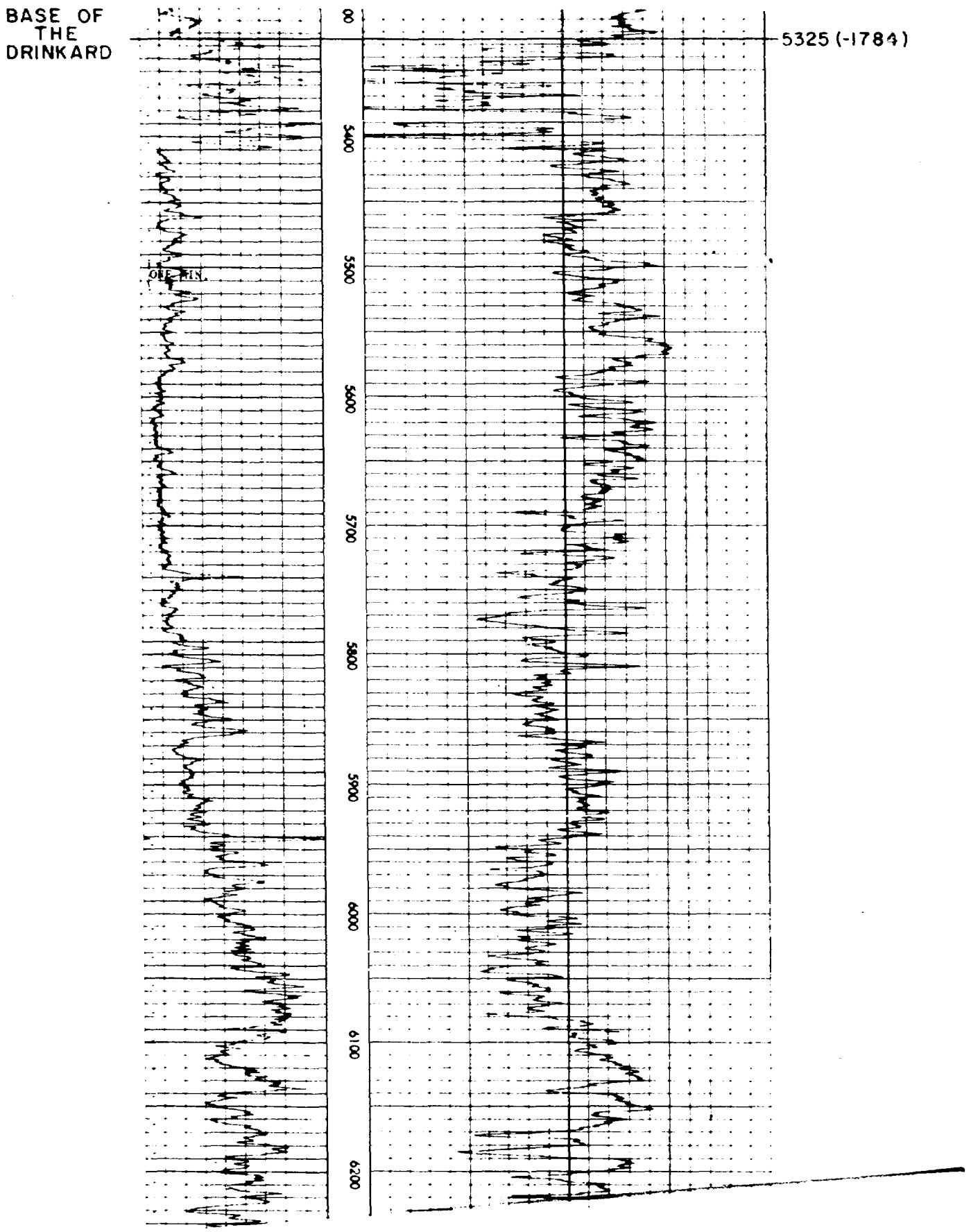
ATLANTIC RICHFIELD COMPANY

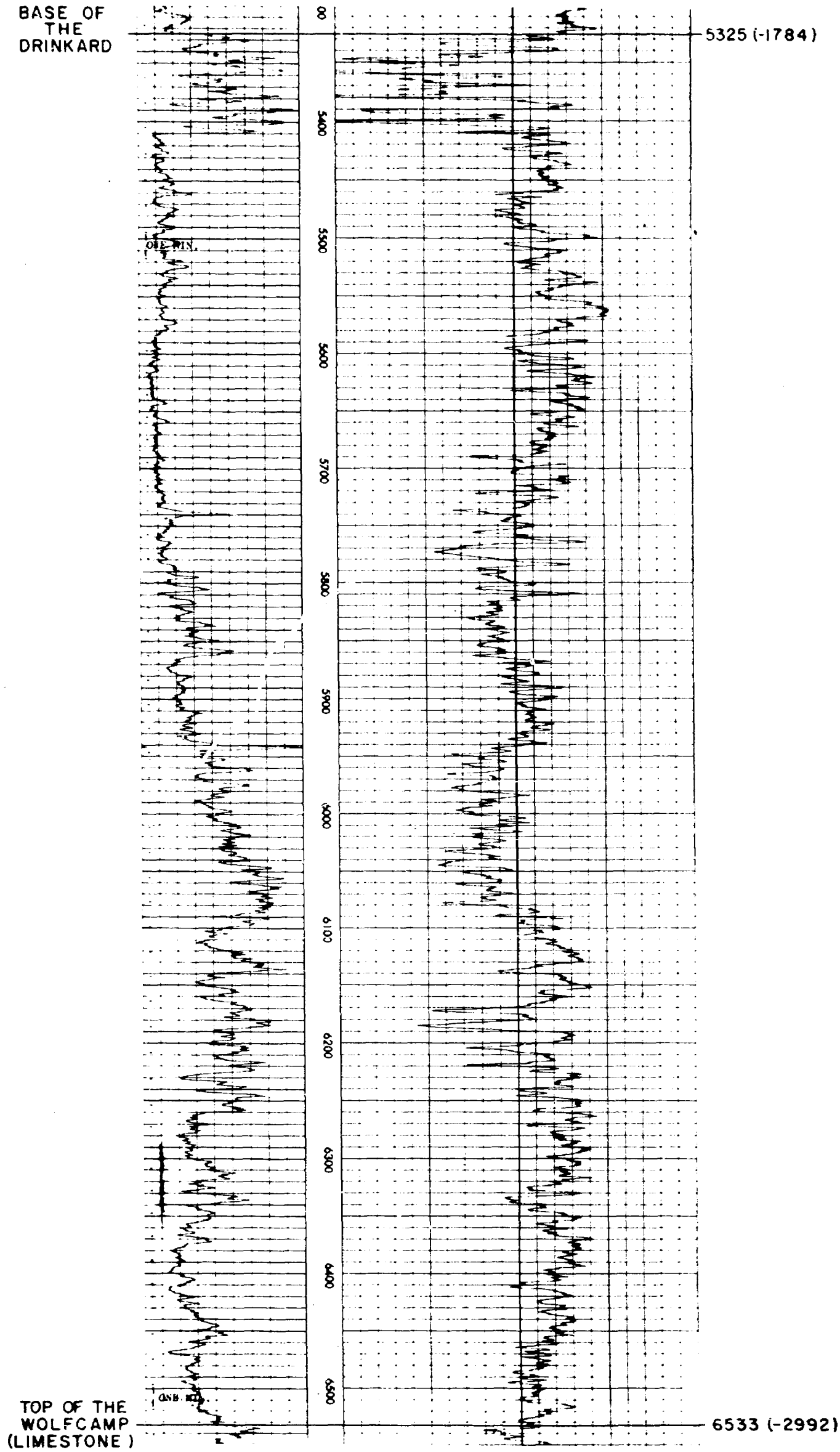
By _____
Member of the Firm of
HINKLE, BONDURANT, COX & EATON
Attorneys for Applicant

EXHIBIT NO. 2, INITIAL PLAN OF OPERATION
TYPE LOG - UNITIZED FORMATION EMPIRE ABO UNIT

Case 4953

AMOCO PRODUCTION COMPANY
State AU No. 1
1980' FSL & 1830' FWL SEC. 2, T-18-S, R-27-E
EDDY COUNTY, NEW MEXICO
RADIOACTIVITY LOG




BASE OF THE DRINKARD
5325 (-1784)
5400
5500
5600
5700
5800
5900
6000
6100
6200
6300
6400
6500
TOP OF THE WOLFCAMP (LIMESTONE)
6533 (-2992)

ATLANTIC RICHFIELD COMPANY

M. Yates "B" (ARC) Well No. 8

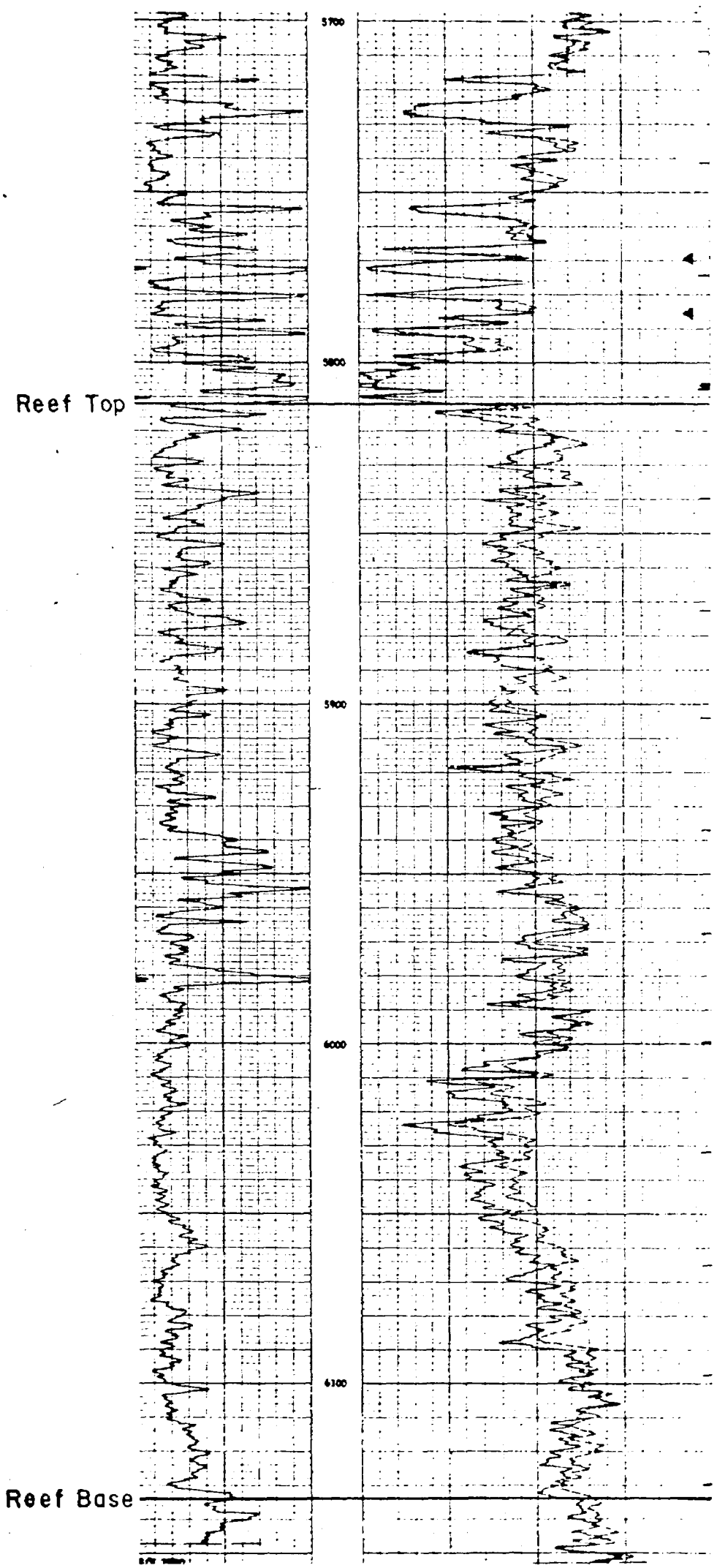
1980' FNL & 2130' FEL SEC. 33, T-17-S, R-28-E

EDDY COUNTY, NEW MEXICO

GAMMA RAY – ISOTRON

EMPIRE ABO UNIT
PLAN OF OPERATION
EXHIBIT 3

Case 4953



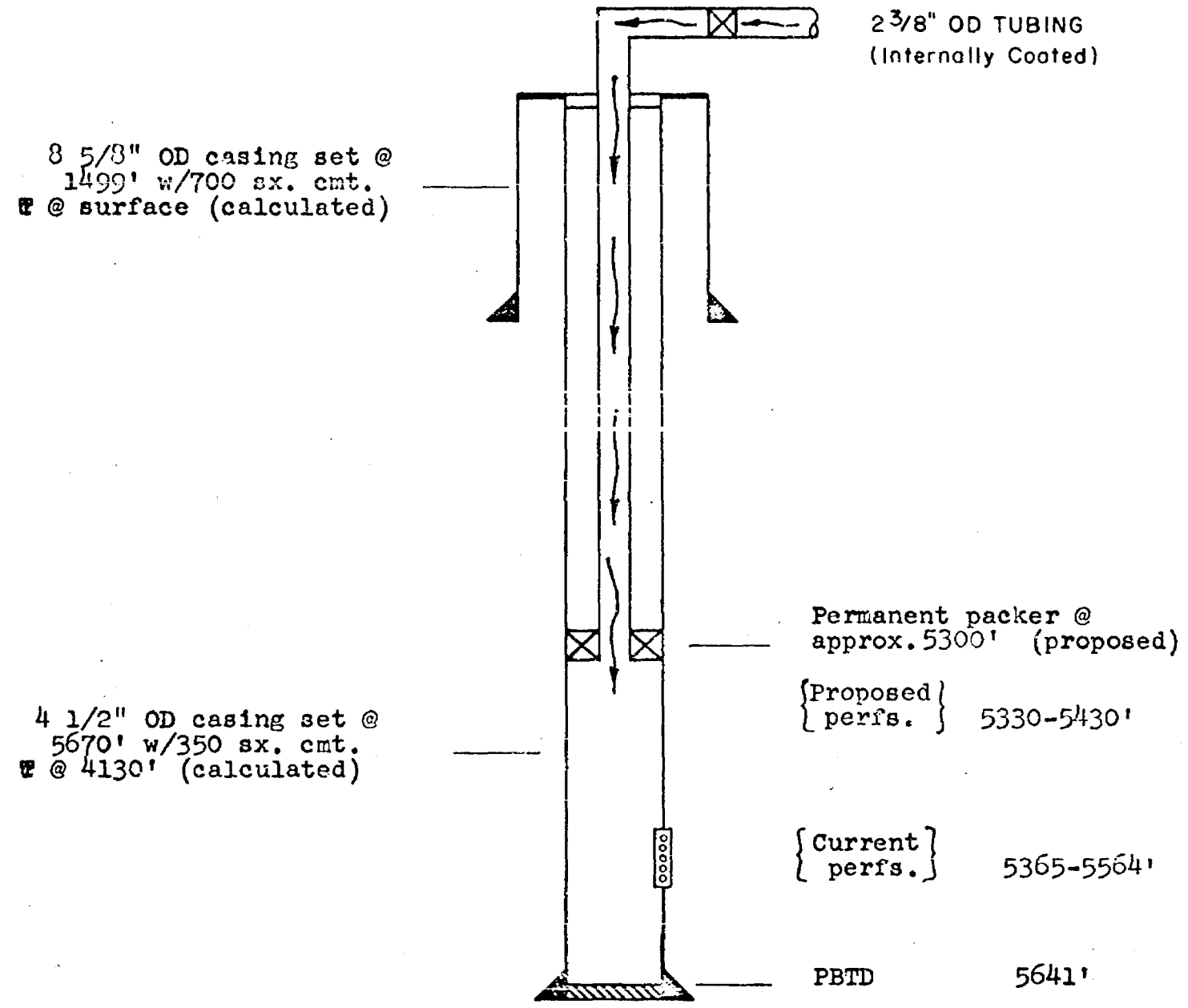
HUMBLE OIL AND REFINING COMPANY

Chalk Bluff Draw Unit A Well No. 4

990' FNL & 2310' FWL SEC. 9, T-18-S, R-27-E

EDDY COUNTY, NEW MEXICO

INJECTION WELL DIAGRAM



Case 495-3

EXHIBIT NO. _____

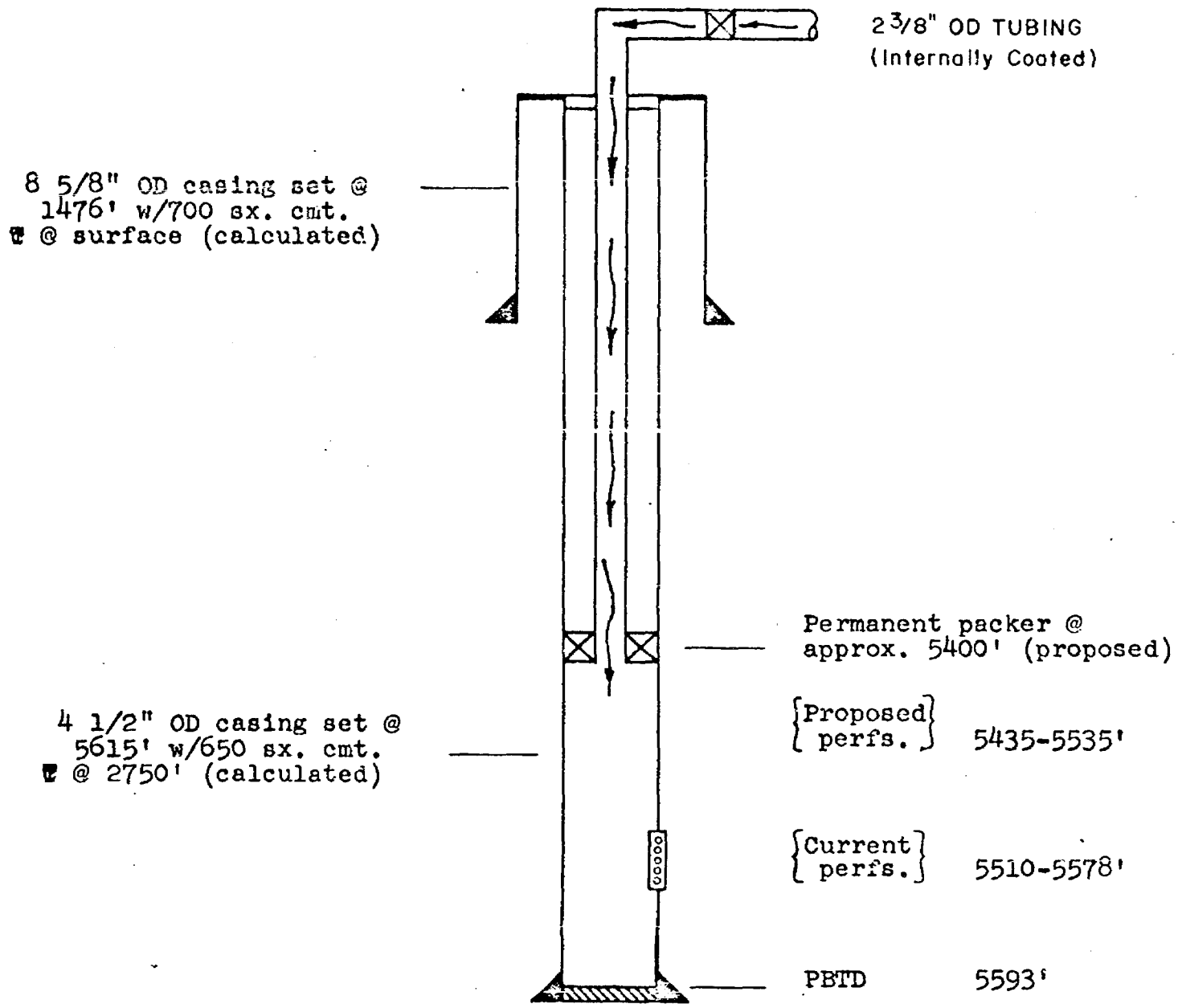
AMOCO PRODUCTION COMPANY

R.H. Windfohr Well No. 4

1582' FSL & 1645' FEL SEC.4, T-18-S, R-27-E

EDDY COUNTY, NEW MEXICO

INJECTION WELL DIAGRAM



Case 4953

EXHIBIT NO. ____

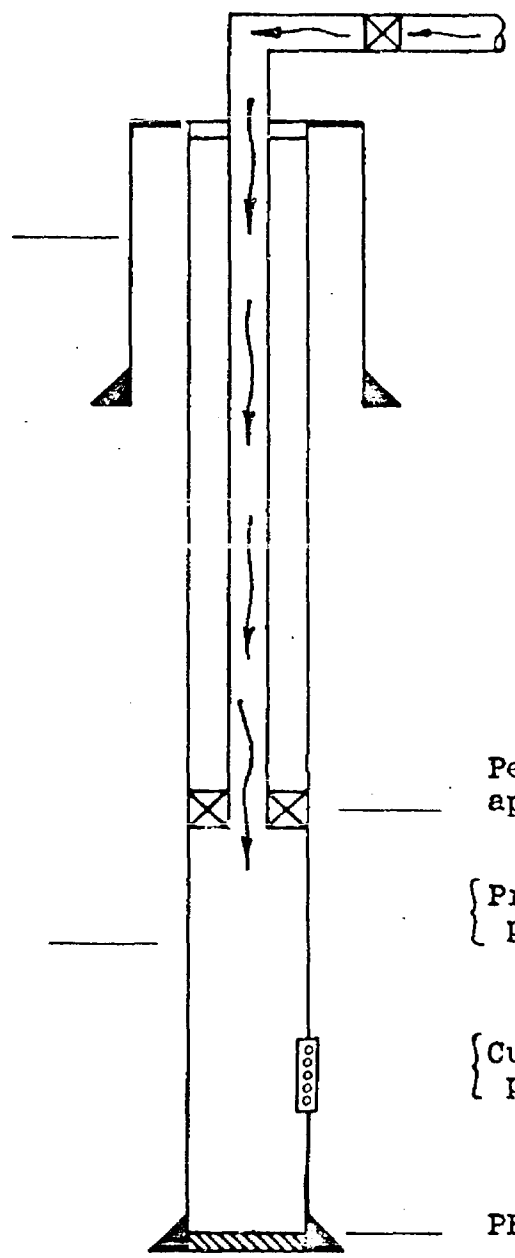
AMOCO PRODUCTION COMPANY

Malco "H" Federal Well No. 2

1980' FNL & 660' FEL SEC. 3, T-18-S, R-27-E

EDDY COUNTY, NEW MEXICO

INJECTION WELL DIAGRAM



2 3/8" OD TUBING
(Internally Coated)

8 5/8" OD casing cmt.
@ 997' w/700 sx.
(cmt. circulated)

Permanent packer @
approx. 5350' (proposed)

5 1/2" OD casing set @
6123' w/350 sx. cmt.
@ 4400' (Temp. Survey)

{Proposed perfs.} 5400-5500'

{Current perfs.} 5650-5670'

PBTD 6090'

Case 4953

EXHIBIT NO. _____

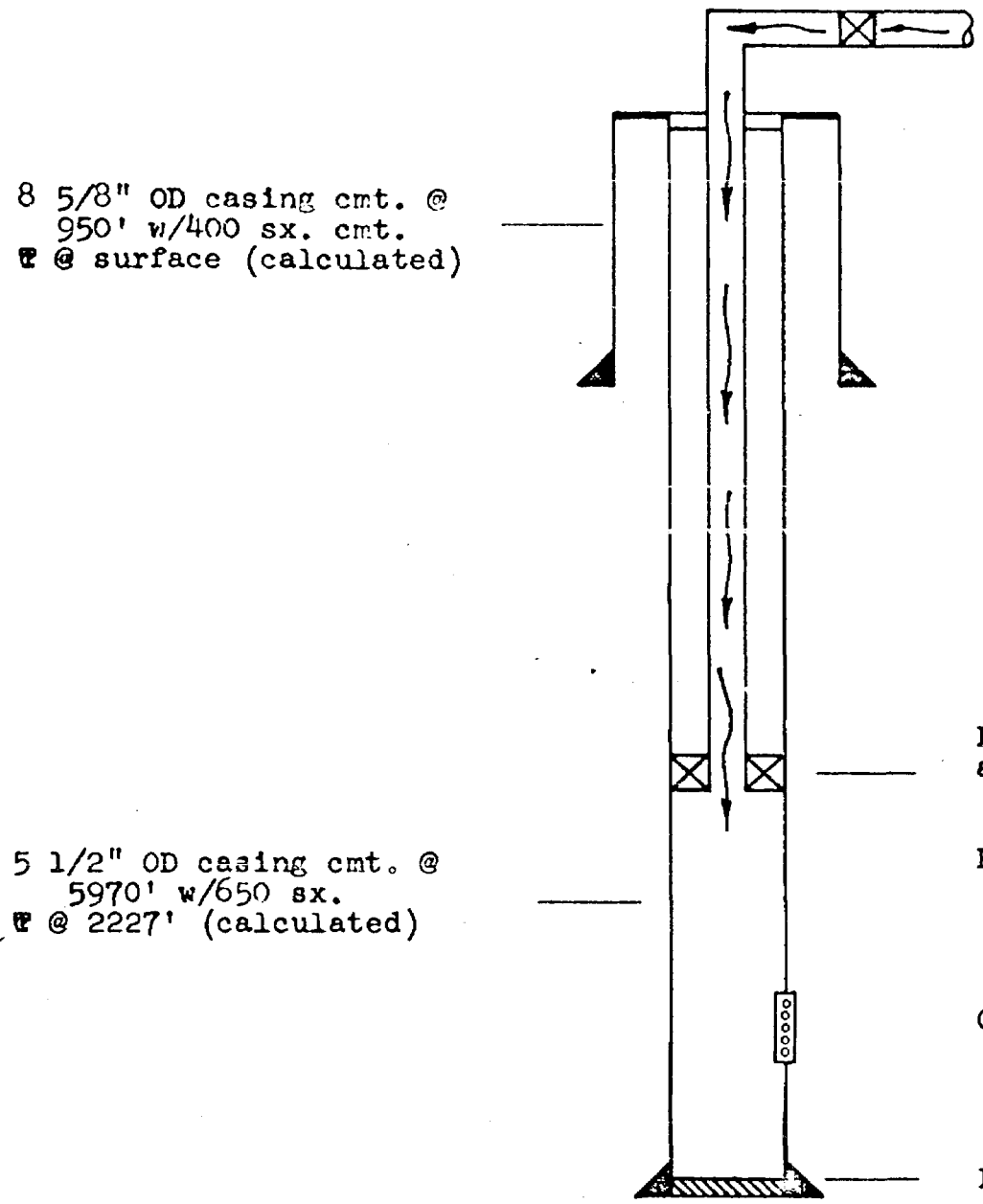
MARTIN YATES, III

Dooley State ABO No. 2

1650' FSL & 1650' FEL SEC. 36, T-17-S, R-27-E

EDDY COUNTY, NEW MEXICO

INJECTION WELL DIAGRAM



Case 4953

EXHIBIT NO. _____

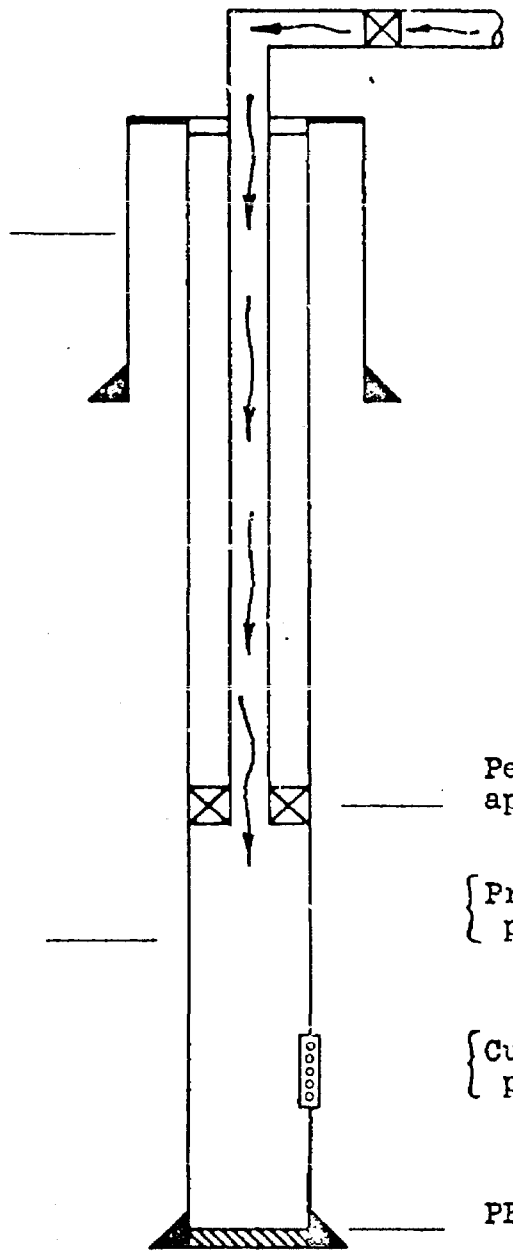
AMOCO PRODUCTION COMPANY

State "BM" Well No. 1

1650' FSL & 2387' FWL SEC. 31, T-17-S, R-28-E

EDDY COUNTY, NEW MEXICO

INJECTION WELL DIAGRAM



2 3/8" OD TUBING
(Internally Coated)

8 5/8" OD casing set @
1275' w/650 sx. cmt.
TOC @ surface (calculated)

Permanent packer @
approx. 5750' (proposed)

4 1/2" OD casing set @
6046' w/750 sx. cmt.
TOC @ 2750' (calculated)

{Proposed perfs.} 5800-5900'

{Current perfs.} 5998-6032'

PBTD 6040'

EXHIBIT NO. _____

Case 495-2

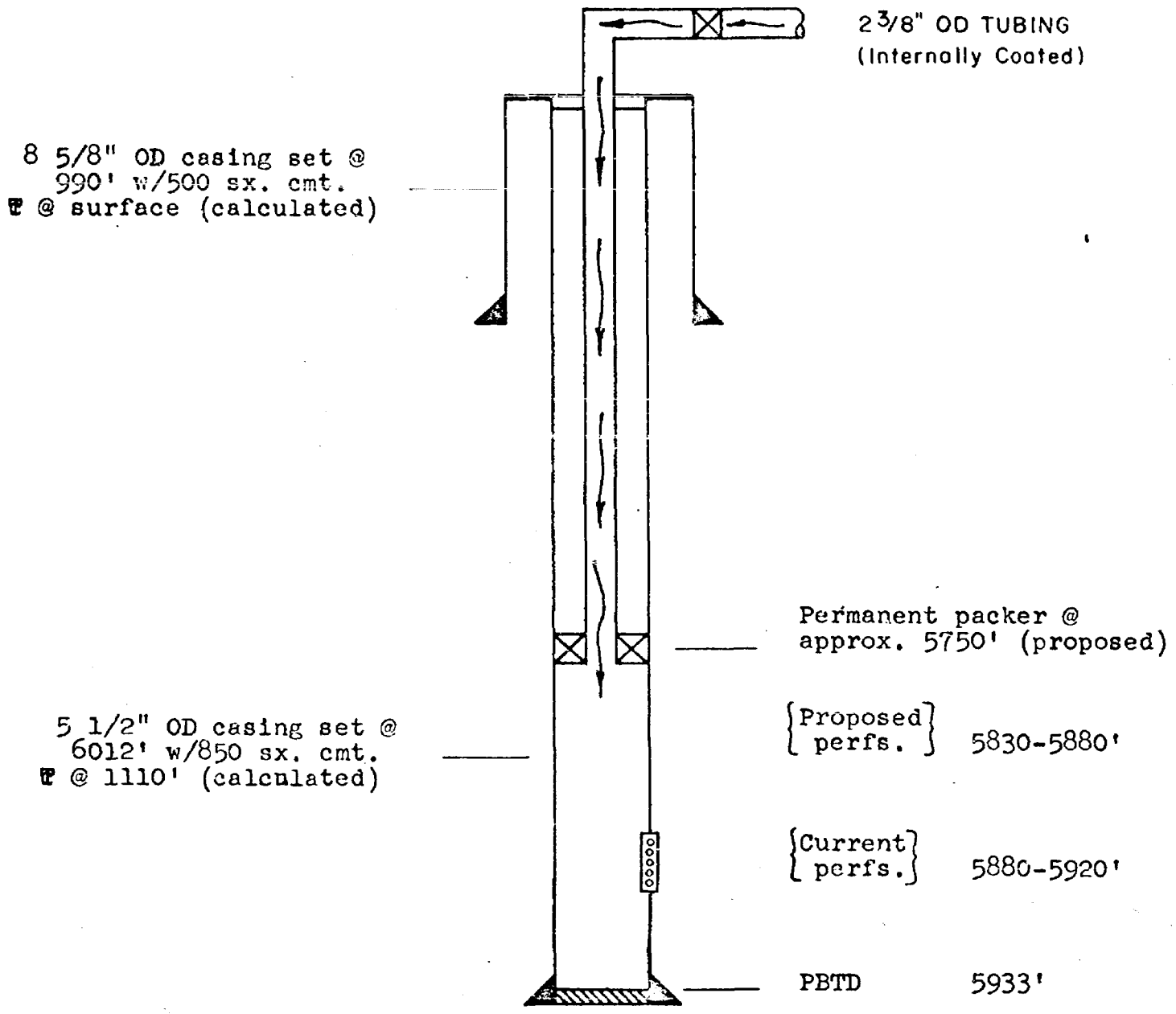
AMOCO PRODUCTION COMPANY

State "BV" Well No. 1

2280' FNL & 978' FEL SEC. 32, T-17-S, R-28-E

EDDY COUNTY, NEW MEXICO

INJECTION WELL DIAGRAM



Case 4953

EXHIBIT NO

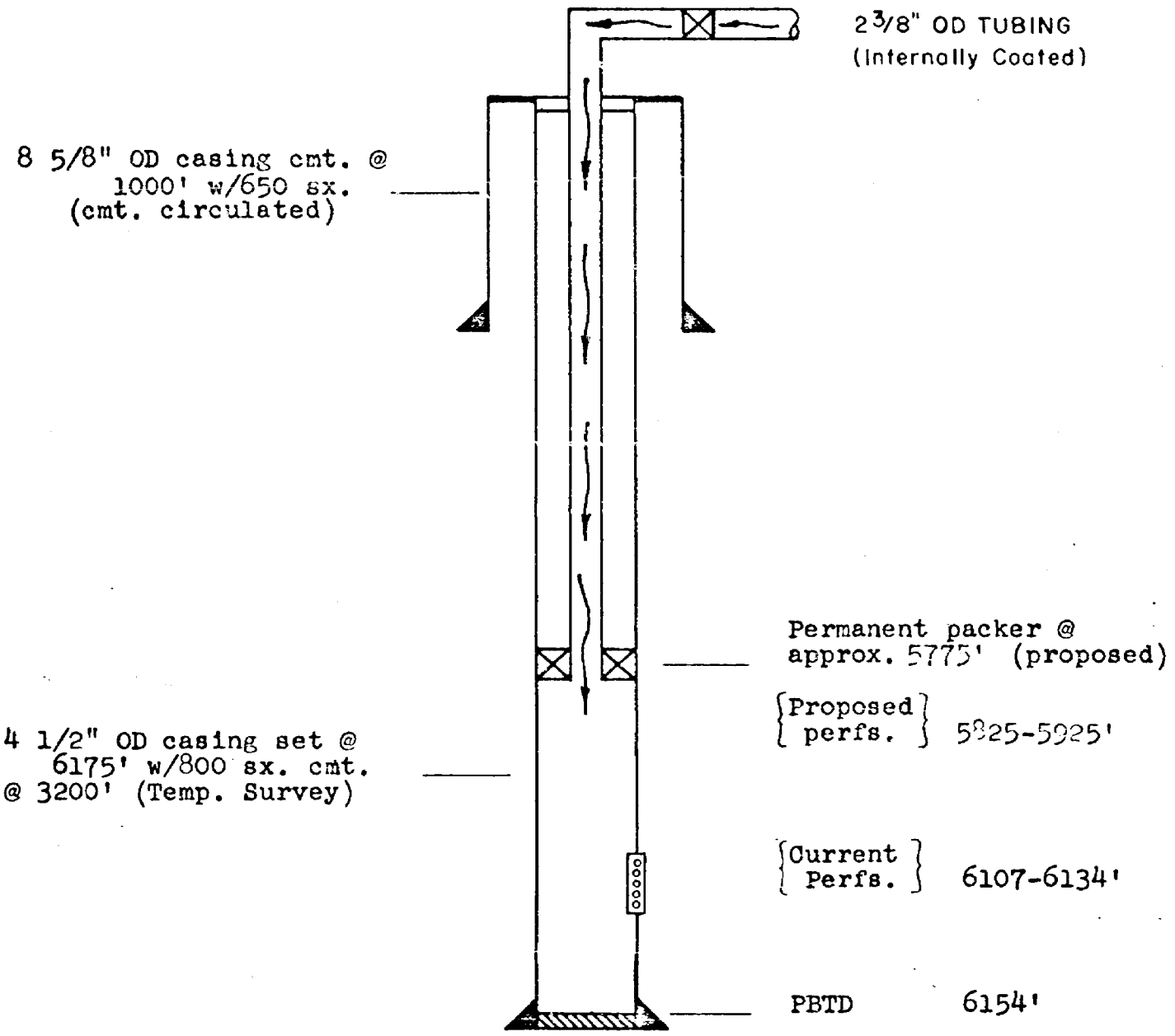
ATLANTIC RICHFIELD COMPANY

M. Yates "B" (ARC) Well No.8

1980' FNL & 2130' FEL SEC. 33, T-17-S, R-28-E

EDDY COUNTY, NEW MEXICO

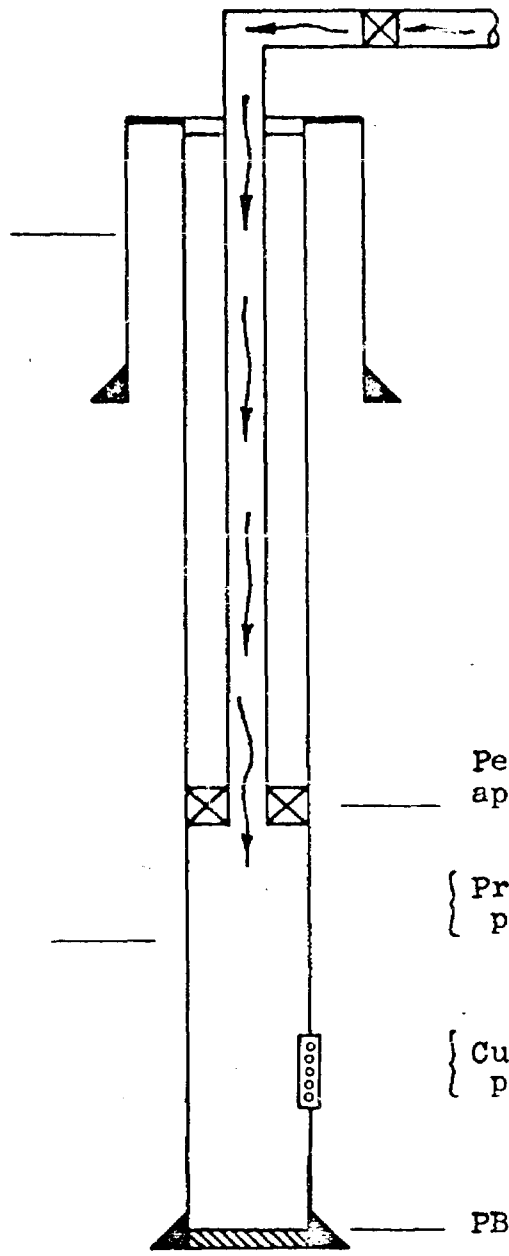
INJECTION WELL DIAGRAM



Case 4953

EXHIBIT NO. _____

HONDO OIL AND GAS COMPANY
(ATLANTIC RICHFIELD COMPANY)
State "A" Well No. 21
1650' FSL & 1980' FWL SEC. 26, T-17-S, R-28-E
EDDY COUNTY, NEW MEXICO
INJECTION WELL DIAGRAM



Case 4953

EXHIBIT NO. _____

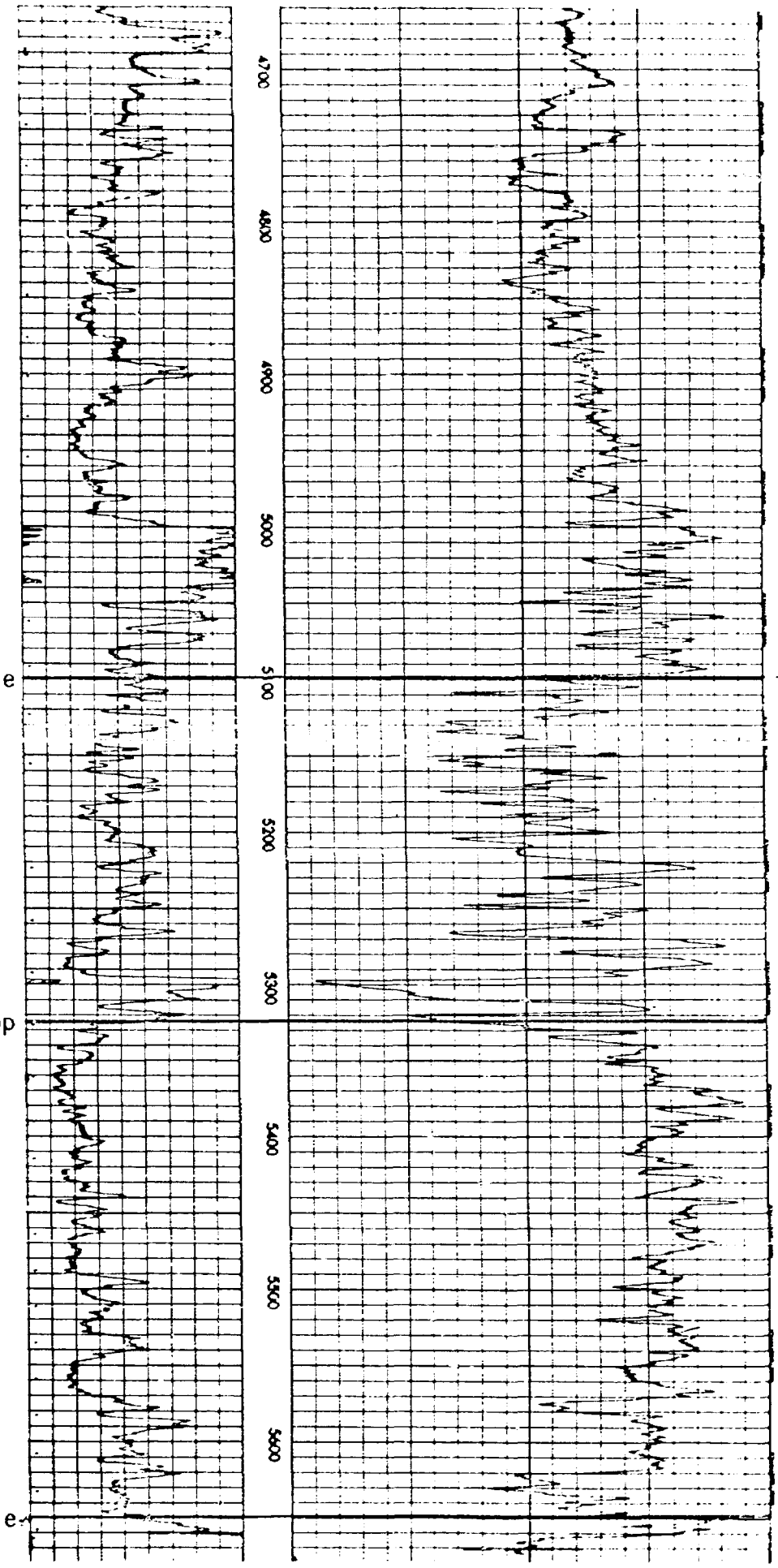
HUMBLE OIL AND REFINING COMPANY

Chalk Bluff Draw Unit A Well No. 4

990' FNL & 2310' FWL SEC. 9, T-18-S, R-27-E

EDDY COUNTY, NEW MEXICO

GAMMA RAY – NEUTRON



Case 4953

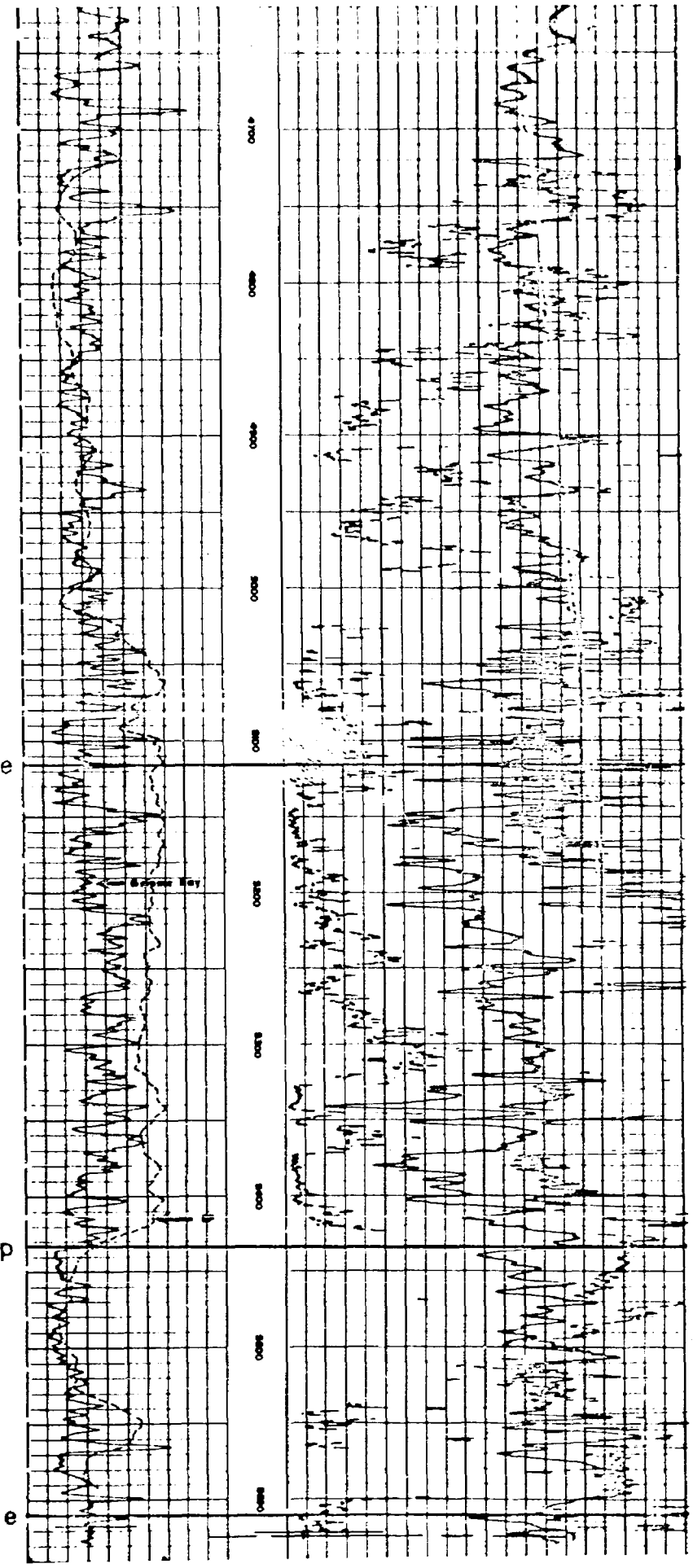
AMOCO PRODUCTION COMPANY

R.H. Windfohr Well No. 4

1582' FSL & 1645' FEL SEC.4, T-18-S, R-27-E

EDDY COUNTY, NEW MEXICO

GAMMA RAY — NEUTRON — LATEROLOG



Case 4953

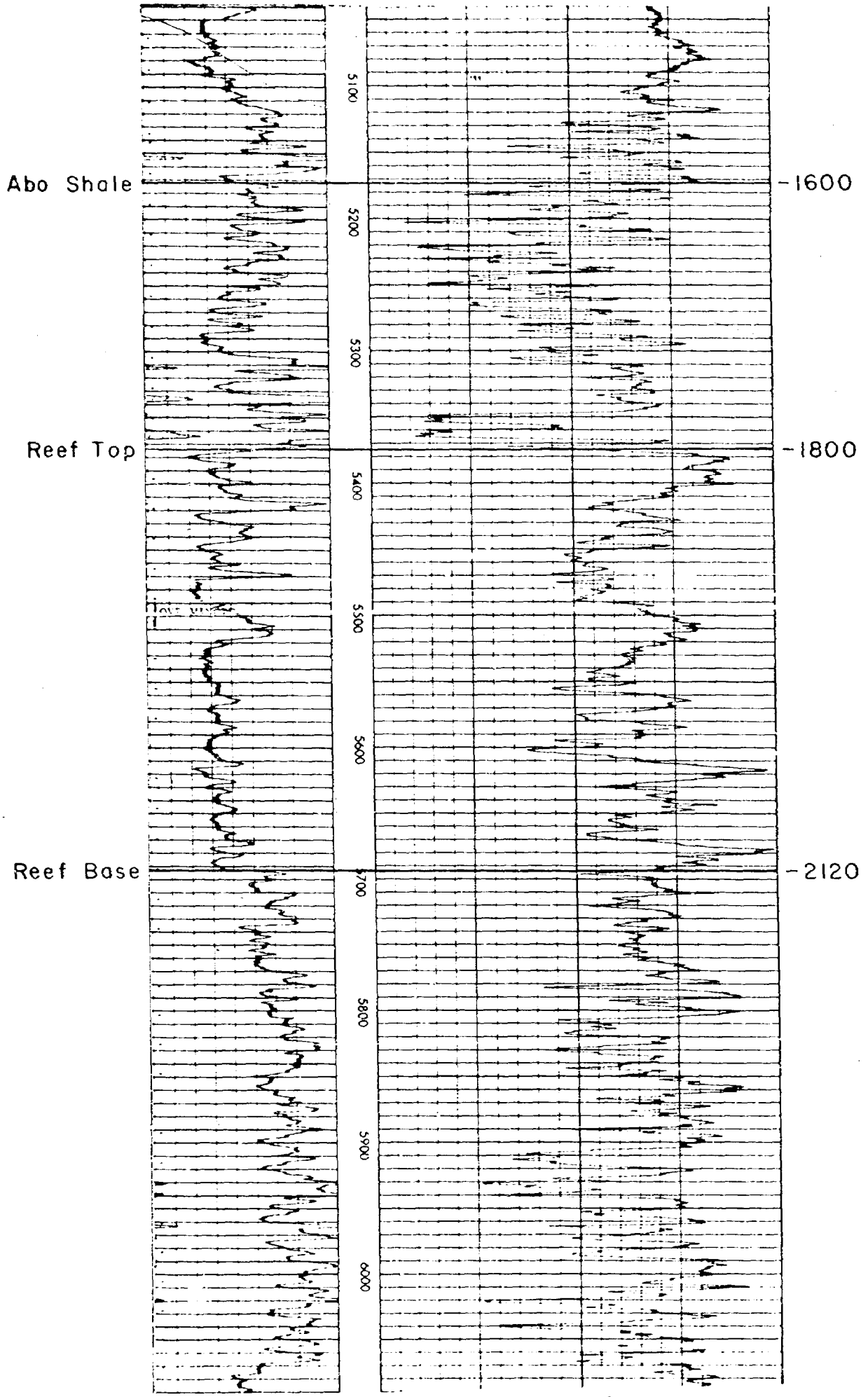
AMOCO PRODUCTION COMPANY

Malco "H" Federal Well No. 2

1980' FNL & 660' FEL SEC. 3, T-18-S, R-27-E

EDDY COUNTY, NEW MEXICO

GAMMA RAY – NEUTRON



Jan 1953

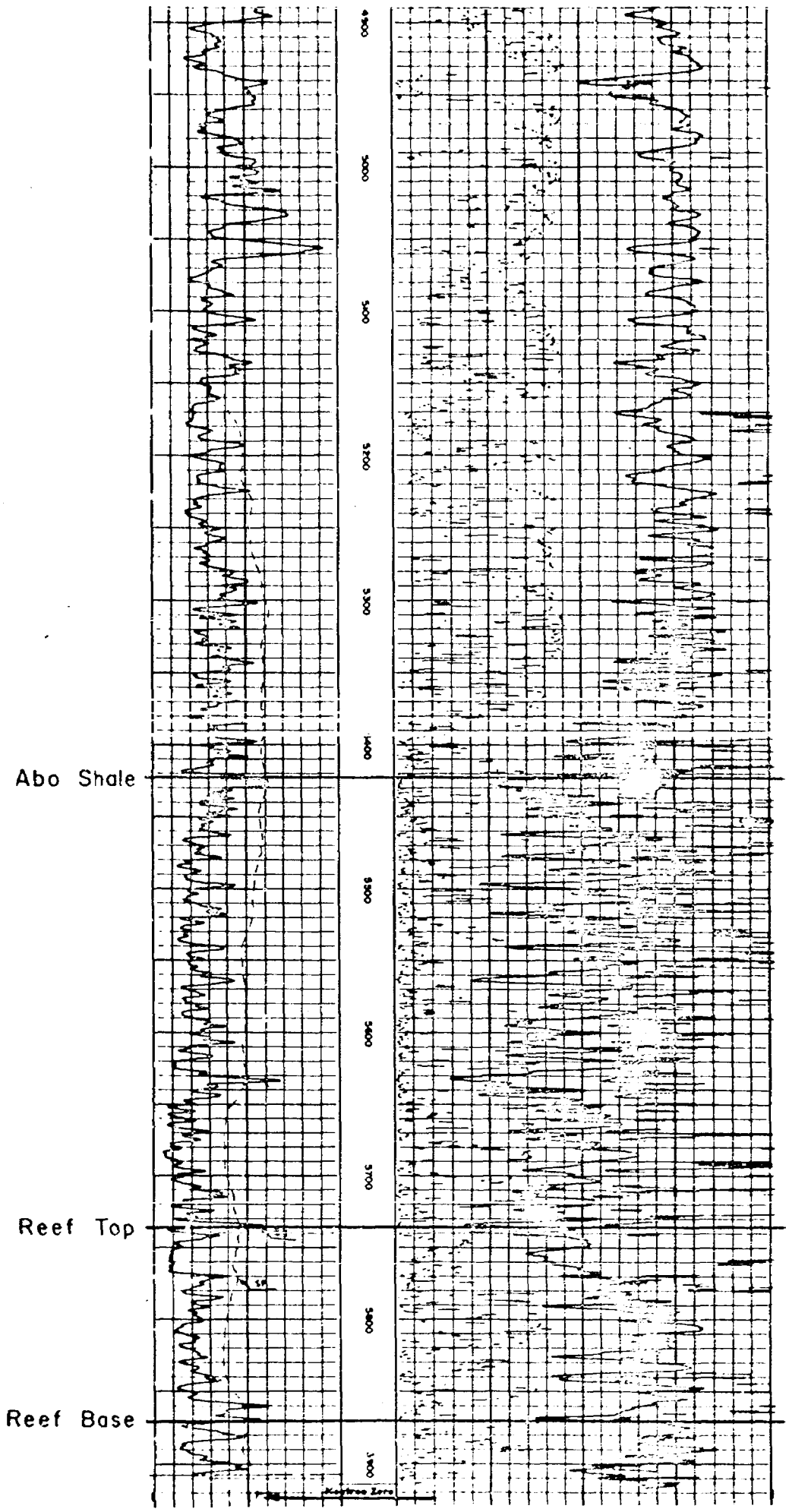
MARTIN YATES, III

Dooley State ABO No. 2

1650' FSL & 1650' FEL SEC. 36, T-17-S, R-27-E

EDDY COUNTY, NEW MEXICO

LATEROLOG-GAMMA RAY-NEUTRON



Case #953

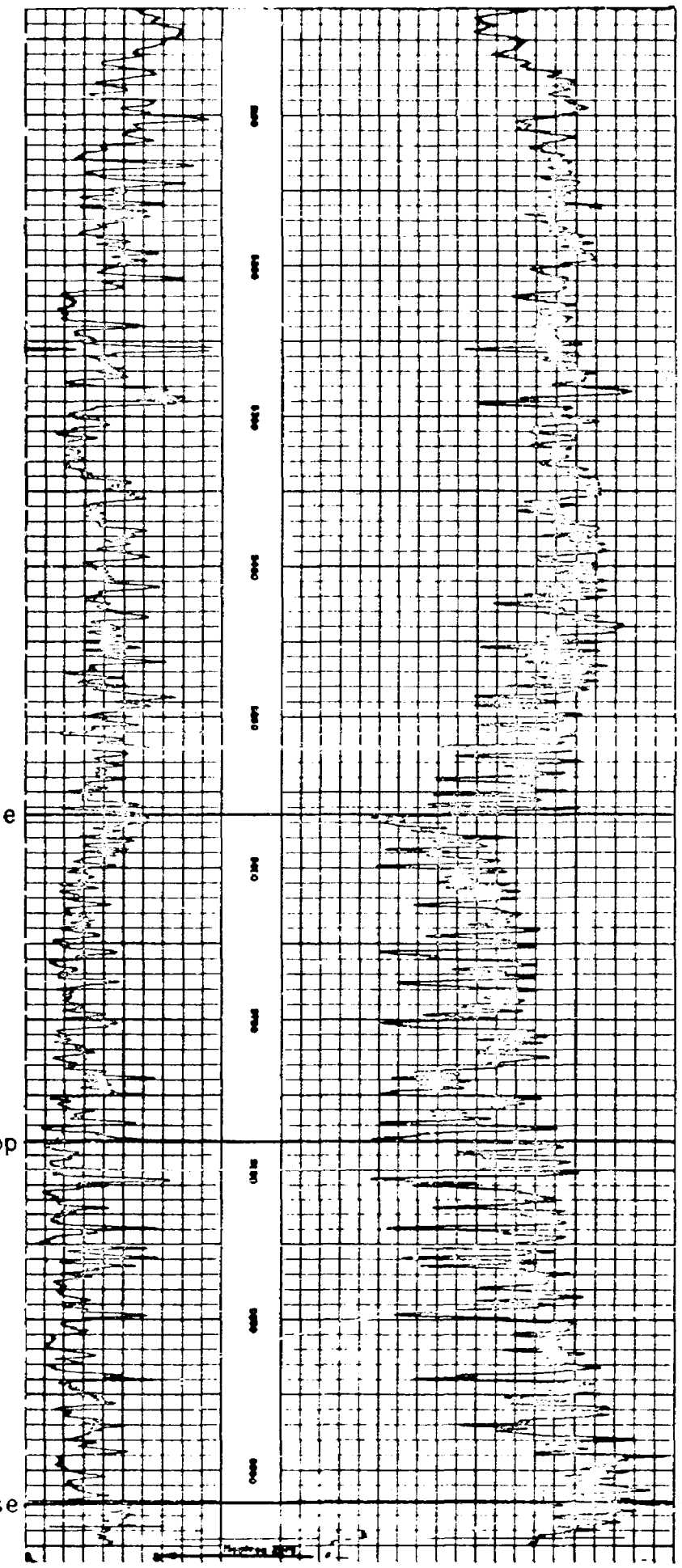
AMOCO PRODUCTION COMPANY

State "BM" Well No. 1

1650' FSL & 2387' FWL SEC. 31, T-17-S, R-28-E

EDDY COUNTY, NEW MEXICO

GAMMA RAY - NEUTRON



Case 4953

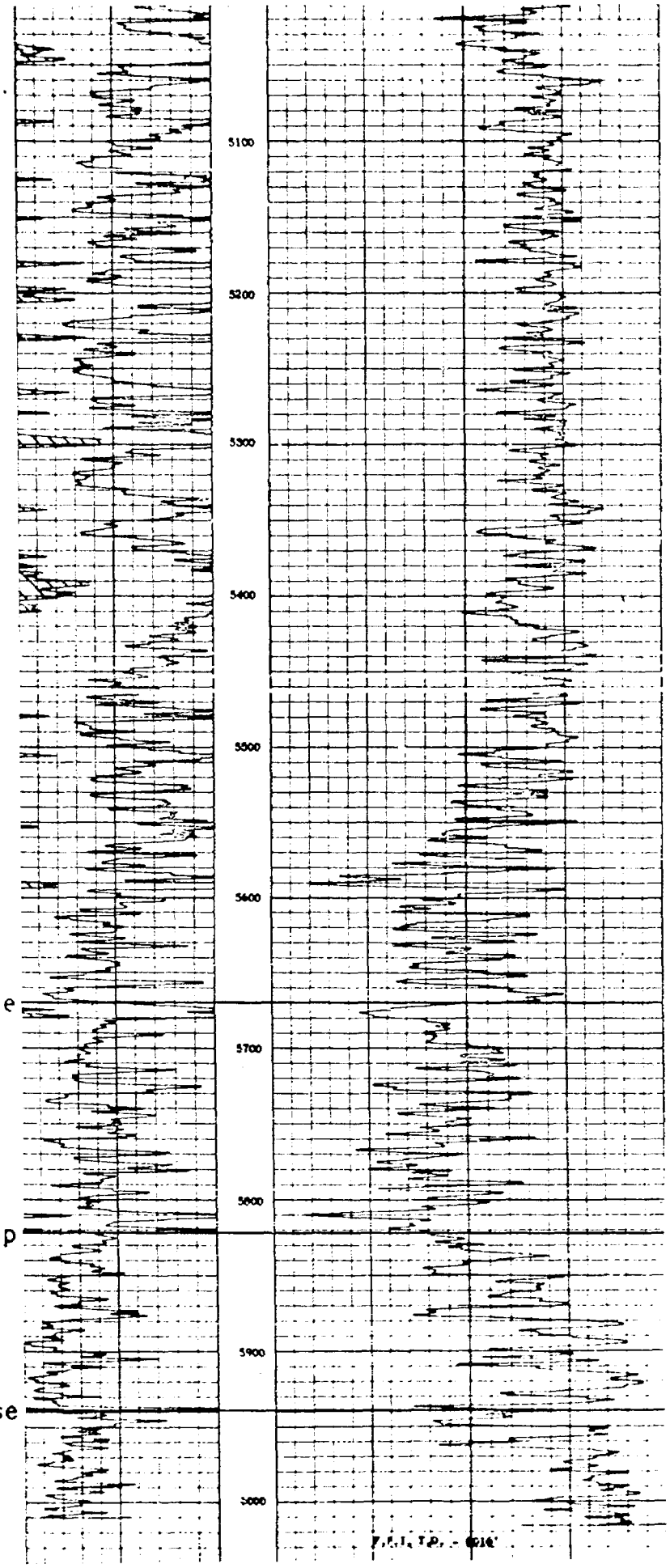
AMOCO PRODUCTION COMPANY

State "BV" Well No. 1

2280' FNL & 978' FEL SEC. 32, T-17-S, R-28-E

EDDY COUNTY, NEW MEXICO

GAMMA RAY – ISOTRON



Case 4953

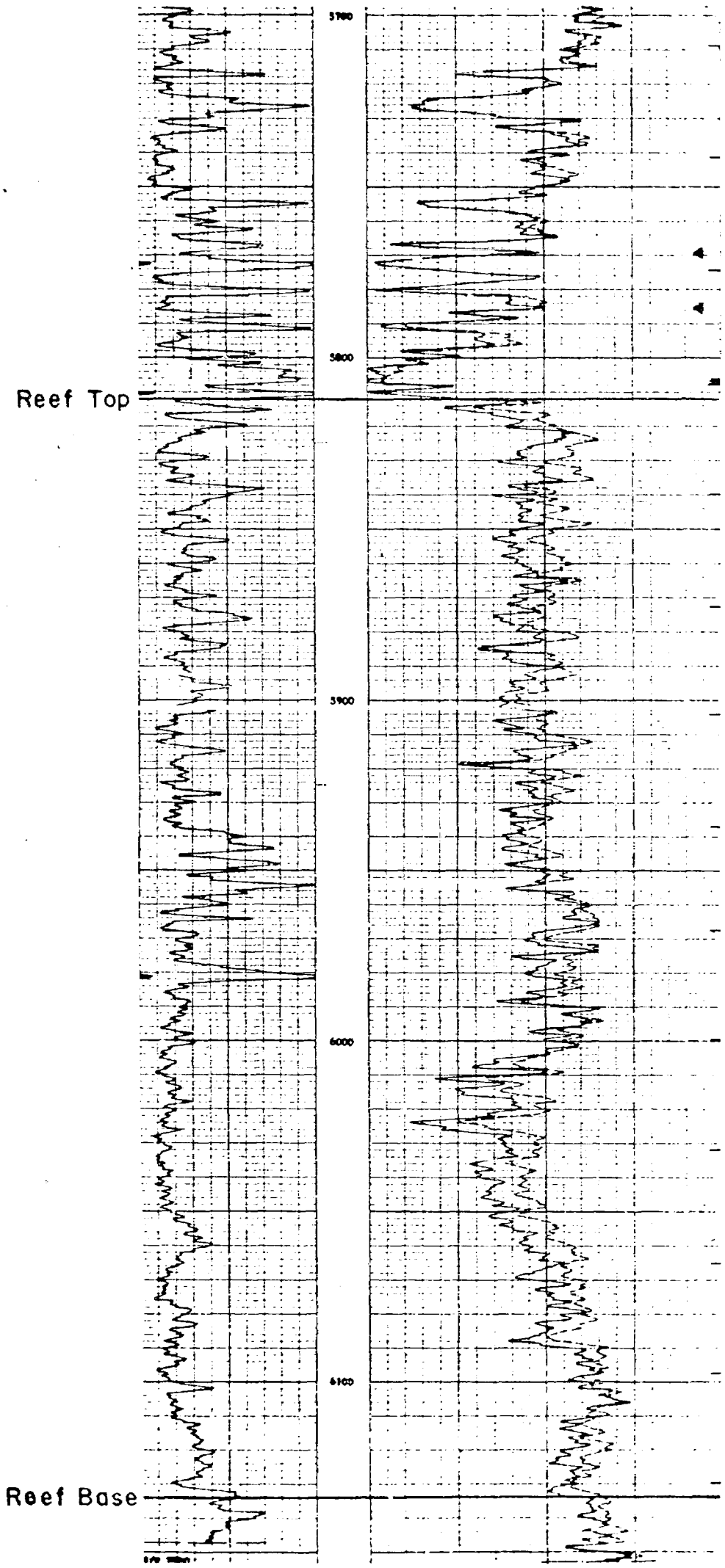
ATLANTIC RICHFIELD COMPANY

M. Yates "B" (ARC) Well No.8

1980' FNL & 2130' FEL SEC. 33, T-17-S, R-28-E

EDDY COUNTY, NEW MEXICO

GAMMA RAY – ISOTRON

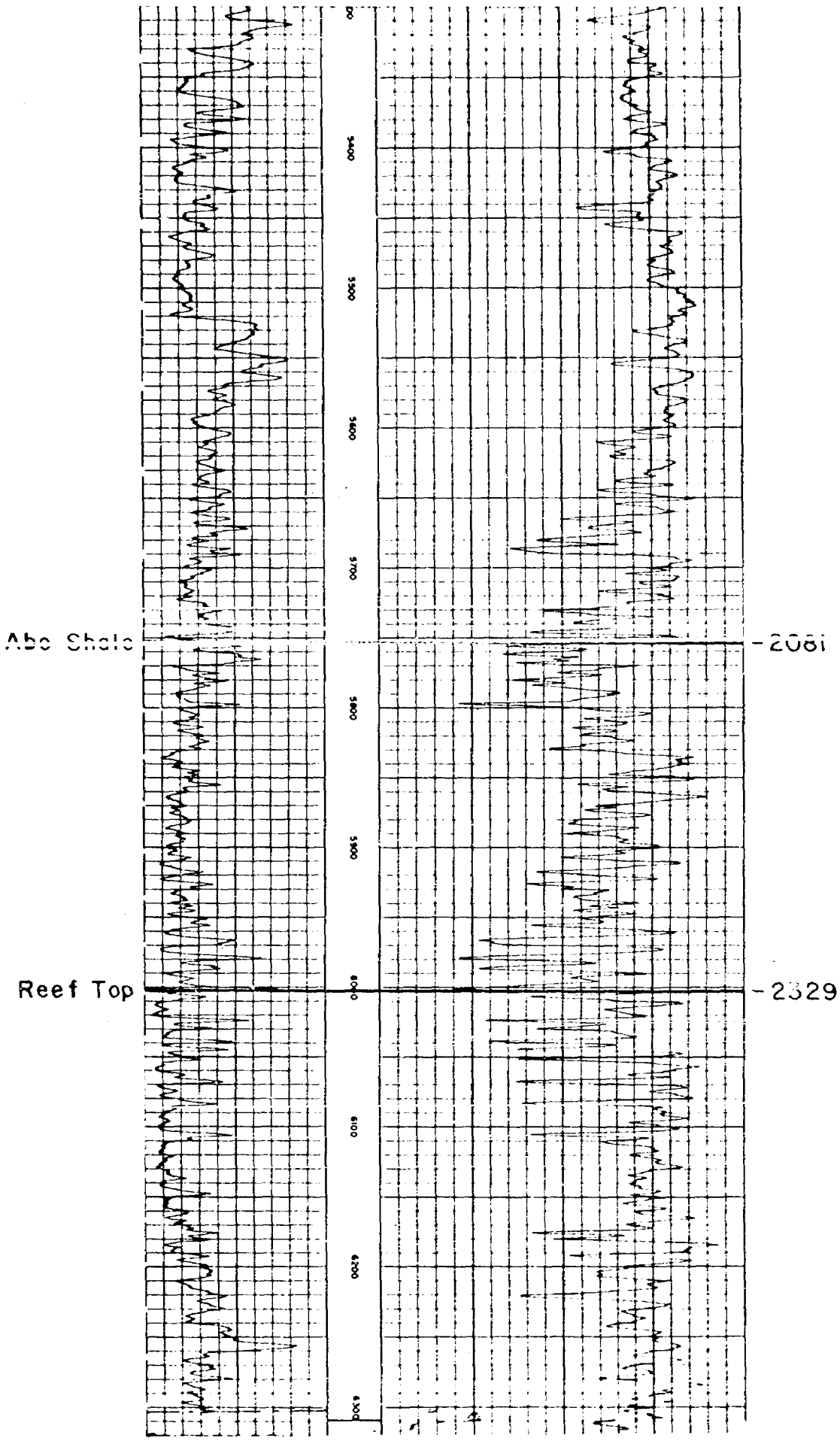


Reef Top -2144

Reef Base -2466

Case 4953

HONDO OIL AND GAS COMPANY
(ATLANTIC RICHFIELD COMPANY)
State "A" Well No. 21
1650' FSL & 1980'FWL SEC.26, T-17-S, R-28-E
EDDY COUNTY, NEW MEXICO
GAMMA RAY - NEUTRON



Case 4953

CASE 4950: Application of Monsanto Company for a dual completion, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks authority to dually complete its Burton Flat Deep Unit Well No. 3 located in Unit V of Section 3, Township 21 South, Range 27 East, Eddy County, New Mexico, to produce gas from the Burton Flat-Morrow Gas Pool Extension and from an undesignated Strawn pool through parallel strings of tubing.

CASE 4951: Application of Atlantic Richfield Company for compulsory pooling, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests underlying the N/2 of Section 15, Township 21 South, Range 26 East, Eddy County, New Mexico, to be dedicated to a well to be drilled by the applicant at a standard location to test the Morrow formation. Also to be considered will be the cost of drilling and completing said well and the allocation of the cost thereof as well as actual operating costs and charges for supervision. Also to be considered is the designation of applicant as operator and the risk involved in drilling said well.

CASE 4952: Application of Atlantic Richfield Company for a unit agreement, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks approval of the Empire Abo Unit Area comprising 11,339 acres, more or less of State and Federal lands in Townships 17 and 18 South, Ranges 27, 28, and 29 East, Eddy County, New Mexico.

CASE 4953: Application of Atlantic Richfield Company for a pressure maintenance project, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks authority to institute a pressure maintenance project in its Empire Abo Unit Area, Empire-Abo Pool, Eddy County, New Mexico, by the injection of gas into the Abo formation through eight wells in Section 36, Township 17 South, Range 27 East, Sections 3, 4, and 9, Township 18 South, Range 27 East, and Sections 26, 31, 32, and 33, Township 17 South, Range 28 East. Applicant further seeks the promulgation of special rules for the operation of said project, including provision for the assignment of special allowables to wells in the project area based on reservoir voidage factors, the shutting-in of less efficient wells, and volumes of gas injected.

CASE 4954: Application of Chace Oil Company for pool creation and down-hole commingling, Rio Arriba County, New Mexico. Applicant, in the above-styled cause, seeks the creation of a new Gallup Oil Pool and Dakota Oil Pool for its Jicarilla 70 Well No. 3 located in Unit C of Section 33, Township 24 North, Range 4 West, Rio Arriba County, New Mexico. Applicant further seeks authority to commingle production from each of said pools in the well-bore of said well and the establishment of an administrative procedure for down-hole commingling of additional wells to be drilled in the area.

CASE 4955: Application of Pierce & Dehlinger for a non-standard oil proration unit, or in the alternative, compulsory pooling, Lea County, New Mexico. Applicant, in the above-styled cause, seeks approval for

drj

Dan Extra Copy

BEFORE THE OIL CONSERVATION COMMISSION
OF THE STATE OF NEW MEXICO

IN THE MATTER OF THE HEARING
CALLED BY THE OIL CONSERVATION
COMMISSION OF NEW MEXICO FOR
THE PURPOSE OF CONSIDERING:

CASE NO. 4953

Order No. R-4579

APPLICATION OF ATLANTIC RICHFIELD
COMPANY FOR A PRESSURE MAINTENANCE
PROJECT, EDDY COUNTY, NEW MEXICO.

ORDER OF THE COMMISSION

BY THE COMMISSION:

This cause came on for hearing at 9 a.m. on April 25, 1973 at Santa Fe, New Mexico, before Examiner Richard L. Stamets.

NOW, on this _____ day of June, 1973, the Commission, a quorum being present, having considered the testimony, the record, and the recommendations of the Examiner, 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, Atlantic Richfield Company, seeks authority to institute a pressure maintenance project in the Empire-Abo Pool in its Empire-Abo Unit Area, Eddy County, New Mexico, by initially limiting reservoir voidage, and within one year by reinjection of approximately 70 percent of the produced gas, as plant residue gas, into the Abo formation through eight wells in Section 36, Township 17 South, Range 27 East, Sections 3, 4, and 9, Township 18 South, Range 27 East, and Sections 26, 31, 32, and 33, Township 17 South, Range 28 East.

(3) That the applicant further seeks the designation of the project area and the promulgation of special rules and regulations governing said project, including provision for the assignment of special allowables to wells in the project area based on reservoir voidage factors, net gas-oil ratios, the shutting-in or curtailment of less efficient wells, and allowable credit for gas injection wells.

(4) That initially the project area should comprise only the following described area:

EDDY COUNTY, NEW MEXICO

TOWNSHIP 17 SOUTH, RANGE 27 EAST, NMPM
Section 34: S/2 SE/4
Section 36: S/2

TOWNSHIP 17 SOUTH, RANGE 28 EAST, NMPM
Section 25: S/2 and S/2 N/2
Section 26: S/2, S/2 NE/4, and SE/4 NW/4
Section 27: N/2 S/2, SE/4 SE/4, and SW/4 SW/4
Section 31: S/2 and S/2 N/2
Section 32: S/2, NE/4, S/2 NW/4, and NE/4 NW/4
Section 33: S/2, NE/4, S/2 NW/4, and NE/4 NW/4
Section 34: N/2, SW/4, and N/2 SE/4
Section 35: N/2 and N/2 S/2
Section 36: N/2 NW/4 and SW/4 NW/4

TOWNSHIP 17 SOUTH, RANGE 29 EAST, NMPM
Section 29: S/2 NW/4 and N/2 SW/4
Section 30: SW/4, S/2 N/2, and N/2 SE/4

TOWNSHIP 18 SOUTH, RANGE 27 EAST, NMPM
Section 1: All
Section 2: S/2, NE/4 NE/4, SW/4 NE/4, S/2 NW/4, and NW/4 NW/4
Section 3: All
Section 4: SE/4, S/2 NE/4, S/2 SW/4, and NE/4 SW/4
Section 8: E/2 SE/4 and SE/4 NE/4
Section 9: All
Section 10: W/2 and NE/4
Section 11: NW/4, W/2 NE/4, and NE/4 NE/4
Section 15: N/2 NW/4 and SW/4 NW/4
Section 16: N/2, SW/4, N/2 SE/4, and SW/4 SE/4
Section 17: S/2 NE/4, NE/4 NE/4, SE/4 NW/4, NE/4 SW/4, and N/2 SE/4

TOWNSHIP 18 SOUTH, RANGE 28 EAST, NMPM
Section 4: N/2 NW/4, SW/4 NW/4, and NW/4 NE/4
Section 5: NE/4 and N/2 NW/4
Section 6: NW/4, N/2 SW/4, N/2 SE/4, SW/4 SE/4, S/2 NE/4, and NE/4 NE/4

(5) That the applicant has been a major operator in the Empire-Abo Pool and that with a majority of the other operators in said pool has conducted extensive reservoir evaluations and studies in and of said pool.

(6) That said evaluations and studies show that the Empire-Abo Pool will be more efficiently produced through the curtailment of production from high gas-oil ratio wells or by reinjection of plant residue gas, or both, and operation of the pool on a net reservoir voidage basis.

(7) That said evaluations and studies show that production from the project area as described in Finding (4) of this order should be limited to the average reservoir voidage for the calendar year 1972 or 30,000 barrels of oil per day, whichever is less, except that after reinjection ~~of approximately~~ of approximately 70% of ~~70% of~~ the produced gas ~~is instituted~~ has been achieved, the production from said project area should be limited to the average reservoir voidage for the calendar year 1972 or 40,192 barrels of oil per day, whichever is less.

(8) That to provide incentive for the reinjection of produced gas prior to achievement of the full 70 percent reinjection planned, production in excess of the aforementioned 30,000 barrels per day should be

(10) Thatspecial rules and regulations for the operation of the ARCO Empire-Abo Unit Pressure Maintenance Project should be promulgated and, for operational convenience, such rules should provide certain flexibility in authorizing the production of the project allowable from any well or wells in the project area in any proportion, provided that no well in the project area which directly or diagonally offsets a well not committed to said unit producing from the same common source of supply should be allowed to produce more than two top unit allowables for the Empire-Abo Pool.

(11) That approval of the application for a pressure maintenance project and the proposed special rules therefore is in the interest of sound conservation practices and will not cause waste or harm correlative rights.

IT IS THEREFORE ORDERED:

(1) That the applicant, Atlantic Richfield Company, is hereby authorized to institute a pressure maintenance project in the Empire-Abo Pool in its Empire-Abo Unit Area, Eddy County, New Mexico, to be designated the ARCO Empire-Abo Unit Pressure Maintenance Project, initially by the shutting in or curtailment of production from less efficient wells within the project and within 12 months after the effective date of this order by the reinjection of approximately 70 percent of the produced gas, as plant residue gas, into the Abo formation, through the following described wells:

OPERATOR	LEASE NAME	WELL NO.	SECTION	LOCATION
Amoco	Malco "H" Federal	2	3	H
Amoco	Windfuhr Federal	4	4	J
Exxon	Chalk Bluff Draw Unit "A"	4	9	C

All in Township 18 South, Range 27 East, NMPM.

M. Yates III	Dooley Abo State	2	36	J

In Township 17 South, Range 27 East, NMPM.

Hondo	State "A"	21	26	K
Amoco	State "BM"	1	31	K
Amoco	State "BV"	1	32	F
Arco	M. Yates B (ARC)	8	33	G

All in Township 17 South, Range 28 East, NMPM.

(2) That the injection should be through 2 3/8-inch internally coated tubing installed in a packer set within 100 feet of the uppermost perforations, and that the casing-tubing annulus should be fitted with a pressure gauge in order to determine leakage in the casing, tubing, or packer.

(3) That Special Rules and Regulations governing the operation of the ARCO Empire-Abo Unit Pressure Maintenance Project, Eddy County, New Mexico, are hereby promulgated as follows:

SPECIAL RULES AND REGULATIONS
FOR THE
EMPIRE-ABO PRESSURE MAINTENANCE PROJECT

RULE 1. The project area of the ARCO Empire-Abo Unit Pressure Maintenance Project, hereinafter referred to as the Project, shall comprise the area described as follows:

ckd AK

EDDY COUNTY, NEW MEXICO

TOWNSHIP 17 SOUTH, RANGE 27 EAST, NMPM
Section 34: S/2 SE/4
Section 36: S/2

TOWNSHIP 17 SOUTH, RANGE 28 EAST, NMPM
Section 25: S/2 and S/2 N/2
Section 26: S/2, S/2 NE/4, and SE/4 NW/4
Section 27: N/2 S/2, SE/4 SE/4, and SW/4 SW/4
Section 31: S/2 and S/2 N/2
Section 32: S/2, NE/4, S/2 NW/4, and NE/4 NW/4
Section 33: S/2, NE/4, S/2 NW/4, and NE/4 NW/4
Section 34: N/2, SW/4, and N/2 SE/4
Section 35: N/2 and N/2 S/2
Section 36: N/2 NW/4 and SW/4 NW/4

TOWNSHIP 17 SOUTH, RANGE 29 EAST, NMPM
Section 29: S/2 NW/4 and N/2 SW/4
Section 30: SW/4, S/2 N/2, and N/2 SE/4

TOWNSHIP 18 SOUTH, RANGE 27 EAST, NMPM
Section 1: All
Section 2: S/2, NE/4 NE/4, SW/4 NE/4, S/2 NW/4, and NW/4 NW/4
Section 3: All
Section 4 : SE/4, S/2 NE/4, S/2 SW/4, and NE/4 SW/4
Section 8: E/2 SE/4 and SE/4 NE/4
Section 9: All
Section 10: W/2 and NE/4
Section 11: NW/4, W/2 NE/4, and NE/4 NE/4
Section 15: N/2 NW/4 and SW/4 NW/4
Section 16: N/2, SW/4, N/2 SE/4, and SW/4 SE/4
Section 17: S/2 NE/4, NE/4 NE/4, SE/4 NW/4, NE/4 SW/4, and N/2 SE/4

TOWNSHIP 18 SOUTH, RANGE 28 EAST, NMPM
Section 4: N/2 NW/4, SW/4 NW/4, and NW/4 NE/4
Section 5: NE/4 and N/2 NW/4
Section 6: NW/4, N/2 SW/4, N/2 SE/4, SW/4 SE/4, S/2 NE/4, and NE/4 NE/4

RULE 2. The allowable for the Project shall be the sum of the allowables of the several wells within the project area, including those wells which are shut-in, curtailed, or used as injection wells. Allowables for all wells shall be determined in a manner hereinafter prescribed.

RULE 3. That the maximum daily project allowable shall be an amount of oil which will result in reservoir voidage no greater than the average daily reservoir voidage in the project area for the calendar year 1972 or 30,000 barrels of oil per day, whichever is less, except that after reinjection ~~of approximately~~ of approximately 70 percent ~~70~~ of the produced gas ~~is instituted~~ has been achieved the maximum daily project allowable shall be an amount of oil which will result in reservoir voidage no greater than the average daily reservoir voidage for the project area for the year 1972 or 40,192 barrels of oil per day, whichever is less.

RULE 4. That after gas reinjection has commenced but before the full 70 percent reinjection has been achieved, ~~additional~~ allowable in addition to the above-described 30,000 barrels per day may be assigned to the project area, provided that said allowable shall be computed in accordance with Rule 10 below and the following formula and shall not exceed 10,192 barrels of oil per day:

$$\text{Additional Allowable, BOPD} = 97.07\left[2\left(\frac{\text{MCF gas inj. previous month} \times 10}{\text{MCF gas prod. previous month}}\right)^2 + \left(\frac{\text{MCF gas inj. previous month} \times 10}{\text{MCF gas prod. previous month}}\right)\right]$$

(based on gas produced and injected in the project area and shall not)

for the pool during the month of transfer, whichever is less.

RULE 8. The allowable credit assigned to any injection well on a 40-acre proration unit shall be top unit allowable for the Empire-Abo Pool.

RULE 9. The allowable credit assigned to any well which is shut-in or curtailed in accordance with Rule 6, shall be determined by a 24-hour test at a stabilized rate of production, which shall be the final 24-hour period of a 72-hour test throughout which the well should be produced in the same manner and at a constant rate. The daily tolerance limitation set forth in Commission Rule 502 I (a) and the limiting gas-oil ratio (2,000 to 1) for the pool shall be waived during such tests. The project operator shall notify all operators offsetting the well, as well as the Commission, of the exact time such tests are to be conducted. Tests may be witnessed by representatives of the offsetting operators and the Commission, if they so desire.

RULE 10. The allowable credit for residue gas injection shall be calculated in accordance with the appropriate fluid properties current in the reservoir (as determined in accordance with Attachment "B" to this Order) and shall be shown on the Pressure Maintenance Project Operator's Monthly Report.

RULE 11. The basic allowable assigned to each producing well in the Project shall be equal to the well's ability to produce or to top unit allowable for the pool, whichever is less. Wells capable of producing more than top unit allowable may also receive transfer allowable, provided however, that no producing well in the project area which directly or diagonally offsets a well not committed to the unit producing from the same common source of supply shall receive an allowable or produce in excess of two times top unit allowable for the pool.

RULE 12. Each month the project operator shall submit to the Commission a Pressure Maintenance Project Operator's Report, on a form prescribed by the Commission, outlining thereon the data required, and requesting allowables for each of the several wells in the Project as well as the total project allowable.

The aforesaid Pressure Maintenance Project Operator's Report shall be filed in lieu of Form C-120 for the Project.

RULE 13. The Commission shall, upon review of the report and after any adjustments deemed necessary, calculate the allowable for each well in the Project for the next succeeding month in accordance with these rules. The sum of the allowables so calculated shall be assigned to the Project and may be produced from the wells in the Project in any proportion except that no well in the Project which directly or diagonally offsets a well not committed to the unit producing from the same common source of supply shall produce in excess of two times top unit allowable for the pool.

RULE 14. The Secretary-Director of the Commission is hereby authorized to approve such additional producing wells and injection wells at orthodox and unorthodox locations within the boundaries of the ARCO Empire-Abo Unit Area as may be necessary to complete an efficient production and injection pattern, provided said wells are drilled no closer than 660 feet to the outer boundary of said unit nor closer than 10 feet to any quarter-quarter section or subdivision inner boundary and provided that no well shall be approved for gas injection when such well is located closer than 1650 feet to a tract which is not committed to the unit and on which is located a well producing from the same common source of supply. To obtain such approval, the project operator shall file proper application with the Commission, which application, if it seeks authorization to convert additional wells to injection or to drill additional production or injection wells shall include the following:

The aforesaid Pressure Maintenance Project Operator's Report shall be filed in lieu of Form C-120 for the Project.

RULE 13. The Commission shall, upon review of the report and after any adjustments deemed necessary, calculate the allowable for each well in the Project for the next succeeding month in accordance with these rules. The sum of the allowables so calculated shall be assigned to the Project and may be produced from the wells in the Project in any proportion except that no well in the Project which directly or diagonally offsets a well not committed to the unit producing from the same common source of supply shall produce in excess of two times top unit allowable for the pool.

RULE 14. The Secretary-Director of the Commission is hereby authorized to approve such additional producing wells and injection wells at orthodox and unorthodox locations within the boundaries of the ARCO Empire-Abo Unit Area as may be necessary to complete an efficient production and injection pattern, provided said wells are drilled no closer than 660 feet to the outer boundary of said unit nor closer than 10 feet to any quarter-quarter section or subdivision inner boundary and provided that no well shall be approved for gas injection when such well is located closer than 1650 feet to a tract which is not committed to the unit and on which is located a well producing from the same common source of supply. To obtain such approval, the project operator shall file proper application with the Commission, which application, if it seeks authorization to convert additional wells to injection or to drill additional production or injection wells shall include the following:

(1) A plat ~~showing~~ the location of the proposed well, all wells within the ~~project~~ area, and offset operators. ~~locating wells which offset the project area.~~

(2) A schematic drawing of the proposed well which fully describes the casing, tubing, perforated interval, and depth.

(3) A letter stating that all offset operators to the proposed well have been furnished a complete copy of the application and the date of notification.

The Secretary-Director may approve the proposed well if, within 20 days after receiving the application, no objection to the proposal is received. The Secretary-Director may grant immediate approval, provided waivers of objection are received from all offset operators.

RULE 15 Expansion or contractions of the project area may be approved by the Secretary-Director of the Commission administratively when good cause is shown therefor.

(4) That jurisdiction of this cause is retained for the entry of such further orders as the Commission amy deem necessary.

DONE at Santa Fe, New Mexico, on the day and year hereinabove designated.

~~(1) A plat of the unit area, identifying thereon the project area and also those tracts not committed to the unit, and showing the location of all wells within the unit area~~

Empire Abo Unit

Reservoir Voidage Formula:

Equation 1: $$V_{rvb} = Q_o \left[B_o + (R_{pn} - R_s) B_g\right] + (Q_{wp} - Q_{we})B_w$$

Where:

V_{rvb} = Reservoir voidage, bbls. per day
Q_o = Oil production rate, Stock tank bbls. per day
B_o = Oil formation volume factor(1), reservoir volumetric bbls/stock tank bbl.
R_{pn} = Net producing gas-oil ratio, MCF/S.T.B.O.

$$R_{pn} = R_p(1.0 - \frac{G_i}{G_p})$$

Where: R_p = producing gas-oil ratio, MCF/BO
G_i = daily volume of gas injected, MCF/Day
G_p = daily volume of gas produced, MCF/Day

R_s = Solution gas-oil ratio(2), MCF/STBO
B_g = Gas formation volume factor (3), RVB/MCF
Q_{wp} = Water production rate, S.T.B.W./Day
Q_{we} = Aquifer water influx rate, S.T.B.W./Day, determined from reservoir numeric model runs to be 1950 BWPD
B_w = Water formation volume factor, RVBW/STBW, use 1.0

Solving Equation 1 for daily oil rate, Q_o,

Equation 2: $$Q_o = \frac{V_{rvb} - (Q_{wp} - Q_{we}) B_w}{\left[B_o + (R_{pn} - R_s) B_g\right]}$$

(1), (2), (3): These values calculated from ~~fluid analysis data~~ Table of Fluid Properties, Attachment "B"

Attachment "A"

EMPIRE ABO UNIT AREA

Table of Fluid Properties (P Base = 15.025 P_{bp} = 2231)

Tres. = 109°F (569° R)

P_r (PSIA)	BO (RVBO/STBO)	Bg RVB/MCF	Rs (MCF/BBL)	Z
15.025	1.000	194.696	0	1.0
100	1.125	28.229	.180	.965
200	1.163	13.749	.235	.940
300	1.193	8.970	.290	.920
400	1.218	6.692	.345	.915
500	1.244	5.236	.395	.895
600	1.263	4.276	.445	.877
700	1.285	3.644	.495	.872
800	1.304	3.108	.540	.850
900	1.325	2.746	.585	.845
1000	1.344	2.437	.625	.833
1100	1.364	2.178	.675	.819
1200	1.384	1.962	.725	.805
1300	1.404	1.790	.775	.795
1400	1.425	1.649	.825	.789
1500	1.445	1.516	.875	.777
1600	1.465	1.404	.925	.768
1700	1.485	1.304	.975	.758
1800	1.505	1.220	1.025	.751
1900	1.525	1.147	1.075	.745
2000	1.548	1.053	1.125	.720
2100	1.573	1.000	1.175	.718
2200	1.597	.953	1.225	.717
2231	1.606	.939	1.250	.716

P_r = Reservoir average pressure at datum -2264' subsea, lbs/in^2 absolute.

B_o = Oil formation volume factor, reservoir volumetric bbls/stock tank bbl.

B_g = Gas formation volume factor, reservoir volumetric bbls/thousand std. cu. ft.

R_s = Solution Gas/Oil Ratio, Thousand std. cu. ft./stock tank bbls. oil.

Z = Gas Compressibility Factor.

Attachment "B"

~~EXHIBIT~~

~~A-25-79~~

New Mexico-Arizona District
P.O. Box 1710
Hobbs, New Mexico 88240
Telephone 505 393 7106

Case 4953
RLS

January 13, 1978

New Mexico Oil Conservation Commission
P. O. Drawer DD
Artesia, New Mexico 88210

Attn: Mr. W. A. Gressett

Dear Sir:

As per your request, I am sending you the latest test results on the gas being injected into the Empire Abo Formation.

Date	Grs. H_2S/100 cu. ft.	Dew Point
01/12/78	500	5°F @ 2040#

If we can help you in any way, please let Norman or me know.

Yours very truly,

L. Troop

LT:rm

SF

New Mexico-Arizona District
P.O. Box 1710
Hobbs, New Mexico 88240
Telephone 505 393 7163

July 6, 1977

New Mexico Oil Conservation Commission
P. O. Drawer DD
Artesia, New Mexico 88210

Attn: Mr. W. A. Gressett

Dear Sir:

As per your request, I am sending you the latest test results on the gas being injected into the Empire Abo Formation.

Date	Grs. H_2S/100 cu. ft.	Dew Point
06/01/77	420	15°F @ 1900#

If we can help you in any way, please let Norman or me know.

Yours very truly,

L. Troop

LT: rm

New Mexico-Arizona District
Post Office Box 1710
Hobbs, New Mexico 88240
Telephone 505 393 7163

Dick

4953

January 3, 1977

New Mexico Oil Conservation Commission
P. O. Drawer DD
Artesia, New Mexico 88210

Attn: Mr. W. A. Gressett

Dear Sir:

As per your request, I am sending you the latest test results on the gas being injected into the Empire Abo Formation.

Date	Grs. H_2S/100 cu. ft.	Dew Point
11/16/76	440	40°F @ 1980#

If we can help you in any way, please let Norman or me know.

Yours very truly,

L. Troop

L. Troop

LT:rm

AtlanticRichfieldCompany North American Producing Division
Post Office Box 1710
Hobbs, New Mexico 88240
Telephone 505 393 7103

RECEIVED
JAN 14 1976
O. C. C.
ARTESIA, OFFICE

January 13, 1976

New Mexico Oil Conservation Commission
P. O. Drawer DD
Artesia, New Mexico 88210

Attn: Mr. W. A. Gressett

Dear Sir:

In regard to your inquiry about the gas that we are injecting into the Empire Abo Unit, we are running H_2S content and dew point on the gas. Following is a tabulation of the tests we have run.

Prod gas runs 10000 +- grains H_2S/100 cu ft

Bill G says Norman

Date	Grs. H_2S/100 cu.ft.	Dew Point
~~11/20/75~~	~~No test taken~~	~~-16° @ 640 Psig~~
06/14/74	No test taken	-12° @ 654 Psig
01/09/75	160	-18° @ 650 Psig
06/13/75	420	- 8° @ 655 Psig
12/30/75	1800	-14° @1580 Psig

You will note the H_2S content increased considerably on the 12/30/75 test. This was due to the Phillips Plant sending us all sour gas beginning the first week in December.

If we can help you in any way, let Norman or me know.

Yours very truly,

L. Troop

LT: rm

DAN NUTTER

Xerox copies of this letter were made and were signed by ALP to be sent to Amoco and Phillips. Also cc's as indicated.

OIL CONSERVATION COMMISSION

STATE OF NEW MEXICO
P. O. BOX 2088 - SANTA FE
87501

July 12, 1974

Amoco Production Company
P. O. Box 68
Hobbs, New Mexico 88240

Phillips Petroleum Company
Phillips Building
Fourth and Washington
Odessa, Texas 79760

Re: Gasoline Plants
Empire-Abo Pool
Eddy County, New Mexico

Gentlemen:

Your attention is called to Order No. R-4549, as amended by Order No. R-4549-B, which authorized Atlantic Richfield Company to conduct pressure maintenance operations in the Empire-Abo Pool by the injection of residue gas produced by your gasoline plants from the raw Empire-Abo casinghead gas.

Your attention is particularly invited to that paragraph of amended Rule 4 of the Project Rules (as contained in Order No. R-4549-B) wherein "Available Residue Gas" is defined as being all gas produced from the unitized formation less plant shrinkage, plant fuel, and lease fuel required for operation of the lease, and to the next paragraph which provides that no raw gas nor plant residue gas attributable to the project shall be sold or otherwise disposed of by any means other than injection into the unitized formation except during emergency situations of temporary nature.

We recognize that it will be difficult to determine that volume of residue gas which can be attributed to the project after deduction of shrinkage and plant fuel, particularly where gas from other pools or projects is also going into the plant, but this figure will be necessary to permit application of the project's allowable formula.

We therefore request that Amoco, in preparing Sheet 1 of Form C-111 for its Empire Abo Gasoline Plant, and Phillips, in preparing

Sheet 1 of Form C-111 for its Artesia Gasoline Plant, fill out an additional Sheet 1 of Form C-111 for casinghead gas from the ARCO project area only, showing ARCO project gas taken, and making your best estimate of plant fuel, shrinkage, manufactured products, etc., which should be attributed to the ARCO project gas. Also to be shown, of course, would be the volume of residue returned to ARCO for injection.

Your cooperation in providing this information to the Commission will be greatly appreciated, as it is our belief that only with this data available will we be able to help make this important project a success.

Very truly yours,

A. L. PORTER, Jr.
Secretary-Director

ALP/DSN/dr
enclosures

cc: Atlantic Richfield Company
P. O. Box 1610
Midland, Texas 79701

U. S. Geological Survey - Roswell
Oil Conservation Commission - Artesia

OIL CONSERVATION COMMISSION
P. O. BOX 2088
SANTA FE, NEW MEXICO 87501

July 11, 1974

Atlantic Richfield Company
P. O. Box 1610
Midland, Texas 79701

Attention: Mr. C. R. Leggott, Jr.

Re: Emergency Holding Pits
Empire-Abo Pool
Eddy County, New Mexico

COPY

Gentlemen:

Reference is made to your letter dated June 18, 1974, wherein you requested a permit to construct four nylon-reinforced neoprene lined emergency holding pits at four new tank batteries now under construction for the Empire Abo Unit, Empire-Abo Pool, Eddy County, New Mexico.

Atlantic Richfield Company is hereby authorized to construct and utilize the aforesaid pits as proposed subject to the following provisions:

1. The automatic lease shut-down equipment and alarm alert system on each battery shall be installed and maintained in good working order to minimize the possibility of the emergency overflow pits being needed.

2. The oil overflow lines to the pits shall not be connected until the permanent pumps (P-2 on Drawing No. E-P-154) have been installed and are operative.

3. The 4-inch line labeled "Future Inlet" on Drawing No. E-P-154 shall not be connected without prior approval from this office.

4. No deliberate flow of oil into the pits shall be permitted.

OIL CONSERVATION COMMISSION
P. O. BOX 2088
SANTA FE, NEW MEXICO 87501

5. At any time an emergency situation occurs, causing oil to overflow into an emergency holding pit, the Artesia District Office of the Commission shall be immediately notified. All oil shall be removed from the pit within 12 hours after the LACT resumes pipe line shipments.

It is the Commission's belief that the systems as proposed, if operated in accordance with the above provisions, are in the interest of conservation and will prevent waste. Further, that if proper attention and maintenance is given the systems, and if immediate evacuation of the pits is made after use, that they will be environmentally beneficial.

The Commission does reserve the right to rescind this approval if it appears that excessive or negligent use is being made of the pits.

Very truly yours,

A. L. PORTER, Jr.
Secretary-Director

ALP/DSN/dr

cc: U. S. Geological Survey - Roswell
Oil Conservation Commission - Artesia

AtlanticRichfieldCompany

North American Producing Division
Post Office Box 2819
Dallas, Texas 75221
Telephone 214 651 5151

Gordon Hommers
(915) 682 8631

June 18, 1974

Mr. D. S. Nutter, Chief Engineer
New Mexico Oil Conservation Commission
P. O. Box 2088
Santa Fe, New Mexico 87501

Dear Sir:

Atlantic Richfield Company is requesting a permit to construct four nylon reinforced neoprene lined emergency holding pits at four new batteries now under construction for the Empire Abo Unit located in the Empire Abo Field, Eddy County. New Mexico.

Three sets of drawings showing the details of the proposed lined pits are attached to this letter. These drawings are entitled as follows:

Drawing No.	Title
E-P-154	Lined Pit Layout and Piping
B-P-63, Sh. 8 of 14	Piping Outside Battery Limits, Btty. "H"
B-P-63, Sh. 10 of 14	Piping Outside Battery Limits, Btty. "J"
B-P-63, Sh. 11 of 14	Piping Outside Battery Limits, Btty. "K"
B-P-63, Sh. 12 of 14	Piping Outside Battery Limits, Btty. "L"

Each lined pit will be kept empty to insure sufficient capacity for emergency overflow from the three 1000 barrel oil tanks at each battery. There is a high oil tank level lease shutdown control at each battery to shut-in all wells producing into this battery, should the three 1000 barrel oil tanks fill to a predetermined high level. An alarm is actuated before this fill-up occurs to alert the field operators that a system malfunction, such as an LACT Unit failure, has occurred. These oil tanks are also equipped with an overflow line to the proposed lined pit so that in the event of a malfunction to the high oil tank level lease shutdown control, oil will flow to the lined pit instead of overflowing into the battery dike, creating a serious fire hazard, a safety hazard to the operating personnel and a major clean-up job.

As soon as the system malfunction has been corrected the emergency lined holding pit will be emptied by pumping the contained oil back through the treating system and sold to the pipe line through the LACT Unit.

All battery vessel drains are also connected to the lined pit. This oil will be recirculated through the heater treaters using the pump permanently located at each lined pit. Any basic sediment or non pipeline oil remaining in the lined pit will be sold to a reclaiming company so that the lined pit will be kept empty for emergency use when required.

The nylon reinforced neoprene liner will be purchased from the Misco Supply Company, Wichita, Kansas. Atlantic Richfield has used many of these liners in Kansas and Oklahoma with success. This liner was recommended by the Atlantic Richfield Research Center Chemical Engineering Section after tests were made to determine its resistance to saturated hydrocarbon fluids and chemical and acid wastes. Copies of Misco's specifications for the nylon reinforced neoprene liner are attached.

If any additional information or drawings are required by the Commission, Atlantic Richfield will be pleased to furnish them at your request.

Very truly yours,

C. R. Leggott, Jr.

C. R. Leggott, Jr.
District Engineer, West Area
P. O. Box 1610
Midland, Texas 79701

PHONE (316) 265-6641

MISCO SUPPLY CO.
Division of MISCO INDUSTRIES, Inc.
FORMERLY MOUNTAIN IRON & SUPPLY COMPANY

SPECIFICATIONS FOR NYLON REINFORCED NEOPRENE

	MN-21
Total weight, oz./sq.yd.	16.0
Gauge, inches	.021
Kind of coating	Neoprene
Coating distribution	50/50
Base fabric: fiber	Nylon
weight, oz./sq.yd.	5.1
count	22 x 22
denier	840
Grab tensile, lbs./in.	450 x 375
Mullen burst, lbs./sq.in.	825
Hydrostatic, lbs./sq.in.	750
Tongue tear, lbs.	40 x 40
Adhesion of coating, lbs./in.	20
Low Temp. Res., 1/8 in. mandrel	$-40^{\circ}F$
30° flame time, seconds	15[2]
Abrasion Res., Taber, cycles	300[2]
Abrasion Res., duPont Scrub, cycles	2500[2]

$$y = 2\left(\frac{\text{Percent of prod. gas reinjected}}{10}\right)^2 + \frac{\text{percent prod gas reinjected}}{10}$$

2

10% $2\left(\frac{10}{10}\right)^2 + \frac{10}{10} = 2(1) + 1 = 2 + 1 = 3$

20% $2\left(\frac{20}{10}\right)^2 + \frac{20}{10} = 2(2)^2 + 2 = 8 + 2 = 10$

30% $2\left(\frac{30}{10}\right)^2 + \frac{30}{10} = 2(3)^2 + 3 = 18 + 3 = 21$

40% $2\left(\frac{40}{10}\right)^2 + \frac{40}{10} = 2(4)^2 + 4 = 32 + 4 = 36$

50% $2\left(\frac{50}{10}\right)^2 + \frac{50}{10} = 2(5)^2 + 5 = 50 + 5 = 55$

60% $2\left(\frac{60}{10}\right)^2 + \frac{60}{10} = 2(6)^2 + 6 = 72 + 6 = 78$

70% $2\left(\frac{70}{10}\right)^2 + \frac{70}{10} = 2(7)^2 + 7 = 98 + 7 = 105$

$y = .9707\left[2\left(\frac{70}{10}\right)^2 + \frac{70}{10}\right] = 2(7)^2 + 7 = 98 + 7 =$

$y = 97.07$ M

$$y = 97.07\left[2\left(\frac{\text{MCF inj} \times 100}{\text{MCF prod}}\right)^2 + \frac{\text{MCF inj} \times 100}{\text{MCF prod}}\right]$$

@ 30,000 inj MCF prod = 45000

$$y = 97.07\left[2\left(\frac{30{,}000 \times 100}{45000}\right)^2 + \frac{30000 \times 100}{45000}\right]$$

$y = 97.07\left[\quad 8889 \quad + \quad 67 \quad\right]$

BEFORE THE OIL CONSERVATION COMMISSION
OF THE STATE OF NEW MEXICO

IN THE MATTER OF THE HEARING
CALLED BY THE OIL CONSERVATION
COMMISSION OF NEW MEXICO FOR
THE PURPOSE OF CONSIDERING:

CASE NO. 4953
Order No. R-4549

APPLICATION OF ATLANTIC RICHFIELD
COMPANY FOR A PRESSURE MAINTENANCE
PROJECT, EDDY COUNTY, NEW MEXICO.

ORDER OF THE COMMISSION

BY THE COMMISSION:

This cause came on for hearing at 9 a.m. on April 25, 1973, at Santa Fe, New Mexico, before Examiner Richard L. Stamets.

NOW, on this 15th day of June, 1973, the Commission, a quorum being present, having considered the testimony, the record, and the recommendations of the Examiner, 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, Atlantic Richfield Company, seeks authority to institute a pressure maintenance project in the Empire-Abo Pool in its Empire-Abo Unit Area, Eddy County, New Mexico, by initially limiting reservoir voidage, and within one year by reinjection of approximately 70 percent of the produced gas, as plant residue gas, into the Abo formation through eight wells in Section 36, Township 17 South, Range 27 East, Sections 3, 4, and 9, Township 18 South, Range 27 East, and Sections 26, 31, 32, and 33, Township 17 South, Range 28 East.

(3) That the applicant further seeks the designation of the project area and the promulgation of special rules and regulations governing said project, including provision for the assignment of special allowables to wells in the project area based on reservoir voidage factors, net gas-oil ratios, the shutting in or curtailment of less efficient wells, and allowable credit for gas injection wells.

(4) That initially the project area should comprise only the following described area:

EDDY COUNTY, NEW MEXICO

TOWNSHIP 17 SOUTH, RANGE 27 EAST, NMPM
Section 34: S/2 SE/4
Section 35: S/2

TOWNSHIP 17 SOUTH, RANGE 28 EAST, NMPM
Section 25: S/2 and S/2 N/2
Section 26: S/2, S/2 NE/4, and SE/4 NW/4
Section 27: N/2 S/2, SE/4 SE/4, and SW/4 SW/4
Section 31: S/2 and S/2 N/2
Section 32: S/2, NE/4, S/2 NW/4, and NE/4 NW/4
Section 33: S/2, NE/4, S/2 NW/4, and NE/4 NW/4
Section 34: N/2, SW/4, and N/2 SE/4
Section 35: N/2 and N/2 S/2
Section 36: N/2 NW/4 and SW/4 NW/4

TOWNSHIP 17 SOUTH, RANGE 29 EAST, NMPM
Section 29: S/2 NW/4 and N/2 SW/4
Section 30: SW/4, S/2 N/2, and N/2 SE/4

TOWNSHIP 18 SOUTH, RANGE 27 EAST, NMPM
Section 1: All
Section 2: S/2, NE/4 NE/4, SW/4 NE/4, S/2 NW/4, and NW/4 NW/4
Section 3: All
Section 4: SE/4, S/2 NE/4, S/2 SW/4, and NE/4 SW/4
Section 8: E/2 SE/4 and SE/4 NE/4
Section 9: All
Section 10: W/2 and NE/4
Section 11: NW/4, W/2 NE/4, and NE/4 NE/4
Section 15: N/2 NW/4 and SW/4 NW/4
Section 16: N/2, SW/4, N/2 SE/4, and SW/4 SE/4
Section 17: S/2 NE/4, NE/4 NE/4, SE/4 NW/4, NE/4 SW/4, and N/2 SE/4

TOWNSHIP 18 SOUTH, RANGE 28 EAST, NMPM
Section 4: N/2 NW/4, SW/4 NW/4, and NW/4 NE/4
Section 5: NE/4 and N/2 NW/4
Section 6: NW/4, N/2 SW/4, N/2 SE/4, SW/4 SE/4, S/2 NE/4, and NE/4 NE/4

(5) That the applicant has been a major operator in the Empire-Abo Pool and that with a majority of the other operators in said pool has conducted extensive reservoir evaluations and studies in and of said pool.

(6) That said evaluations and studies show that the Empire-Abo Pool will be more efficiently produced through the curtailment of production from high gas-oil ratio wells or by reinjection of plant residue gas or both, and operation of the pool on a net reservoir voidage basis.

(7) That said evaluations and studies show that production from the project area as described in Finding (4) of this order should be limited to the average reservoir voidage for the project area for the calendar year 1972 or 30,000 barrels of oil per day, whichever is less, except that after reinjection of approximately 70 percent of the produced gas has been achieved, the production from said project area should be limited to the average reservoir voidage for the calendar year 1972 or 40,192 barrels of oil per day, whichever is less.

(8) That to provide incentive for the reinjection of produced gas prior to achievement of the full 70 percent reinjection planned, production in excess of the aforementioned 30,000 barrels per day should be permitted within the project area. Said excess production should be computed in accordance with the following formula and should be limited to 10,192 barrels per day:

$$\text{Additional Allowable in Excess of 30,000 BOPD} = 97.07\left[2\left(\frac{\text{MCF gas inj. previous month} \times 10}{\text{MCF gas prod. previous month}}\right)^2 + \left(\frac{\text{MCF gas inj. previous month} \times 10}{\text{MCF gas prod. previous month}}\right)\right]$$

(9) That the aforesaid pressure maintenance project, designated the ARCO Empire-Abo Unit Pressure Maintenance Project, and comprising the above-described area, is in the interest of conservation and should result in the recovery of approximately thirty million barrels of additional oil from said reservoir.

(10) That an administrative procedure should be established whereby said project area may be contracted or expanded for good cause shown and whereby additional injection wells and producing wells at orthodox and unorthodox locations in the project area may be approved without the necessity of notice and hearing.

(11) That special rules and regulations for the operation of the ARCO Empire-Abo Unit Pressure Maintenance Project should be promulgated and, for operational convenience, such rules should provide certain flexibility in authorizing the production of the project allowable from any well or wells in the project area in any proportion, provided that no well in the project area which directly or diagonally offsets a well not committed to said unit producing from the same common source of supply should be allowed to produce more than two top unit allowables for the Empire-Abo Pool.

(12) That approval of the application for a pressure maintenance project and the proposed special rules therefore is in the interest of sound conservation practices and will not cause waste or harm correlative rights.

IT IS THEREFORE ORDERED:

(1) That the applicant, Atlantic Richfield Company, is hereby authorized to institute a pressure maintenance project in the Empire-Abo Pool in its Empire-Abo Unit Area, Eddy County, New Mexico, to be designated the ARCO Empire-Abo Unit Pressure Maintenance Project, initially by the shutting in or curtailment of production from less efficient wells within the project and within 12 months after the effective date of this order by the reinjection of approximately 70 percent of the produced gas, as plant residue gas, into the Abo formation, through the following described wells:

OPERATOR	LEASE NAME	WELL NO.	SECTION	LOCATION
Amoco	Malco "H" Federal	2	3	H
Amoco	Windfuhr Federal	4	4	J
Exxon	Chalk Bluff Draw Unit "A"	4	9	C
All in Township 18 South, Range 27 East, NMPM.				
M. Yates III	Dooley Abo State	2	36	J
In Township 17 South, Range 27 East, NMPM.				
Hondo	State "A"	21	26	K
Amoco	State "BM"	1	31	K
Amoco	State "BV"	1	32	F
Arco	M. Yates B (ARC)	8	33	G
All in Township 17 South, Range 28 East, NMPM.				

(2) That the injection should be through 2 3/8-inch internally coated tubing installed in a packer set within 100 feet of the uppermost perforations, and that the casing-tubing annulus should be fitted with a pressure gauge in order to determine leakage in the casing, tubing, or packer.

(3) That Special Rules and Regulations governing the operation of the ARCO Empire-Abo Unit Pressure Maintenance Project, Eddy County, New Mexico, are hereby promulgated as follows:

SPECIAL RULES AND REGULATIONS
FOR THE
EMPIRE-ABO PRESSURE MAINTENANCE PROJECT

RULE 1. The project area of the ARCO Empire-Abo Unit Pressure Maintenance Project, hereinafter referred to as the Project, shall comprise the area described as follows:

EDDY COUNTY, NEW MEXICO

TOWNSHIP 17 SOUTH, RANGE 27 EAST, NMPM
Section 34: S/2 SE/4
Section 36: S/2

TOWNSHIP 17 SOUTH, RANGE 28 EAST, NMPM
Section 25: S/2 and S/2 N/2
Section 26: S/2, S/2 NE/4, and SE/4 NW/4
Section 27: N/2 S/2, SE/4 SE/4, and SW/4 SW/4
Section 31: S/2 and S/2 N/2
Section 32: S/2, NE/4, S/2 NW/4, and NE/4 NW/4
Section 33: S/2, NE/4, S/2 NW/4, and NE/4 NW/4
Section 34: N/2, SW/4, and N/2 SE/4
Section 35: N/2 and N/2 S/2
Section 36: N/2 NW/4 and SW/4 NW/4

TOWNSHIP 17 SOUTH, RANGE 29 EAST, NMPM
Section 29: S/2 NW/4 and N/2 SW/4
Section 30: SW/4, S/2 N/2, and N/2 SE/4

TOWNSHIP 18 SOUTH, RANGE 27 EAST, NMPM
Section 1: All
Section 2: S/2, NE/4 NE/4, SW/4 NE/4, S/2 NW/4, and NW/4 NW/4
Section 3: All
Section 4: SE/4, S/2 NE/4, S/2 SW/4, and NE/4 SW/4
Section 8: E/2 SE/4 and SE/4 NE/4
Section 9: All
Section 10: W/2 and NE/4
Section 11: NW/4, W/2 NE/4, and NE/4 NE/4
Section 15: N/2 NW/4 and SW/4 NW/4
Section 16: N/2, SW/4, N/2 SE/4, and SW/4 SE/4
Section 17: S/2 NE/4, NE/4 NE/4, SE/4 NW/4, NE/4 SW/4, and N/2 SE/4

TOWNSHIP 18 SOUTH, RANGE 28 EAST, NMPM
Section 4: N/2 NW/4, SW/4 NW/4, and NW/4 NE/4
Section 5: NE/4 and N/2 NW/4
Section 6: NW/4, N/2 SW/4, N/2 SE/4, SW/4 SE/4, S/2 NE/4, and NE/4 NE/4

RULE 2. The allowable for the Project shall be the sum of the allowables of the several wells within the project area, including those wells which are shut in, curtailed, or used as injection wells. Allowables for all wells shall be determined in a manner hereinafter prescribed.

RULE 3. That the maximum daily project allowable shall be an amount of oil which will result in reservoir voidage no greater than the average daily reservoir voidage in the project

area for the calendar year 1972 or 30,000 barrels of oil per day, whichever is less, except that after reinjection of approximately 70 percent of the produced gas has been achieved the maximum daily project allowable shall be an amount of oil which will result in reservoir voidage no greater than the average daily reservoir voidage for the project area for the year 1972 or 40,192 barrels of oil per day, whichever is less.

RULE 4. That after gas reinjection has commenced but before the full 70 percent reinjection has been achieved, allowable in addition to the above-described 30,000 barrels per day may be assigned to the project area, provided that said allowable shall be based on gas produced and injected in the project area and shall be computed in accordance with Rule 10 below and the following formula and shall not exceed 10,192 barrels of oil per day:

$$\text{Additional Allowable in Excess of 30,000 BOPD} = 97.07 \left[2 \left(\frac{\text{MCF gas inj. previous month} \times 10}{\text{MCF gas prod. previous month}} \right)^2 + \left(\frac{\text{MCF gas inj. previous month} \times 10}{\text{MCF gas prod. previous month}} \right) \right]$$

RULE 5. That all calculations of reservoir voidage shall be in accordance with the formula set out in Attachment "A" to this order utilizing the Table of Fluid Properties set out in Attachment "B" of this order.

RULE 6. Allowable credit for injection wells may be transferred to producing wells within the project area, as may the allowable credit for producing wells which, in the interest of more efficient operation of the Project, are shut in or curtailed because of high gas-oil ratio or are shut in for any of the following reasons: Pressure regulation, control of pattern or sweep efficiencies, or to observe changes in pressures or changes in characteristics of reservoir liquids or progress of sweep.

RULE 7. The allowable credit assigned to any well which is shut in or which is curtailed in accordance with the provisions of Rule 6 which allowable credit is to be transferred to any well or wells in the project area for production, shall in no event be greater than its ability to produce during the test prescribed by Rule 9 below or greater than the current top unit allowable for the pool during the month of transfer, whichever is less.

RULE 8. The allowable credit assigned to any injection well on a 40-acre proration unit shall be top unit allowable for the Empire-Abo Pool.

RULE 9. The allowable credit assigned to any well which is shut in or curtailed in accordance with Rule 6, shall be determined by a 24-hour test at a stabilized rate of production, which shall be the final 24-hour period of a 72-hour test throughout which the well should be produced in the same manner and at a constant rate. The daily tolerance limitation set forth in Commission Rule 502 I (a) and the limiting gas-oil ratio (2,000 to 1) for the pool shall be waived during such tests. The project operator shall notify all operators offsetting the well, as well as the Commission, of the exact time such tests are to be conducted. Tests may be witnessed by representatives of the offsetting operators and the Commission, if they so desire.

RULE 10. The allowable credit for residue gas injection shall be calculated in accordance with the appropriate fluid properties current in the reservoir (as determined in accordance with Attachment "B" to this Order) and shall be shown on the Pressure Maintenance Project Operator's Monthly Report.

RULE 11. The basic allowable assigned to each producing well in the Project shall be equal to the well's ability to produce or to top unit allowable for the pool, whichever is less. Wells capable of producing more than top unit allowable may also receive transfer allowable, provided however, that no producing well in the project area which directly or diagonally offsets a well not committed to the unit producing from the same common source of supply shall receive an allowable or produce in excess of two times top unit allowable for the pool.

RULE 12. Each month the project operator shall submit to the Commission a Pressure Maintenance Project Operator's Report, on a form prescribed by the Commission, outlining thereon the data required, and requesting allowables for each of the several wells in the Project as well as the total project allowable. The aforesaid Pressure Maintenance Project Operator's Report shall be filed in lieu of Form C-120 for the Project.

RULE 13. The Commission shall, upon review of the report and after any adjustments deemed necessary, calculate the allowable for each well in the Project for the next succeeding month in accordance with these rules. The sum of the allowables so calculated shall be assigned to the Project and may be produced from the wells in the Project in any proportion except that no well in the Project which directly or diagonally offsets a well not committed to the unit producing from the same common source of supply shall produce in excess of two times top unit allowable for the pool.

RULE 14. The Secretary-Director of the Commission is hereby authorized to approve such additional producing wells and injection wells at orthodox and unorthodox locations within the boundaries of the ARCO Empire-Abo Unit Area as may be necessary to complete an efficient production and injection pattern, provided

said wells are drilled no closer than 660 feet to the outer boundary of said unit nor closer than 10 feet to any quarter-quarter section or subdivision inner boundary and provided that no well shall be approved for gas injection when such well is located closer than 1650 feet to a tract which is not committed to the unit and on which is located a well producing from the same common source of supply. To obtain such approval, the project operator shall file proper application with the Commission, which application, if it seeks authorization to convert additional wells to injection or to drill additional production or injection wells shall include the following:

(1) A plat identifying the lands committed to the unit agreement and those lands not committed to said agreement, and showing the location of the proposed well, all wells within the unit area, and offset operators.

(2) A schematic drawing of the proposed well which fully describes the casing, tubing, perforated interval, and depth.

(3) A letter stating that all offset operators to the proposed well have been furnished a complete copy of the application and the date of notification.

The Secretary-Director may approve the proposed well if, within 20 days after receiving the application, no objection to the proposal is received. The Secretary-Director may grant immediate approval, provided waivers of objection are received from all offset operators.

RULE 15. Expansion or contractions of the project area may be approved by the Secretary-Director of the Commission administratively when good cause is shown therefor.

(4) 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

I. R. TRUJILLO, Chairman

ALEX J. ARMIJO, Member

A. L. PORTER, Jr., Member & Secretary

EMPIRE ABC UNIT

Reservoir Voidage Formula:

Equation 1: $$V_{rvb} = Q_o \left[B_o + (R_{pn} - R_s) B_g \right] + (Q_{wp} - Q_{we}) B_w$$

Where:

V_{rvb} = Reservoir voidage, bbls. per day
Q_o = Oil production rate, Stock tank bbls. per day
B_o = Oil formation volume factor (1), reservoir .volumetric bbls/stock tank bbl.
R_{pn} = Net producing gas-oil ratio, MCF/S.T.B.O.

$$R_{pn} = R_p(1.0 - \frac{G_i}{G_p})$$

Where: R_p = producing gas-oil ratio, MCF/BO
G_i = daily volume of gas injected, MCF/Day
G_p = daily volume of gas produced, MCF/Day

R_s = Solution gas-oil ratio(2), MCF/STBO
B_g = Gas formation volume factor(3), RVB/MCF
Q_{wp} = Water production rate, S.T.B.W./Day
Q_{we} = Aquifer water influx rate, S.T.B.W./Day, determined from reservoir numeric model runs to be 1950 BWPD
B_w = Water formation volume factor, RVBW/STBW, use 1.0

(1), (2), (3): These values calculated from Table of Fluid Properties, Attachment "B".

ATTACHMENT "A"

dr/

EMPIRE ABO UNIT AREA

Table of Fluid Properties (P Base = 15.025 P_{bp} = 2231)

Tres. = 109°F (569° R)

P_r(PSIA)	BO (RVBO/STBO)	Bg RVB/MCF	Rs (MCF/BBL)	Z
15.025	1.000	194.696	0	1.0
100	1.125	28.229	.180	.965
200	1.163	13.749	.235	.940
300	1.193	8.970	.290	.920
400	1.218	6.692	.345	.915
500	1.244	5.236	.395	.895
600	1.263	4.276	.445	.877
700	1.285	3.644	.495	.872
800	1.304	3.108	.540	.850
900	1.325	2.746	.585	.845
1000	1.344	2.437	.625	.833
1100	1.364	2.178	.675	.819
1200	1.384	1.962	.725	.805
1300	1.404	1.790	.775	.795
1400	1.425	1.649	.825	.789
1500	1.445	1.516	.875	.777
1600	1.465	1.404	.925	.768
1700	1.485	1.304	.975	.758
1800	1.505	1.220	1.025	.751
1900	1.525	1.147	1.075	.745
2000	1.548	1.053	1.125	.720
2100	1.573	1.000	1.175	.718
2200	1.597	.953	1.225	.717
2231	1.606	.939	1.250	.716

P_r = Reservoir average pressure at datum -2264' subsea, lbs/in^2 absolute.

B_o = Oil formation volume factor, reservoir volumetric bbls/stock tank bbl.

B_g = Gas formation volume factor, reservoir volumetric bbls/thousand std. cu. ft.

R_s = Solution Gas/Oil Ratio, Thousand std. cu. ft/stock tank bbls. oil.

Z = Gas Compressibility Factor.

ATTACHMENT "B"

dr/

BEFORE THE OIL CONSERVATION COMMISSION

STATE OF NEW MEXICO

APPLICATION OF ATLANTIC RICHFIELD COMPANY FOR APPROVAL OF A PRESSURE MAINTENANCE PROJECT FOR THE EMPIRE ABO POOL TO BE EMBRACED WITHIN THE EMPIRE ABO UNIT AREA CONSISTING OF 11,339.15 ACRES IN TOWNSHIPS 17 AND 18 SOUTH, RANGES 27, 28 AND 29 EAST, EDDY COUNTY, NEW MEXICO, INCLUDING EIGHT GAS INJECTION WELLS AND FOR APPROVAL OF SPECIAL POOL RULES INCLUDING A PROJECT ALLOWABLE

Oil Conservation Commission
Box 2088
Santa Fe, New Mexico 87501

Comes Atlantic Richfield Company, acting by and through the undersigned attorneys, and hereby makes application for approval of a pressure maintenance project for the Empire Abo Pool to be embraced within the Empire Abo Unit Area consisting of 11,339.15 acres in Townships 17 and 18 South, Ranges 27, 28 and 29 East, Eddy County, New Mexico, including eight injection wells and for the approval of special pool rules including a project allowable, and in support thereof respectfully shows:

1. That there is filed herewith a plat showing the location of the proposed injection wells and the location of all other wells within a radius of 2 miles from the proposed injection wells and the formation from which said wells are producing or have produced. The plat also shows the boundaries of the proposed unit area and shows the owners of the oil and gas leases within an area of 2 miles of the proposed unit area.

2. As indicated by Exhibit "A" filed herewith, there are 8 proposed injection wells. All of the injection wells consist of presently producing wells to be converted to injection wells. All of said wells will be completed in such a way as to provide for the injection of gas into the gas zone of the Empire Abo Pool which includes the Abo formation. There are filed herewith logs of all the wells. There are also filed herewith diagrammatic sketches of all the proposed injection wells, showing all casing strings, including diameters and

setting depths, quantities used and tops of cement, perforated or open hole intervals, tubing strings, including diameters and setting depths, and types and location of packers to be used.

3. The proposed pressure maintenance project is within the boundaries of the proposed Unit Agreement for the Empire Abo Unit Area and application has been filed for approval of the unit agreement by the Commission.

4. It is proposed to inject gas for increased recovery purposes into the Empire Abo Pool which includes the Abo formation only. The unit agreement identifies the top of the formation at 5325 feet on the Welex Radioactivity Log dated December 21, 1958 for the Amoco Production Company's State of New Mexico "AU" Well No. 1 located 1980 feet from the south line and 1830 feet from the west line of Section 2, Township 18 South, Range 27 East and the bottom of the formation at 6533 feet on the log.

5. That applicant proposes to inject Abo residue gas from the Amoco Empire Gasoline Plant and the Phillips Artesia Gasoline Plant and that it is anticipated that approximately 37,000 MCF per day will be injected after all wells which are to be converted to injection wells have been converted. Maximum wellhead injection pressiure is to be approximately 2,000 psig.

6. That applicant also desires a project allowable to be approved, in accordance with Rule 701 of the Commission rules.

7. Applicant also submits an Initial Plan of Operation as provided by Paragraph 11 of the Unit Agreement, said Plan of Operation to include details of special field rules requested.

8. That the special pool rules to be adopted include a project allowable as well as provision for the administrative approval of the conversion of additional wells for injection purposes.

9. In the opinion of applicant, said pressure maintenance project will be in the interest of conservation, prevention of waste, the protection of correlative rights and will tend to promote the greatest ultimate recovery of oil and gas from that portion of the Empire Abo Pool covered by the project.

10. Applicant requests that this matter be set down for hearing at the examiner's hearing to be held on April 25, 1973.

Respectfully submitted,

ATLANTIC RICHFIELD COMPANY

By _____

Member of the Firm of
HINKLE, BONDURANT, COX & EATON
Attorneys for Applicant

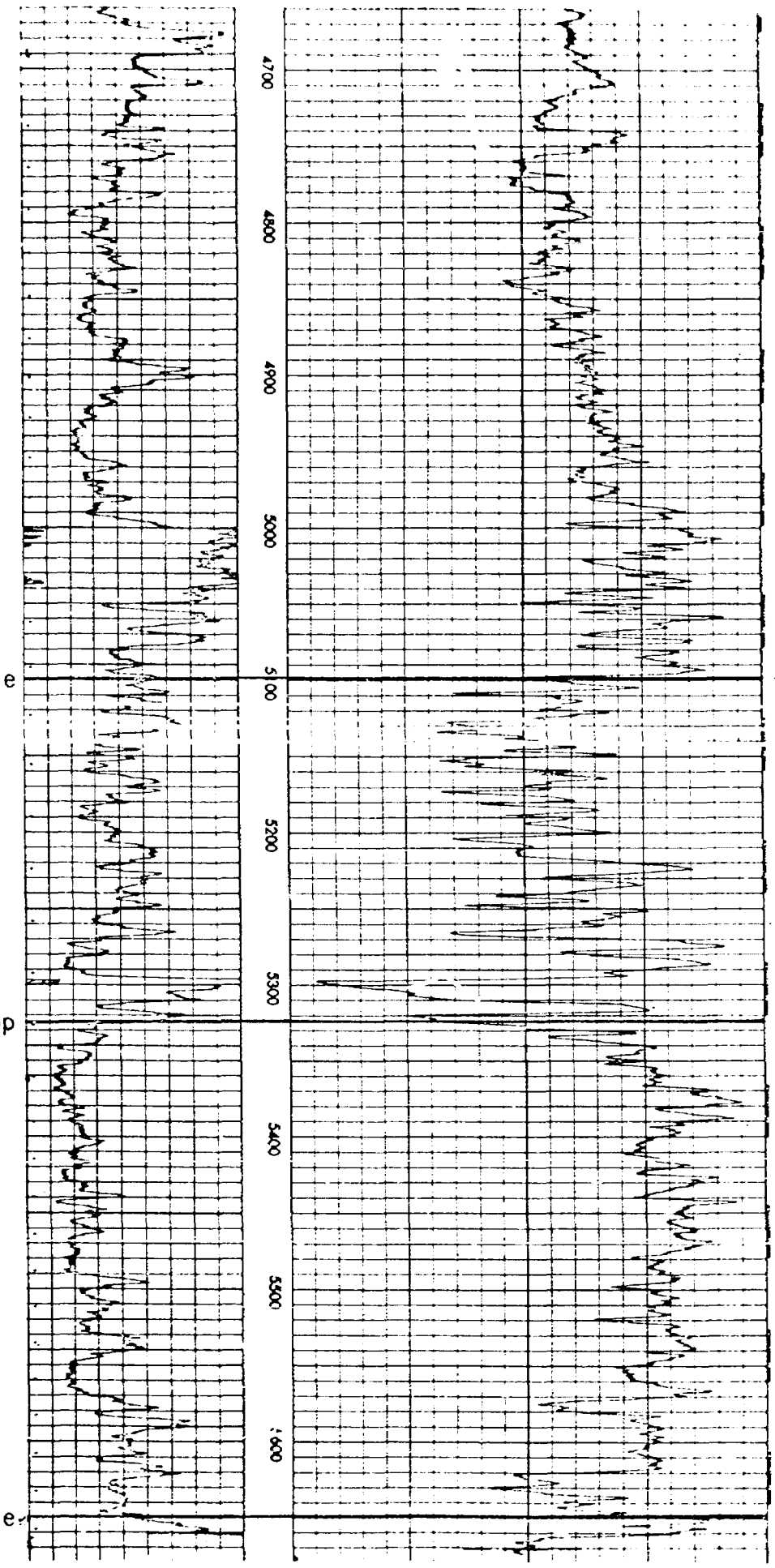
HUMBLE OIL AND REFINING COMPANY

Chalk Bluff Draw Unit A Well No. 4

990' FNL & 2310' FWL SEC. 9, T-18-S, R-27-E

EDDY COUNTY, NEW MEXICO

GAMMA RAY – NEUTRON



Ab Shale -1538

Reef Top -1765

Reef Base -2089

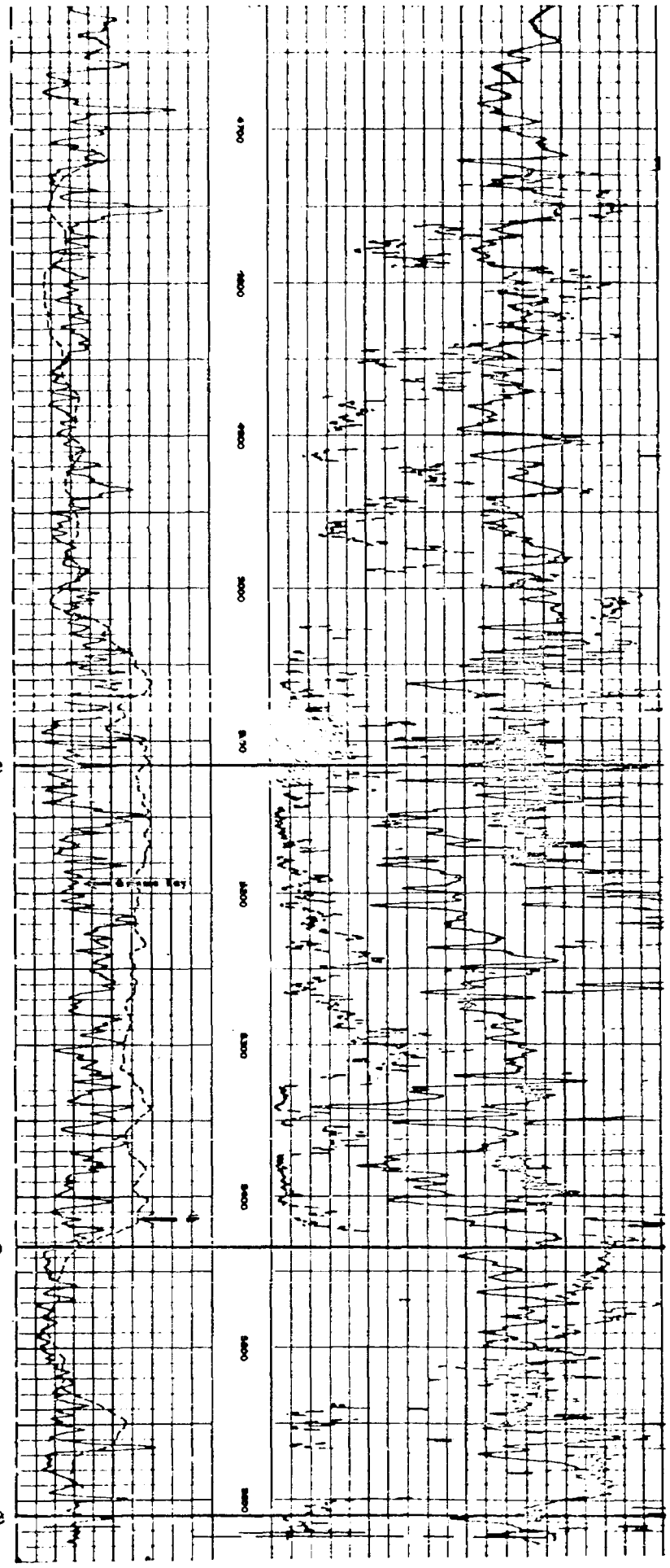
AMOCO PRODUCTION COMPANY

R.H. Windfohr Well No. 4

1582' FSL & 1645' FEL SEC. 4, T-18-S, R-27-E

EDDY COUNTY, NEW MEXICO

GAMMA RAY — NEUTRON — LATEROLOG



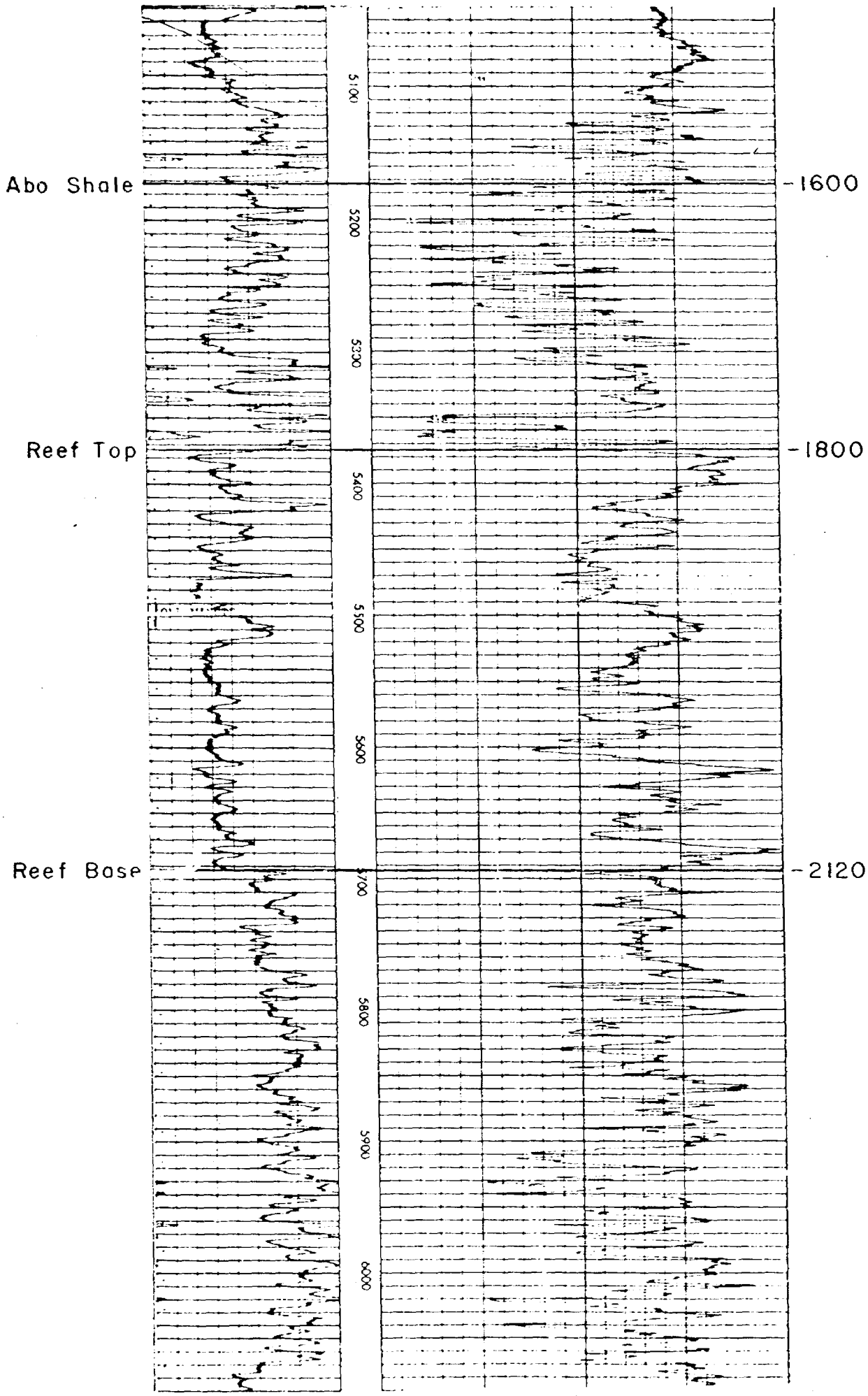
AMOCO PRODUCTION COMPANY

Malco "H" Federal Well No. 2

1980' FNL & 660' FEL SEC. 3, T-18-S, R-27-E

EDDY COUNTY, NEW MEXICO

GAMMA RAY – NEUTRON



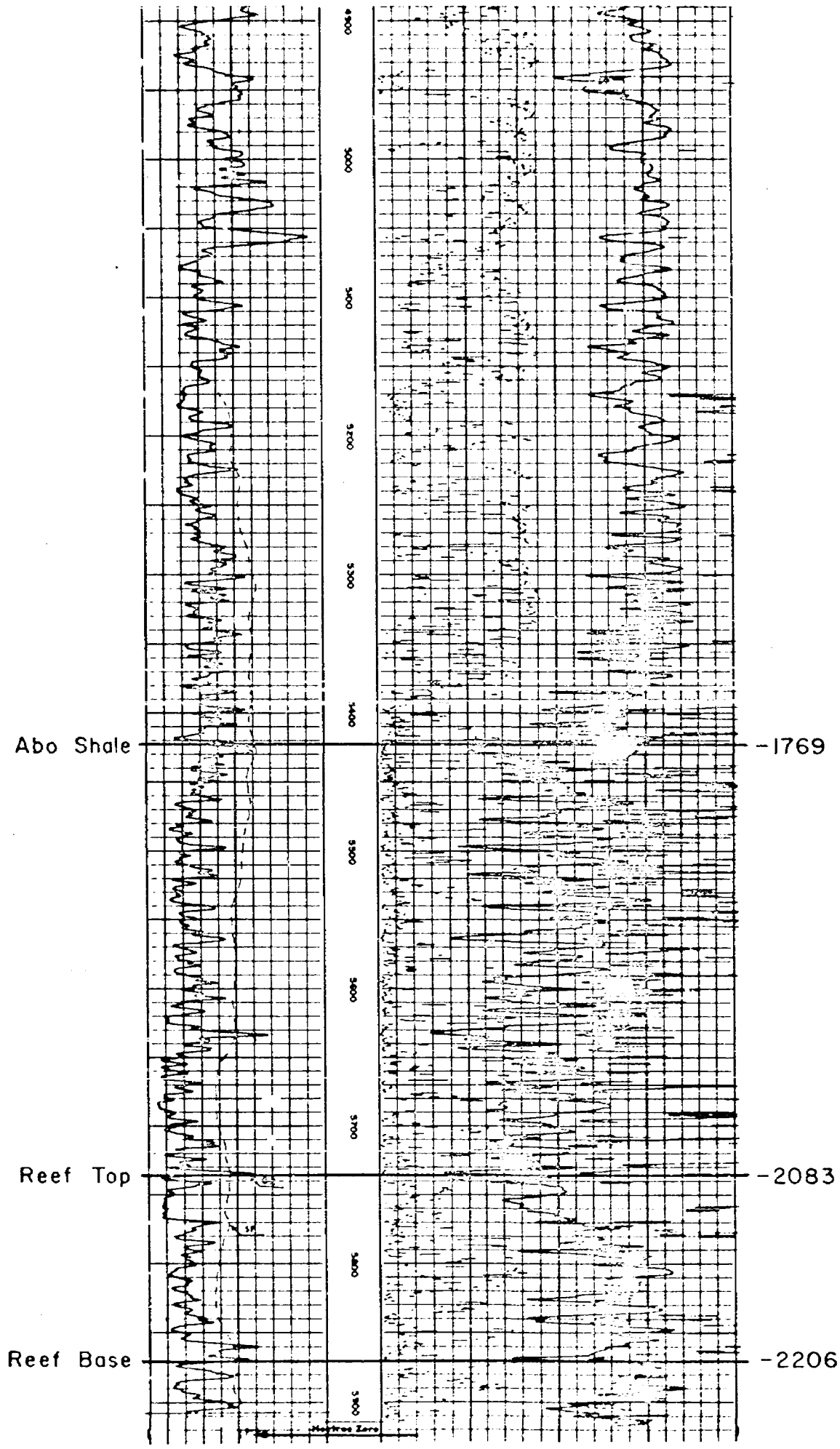
MARTIN YATES, III

Dooley State ABO No 2

1650' FSL & 1650' FEL SEC 36, T-17-S, R-27-E

EDDY COUNTY, NEW MEXICO

LATEROLOG-GAMMA RAY-NEUTRON



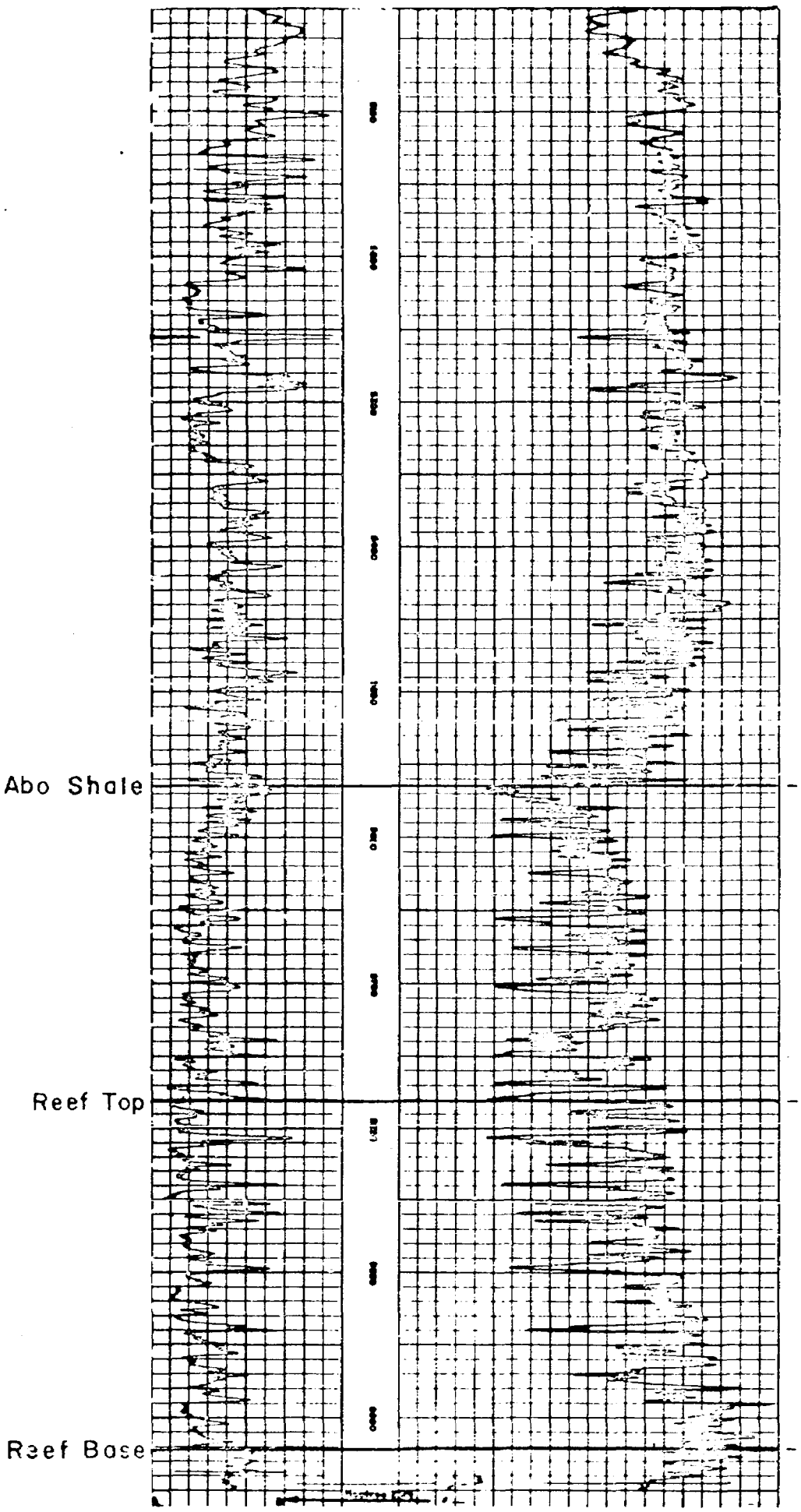
AMOCO PRODUCTION COMPANY

State "BM" Well No. 1

1650' FSL & 2387' FWL SEC. 31, T-17-S, R-28-E.

EDDY COUNTY, NEW MEXICO

GAMMA RAY - NEUTRON



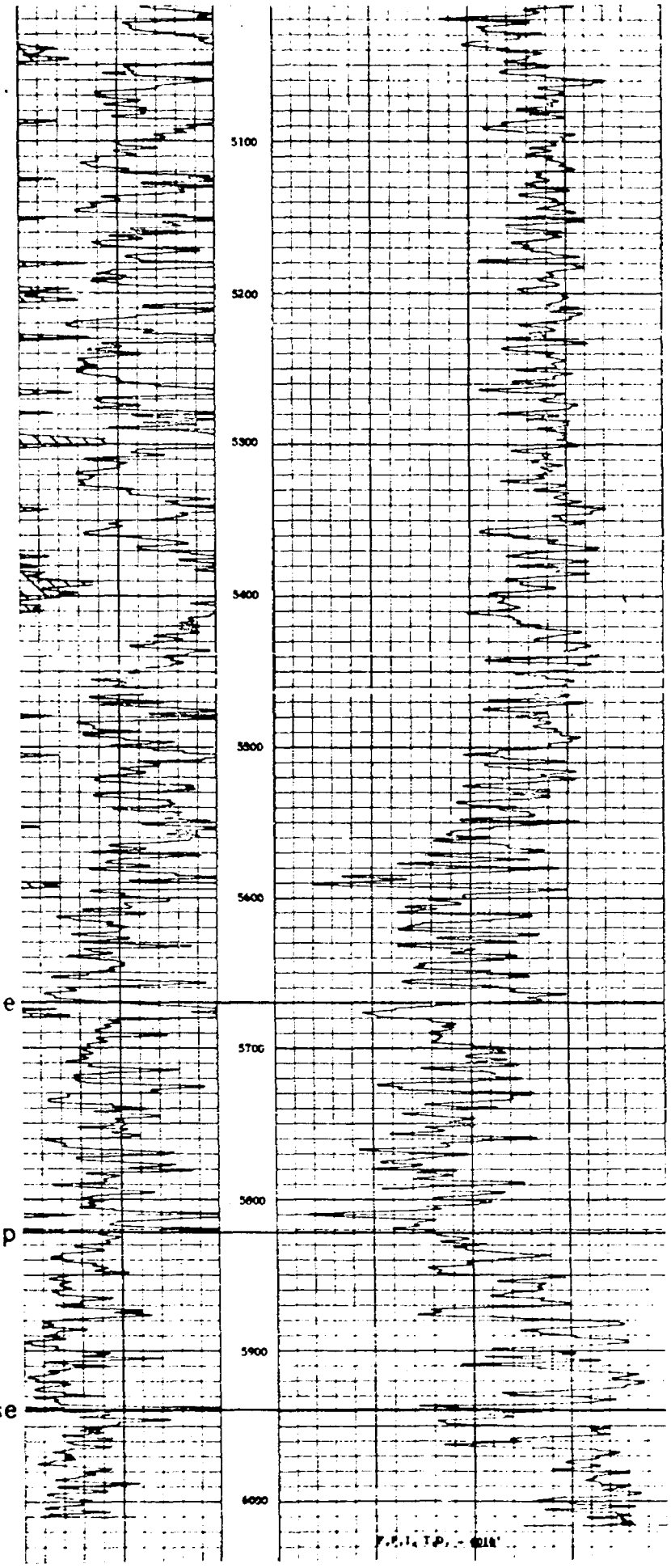
AMOCO PRODUCTION COMPANY

State "BV" Well No. 1

2280' FNL & 978' FEL SEC. 32, T-17-S, R-28-E

EDDY COUNTY, NEW MEXICO

GAMMA RAY — ISOTRON



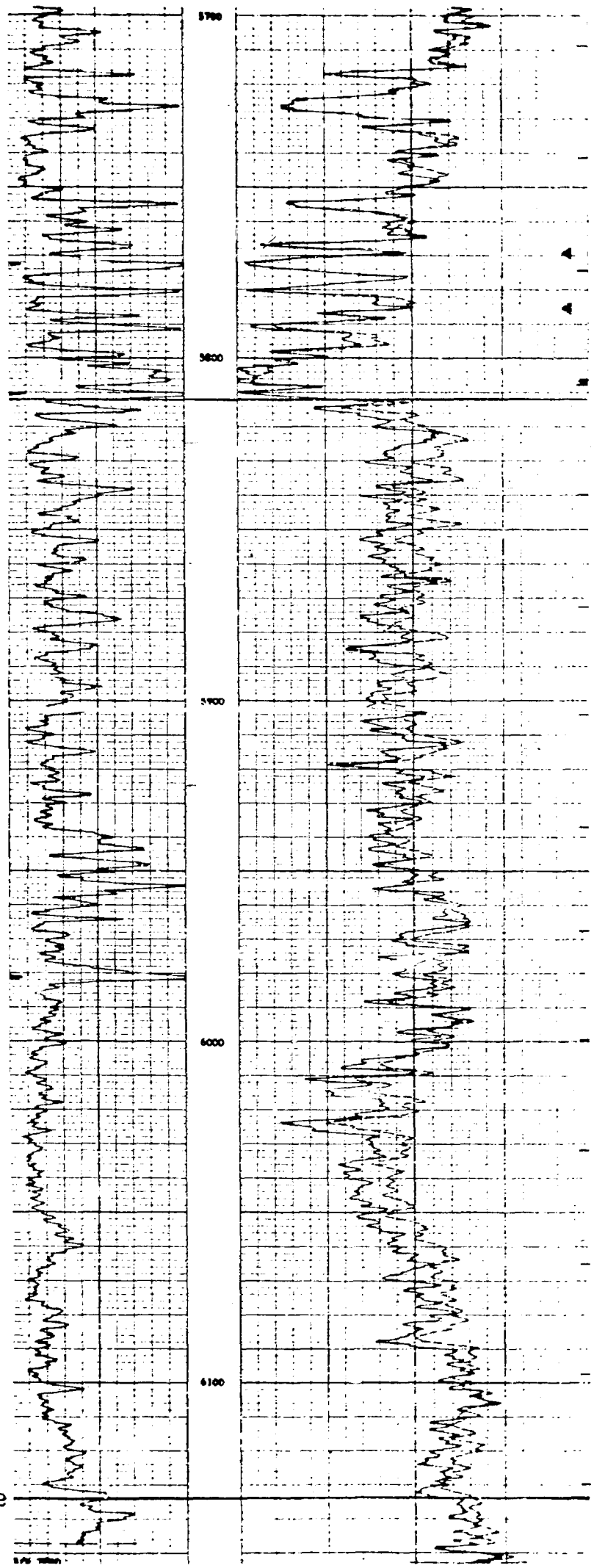
ATLANTIC RICHFIELD COMPANY

M. Yates "B" (ARC) Well No.8

1980' FNL & 2130' FEL SEC. 33, T-17-S, R-28-E

EDDY COUNTY, NEW MEXICO

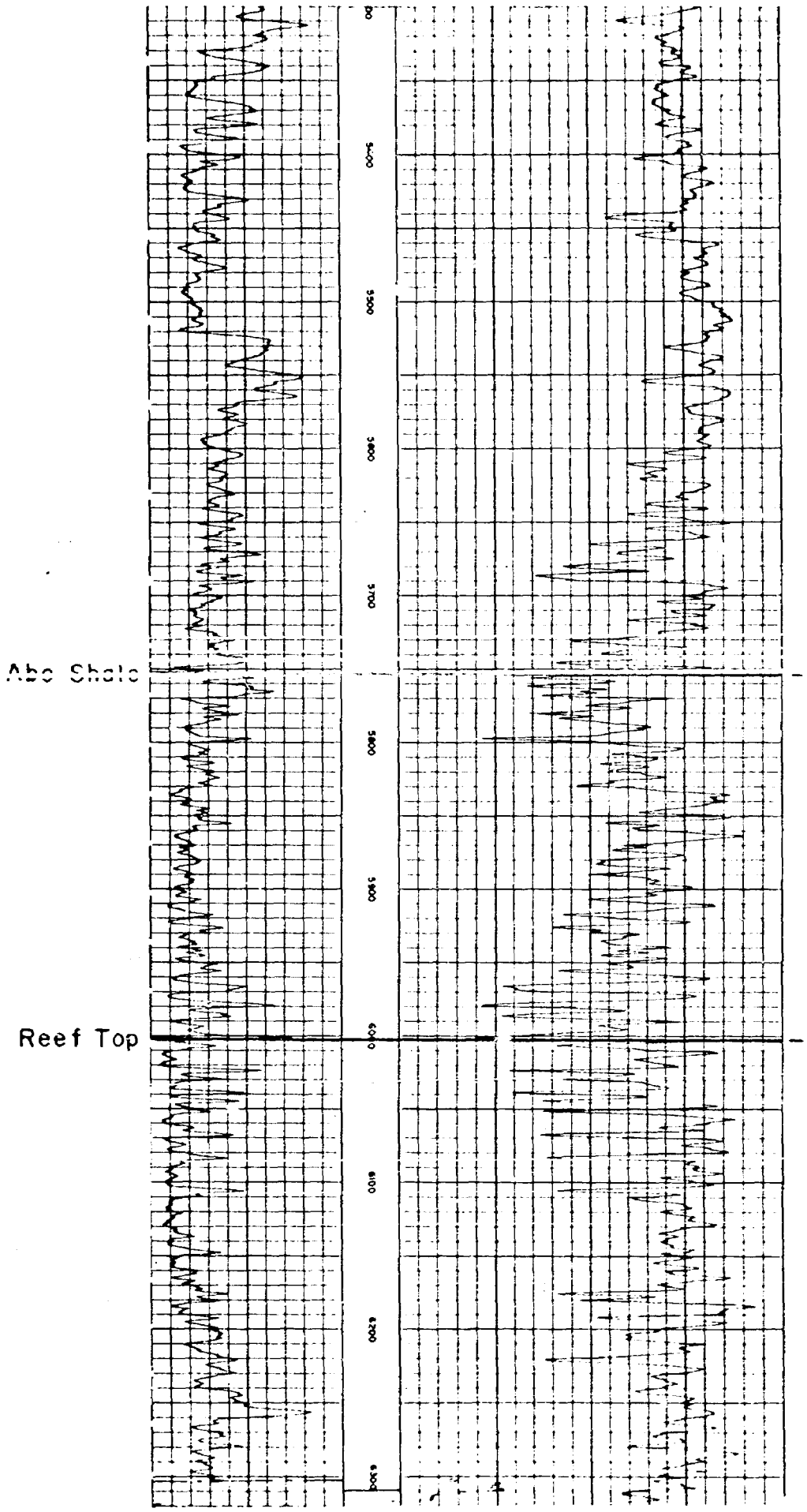
GAMMA RAY – ISOTRON



Reef Top -2144

Reef Base -2466

HONDO OIL AND GAS COMPANY
(ATLANTIC RICHFIELD COMPANY)
State "A" Well No. 21
1650' FSL & 1980'FWL SEC.26, T-17-S, R-28-E
EDDY COUNTY, NEW MEXICO
GAMMA RAY - NEUTRON



HUMBLE OIL AND REFINING COMPANY

Chalk Bluff Draw Unit A Well No. 4

990' FNL & 2310' FWL SEC. 9, T-18-S, R-27-E

EDDY COUNTY, NEW MEXICO

INJECTION WELL DIAGRAM

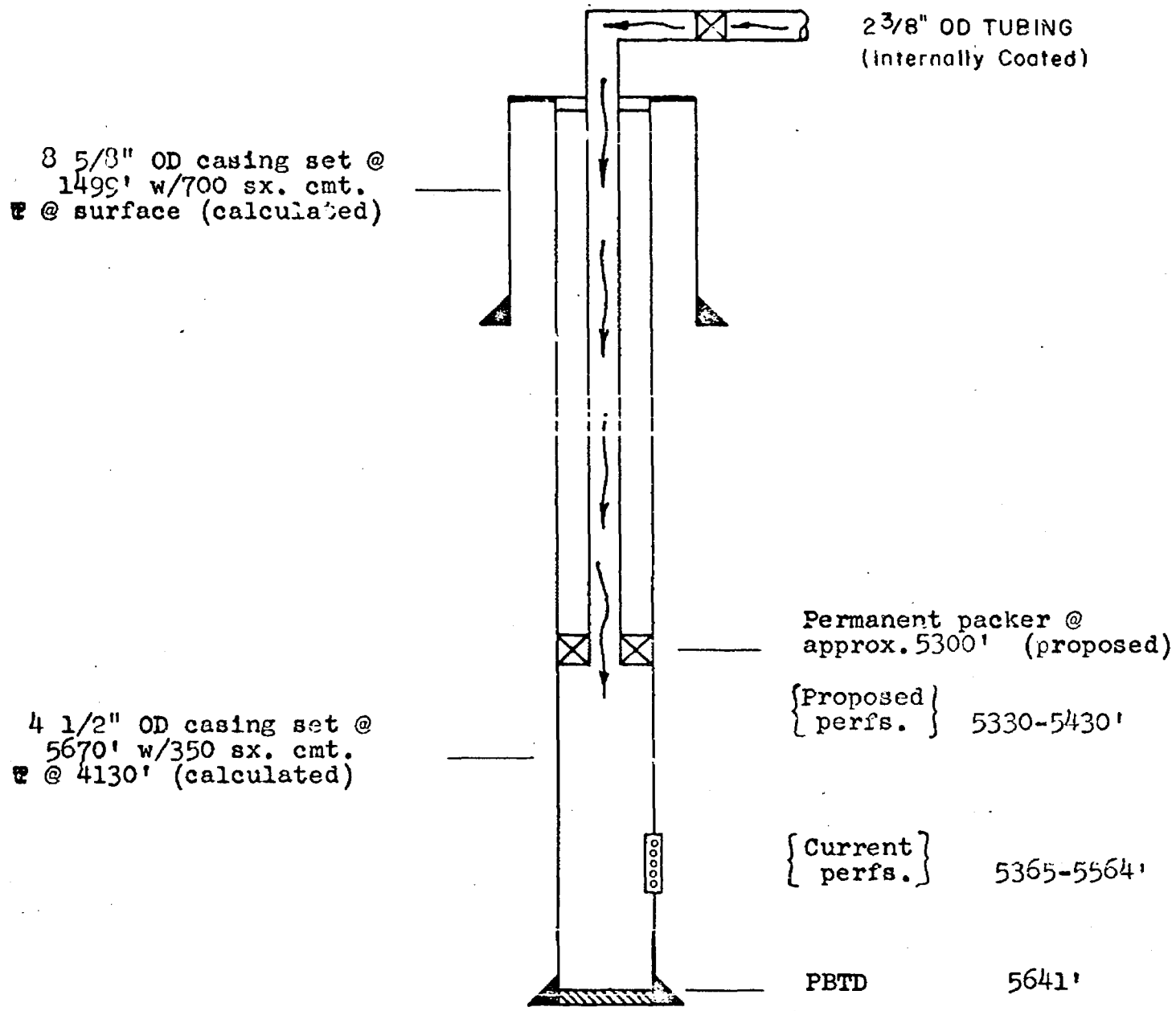


EXHIBIT NO. _____

AMOCO PRODUCTION COMPANY

R.H. Windfohr Well No. 4

1582' FSL & 1645' FEL SEC. 4, T-18-S, R-27-E

EDDY COUNTY, NEW MEXICO

INJECTION WELL DIAGRAM

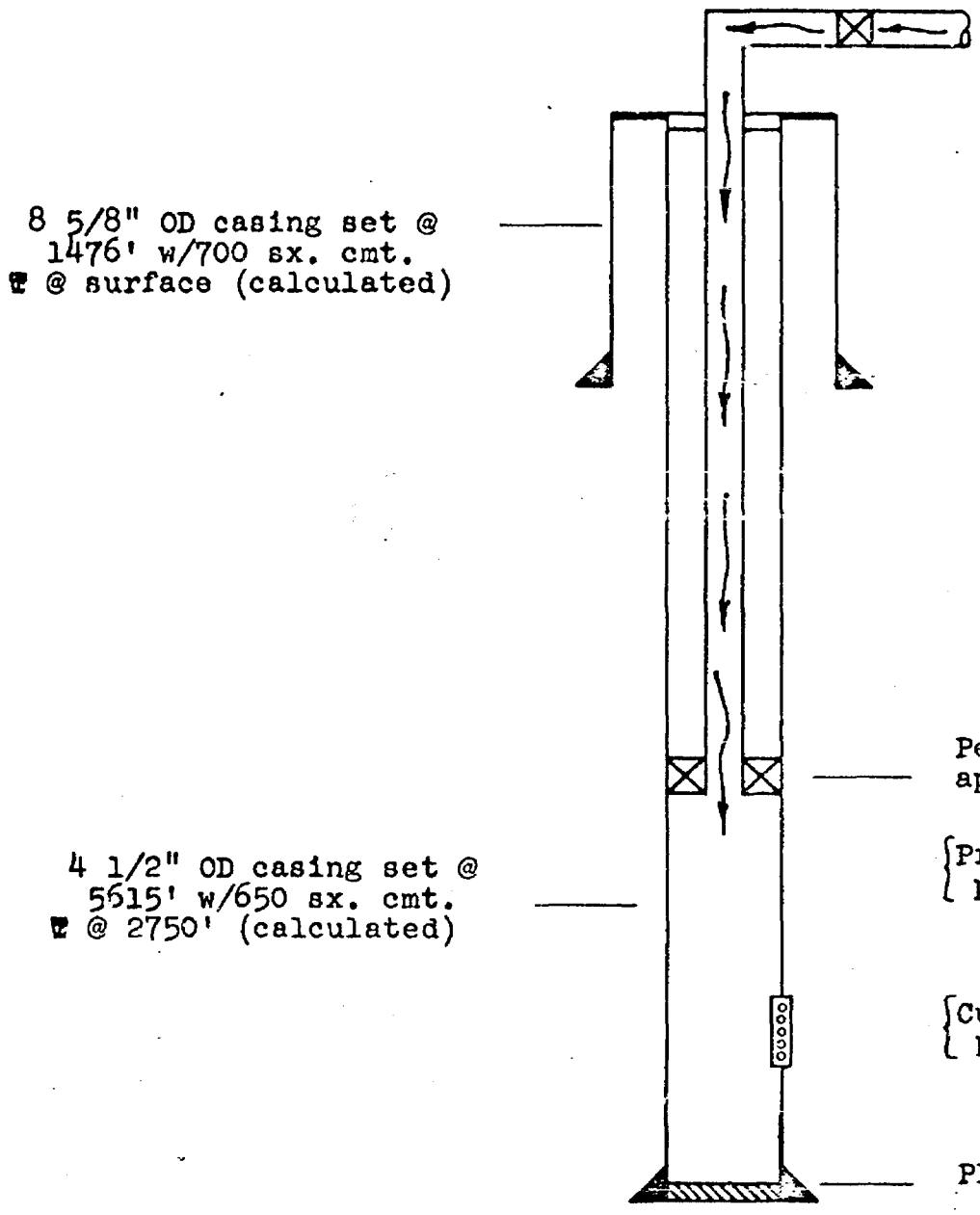


EXHIBIT NO. _____

AMOCO PRODUCTION COMPANY

Malco "H" Federal Well No. 2

1980' FNL & 660' FEL SEC. 3, T-18-S, R-27-E

EDDY COUNTY, NEW MEXICO

INJECTION WELL DIAGRAM

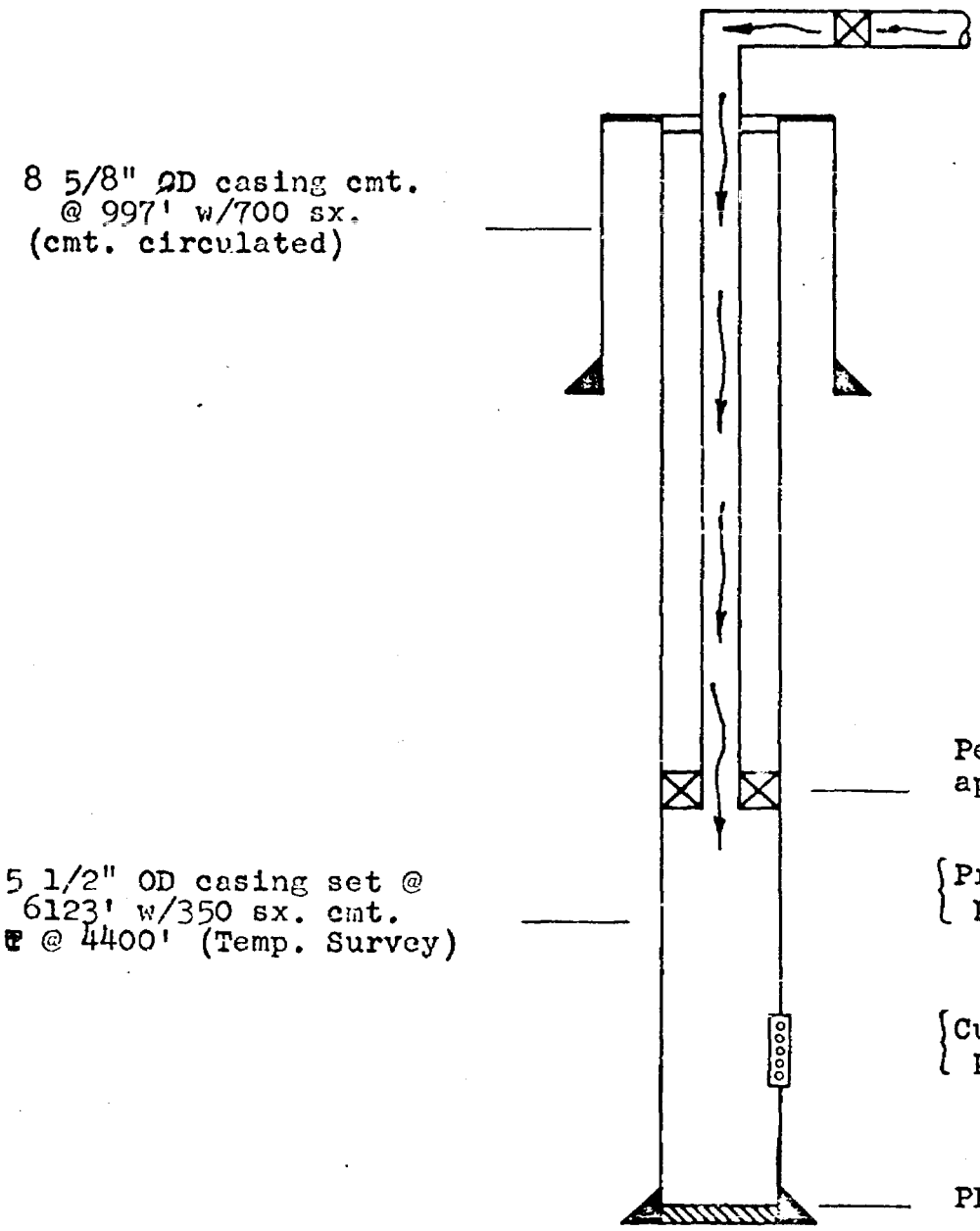


EXHIBIT NO. _____

MARTIN YATES, III

Dooley State ABO No. 2

1650' FSL & 1650' FEL SEC. 36, T-17-S, R-27-E

EDDY COUNTY, NEW MEXICO

INJECTION WELL DIAGRAM

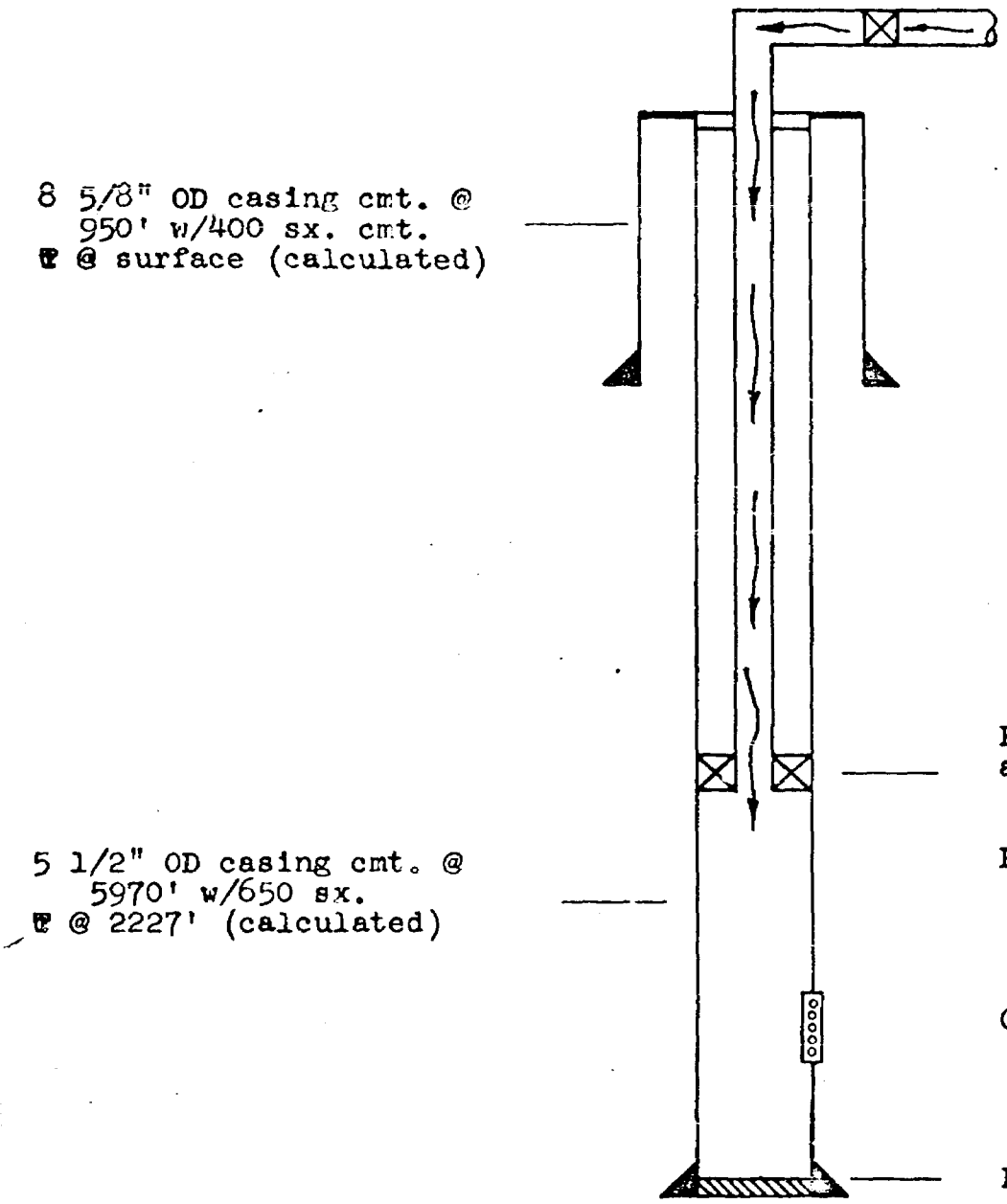


EXHIBIT NO. _____

AMOCO PRODUCTION COMPANY

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EDDY COUNTY, NEW MEXICO

INJECTION WELL DIAGRAM

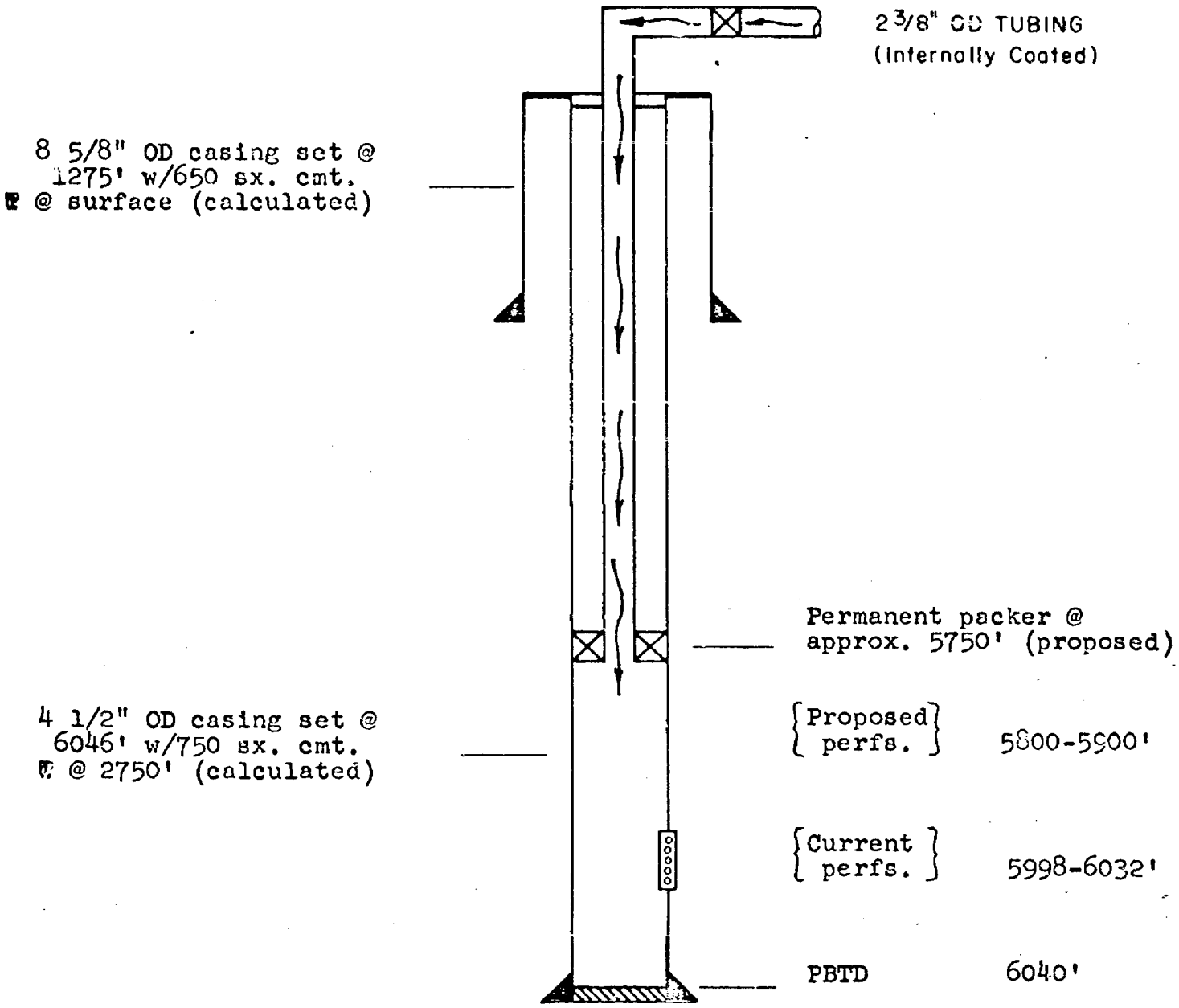

EXHIBIT NO. _____

AMOCO PRODUCTION COMPANY

State "BV" Well No. 1

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EDDY COUNTY, NEW MEXICO

INJECTION WELL DIAGRAM

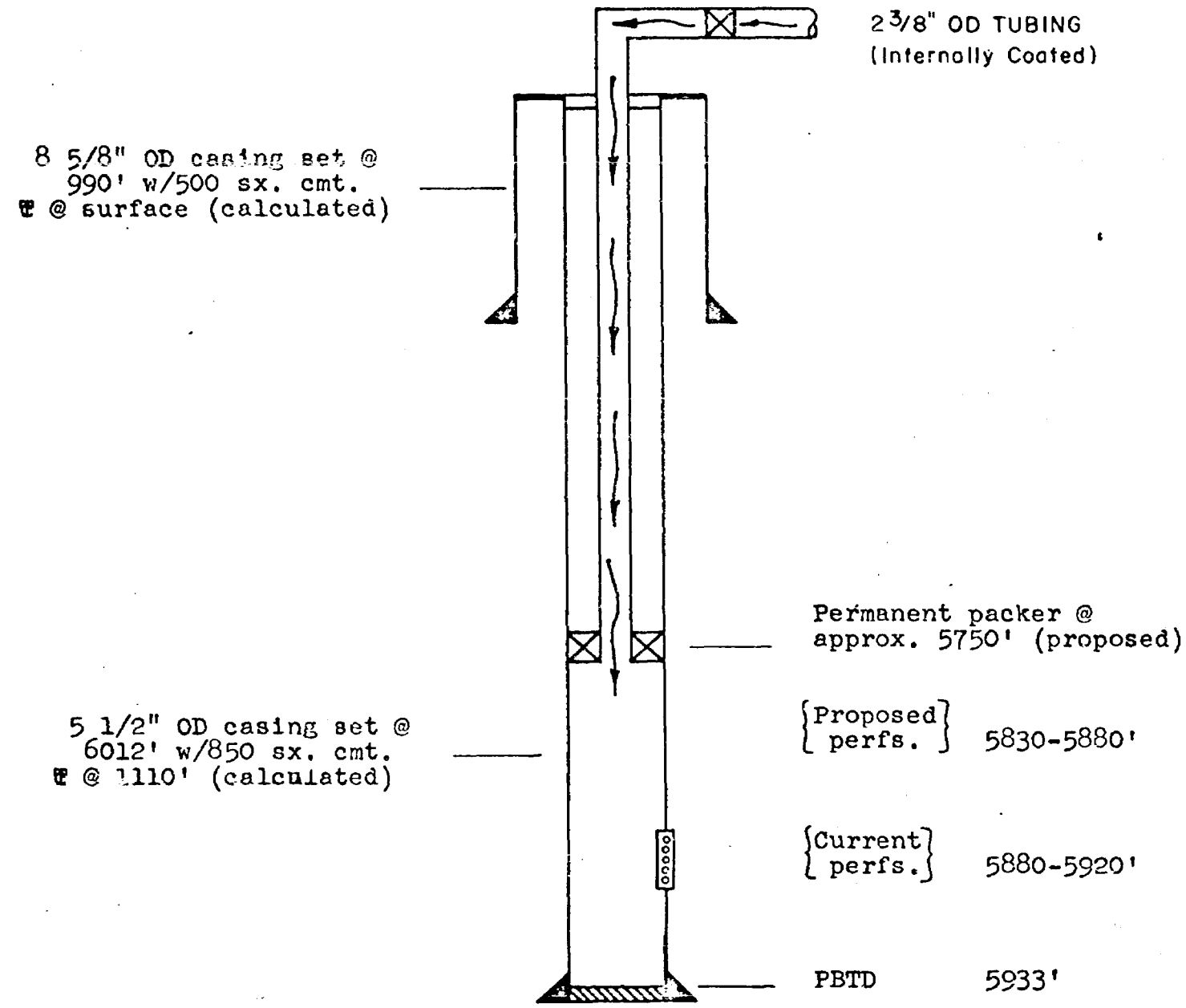


EXHIBIT NO. _____

ATLANTIC RICHFIELD COMPANY

M. Yates "B" (ARC) Well No. 8

1980' FNL & 2130' FEL SEC 33, T-17-S, R-28-E

EDDY COUNTY, NEW MEXICO

INJECTION WELL DIAGRAM

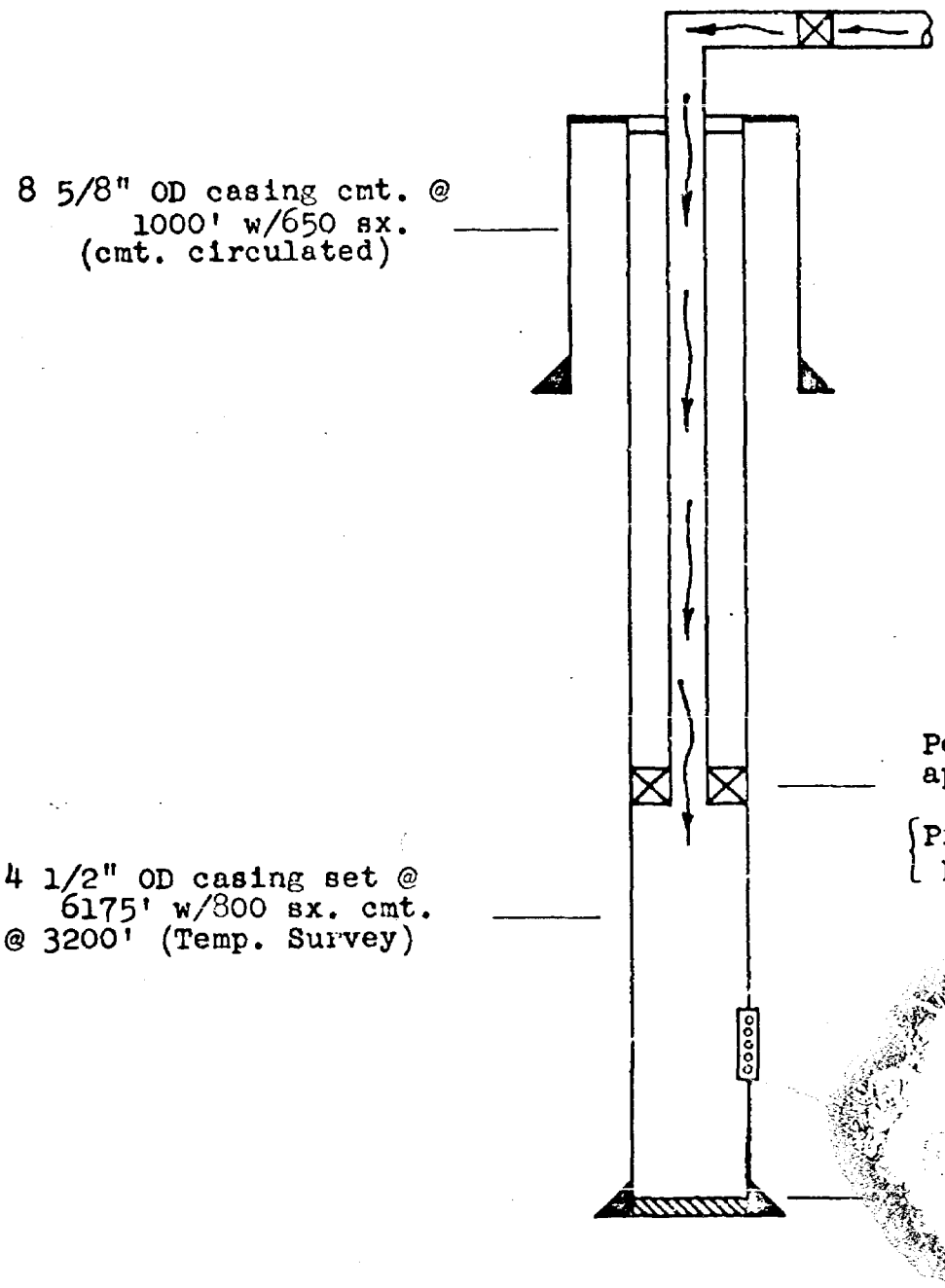


EXHIBIT NO. _____

HONDO OIL AND GAS COMPANY
(ATLANTIC RICHFIELD COMPANY)
State "A" Well No. 21
1650' FSL & 1980' FWL SEC. 26, T-17-S, R-28-E
EDDY COUNTY, NEW MEXICO
INJECTION WELL DIAGRAM

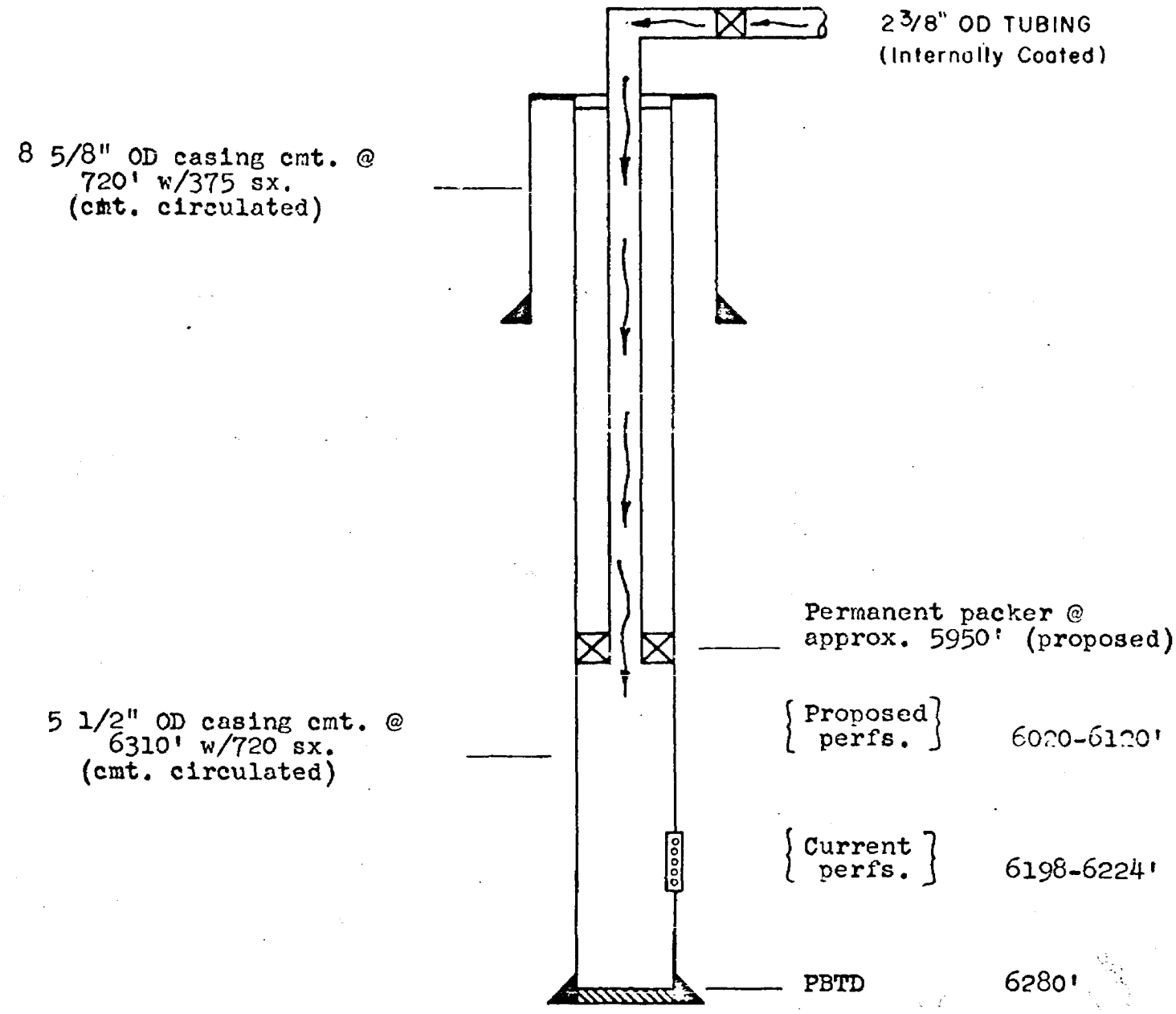


EXHIBIT NO. _____

AtlanticRichfieldCompany
North American Producing Division
Permian District
Post Office Box 1610
Midland, Texas 79701
Telephone 915 682 8631

(Plan of Operation
for Unit Application)

March 28, 1973

United States Department
of the Interior
Geological Survey
P. O. Drawer 1857
Roswell, New Mexico 88201

Attention: Mr. N. O. Frederick (6)
Oil and Gas Supervisor

State of New Mexico
Mr. Alex J. Armijo
Commissioner of Public Lands
P. O. Box 1148
Santa Fe, New Mexico

Attention: Mr. Ray D. Graham, Director (3)
Oil and Gas Department

State of New Mexico
Oil Conservation Commission
P. O. Box 2088
Santa Fe, New Mexico

Attention: Mr. A. L. Porter, Jr. (3)
Secretary Director

Working Interest Owners
Empire Abo Unit
(see attached address list)

Re: Initial Plan of Operation
Empire Abo Unit
Eddy County, New Mexico

Gentlemen:

In compliance with Section 11 of the Unit Agreement, Empire Abo Unit, Eddy County, New Mexico, Atlantic Richfield Company, as

Unit Operator on behalf of itself and the other participating working interest owners, hereby submits for your approval a Plan of Operation to cover the period beginning with the effective date of the Unit Agreement and extending through the remainder of calendar year 1973.

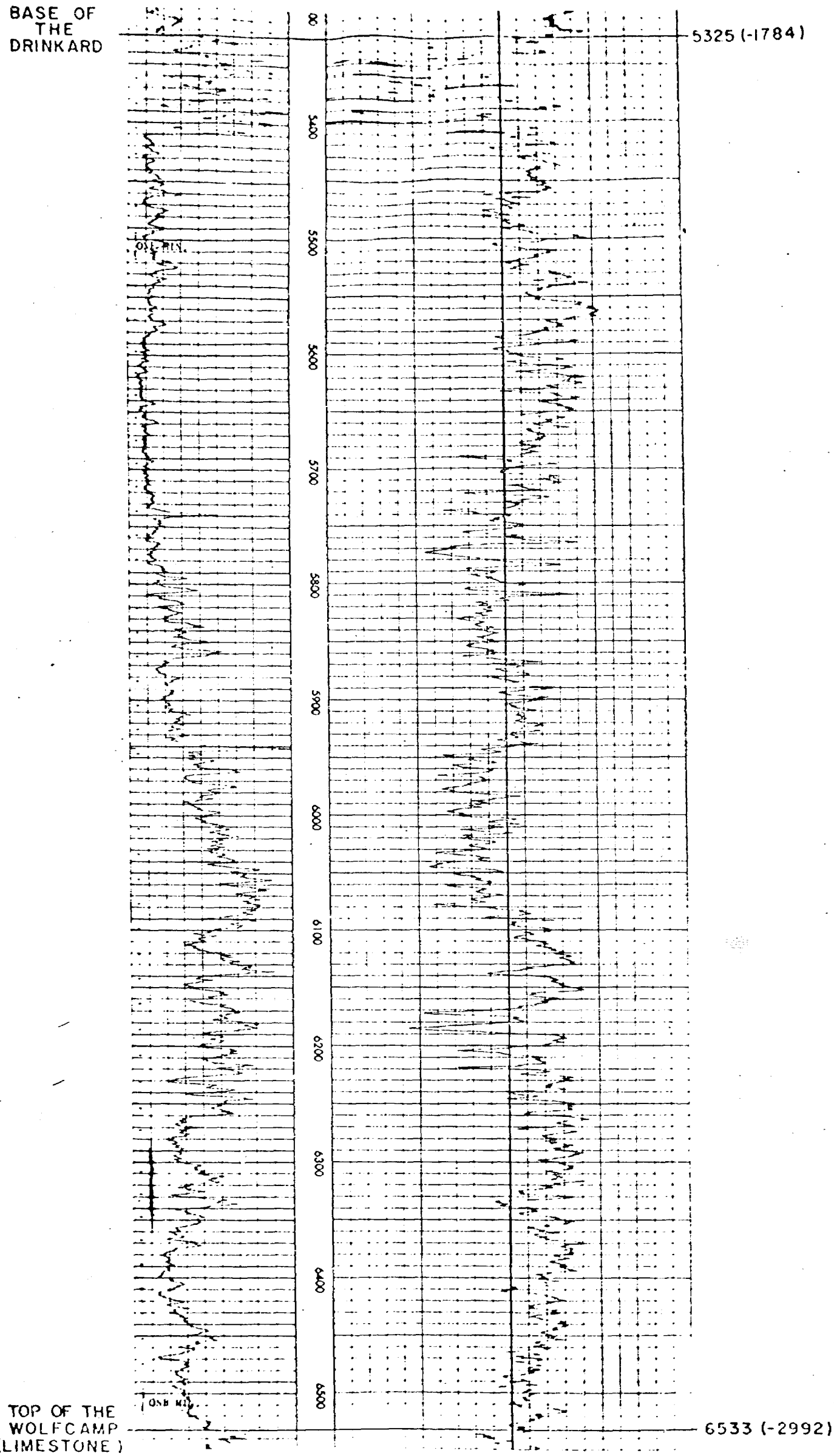
State AU No. 1

1980' FSL & 1830' FWL SEC. 2, T-18-S, R-27-E

EDDY COUNTY, NEW MEXICO

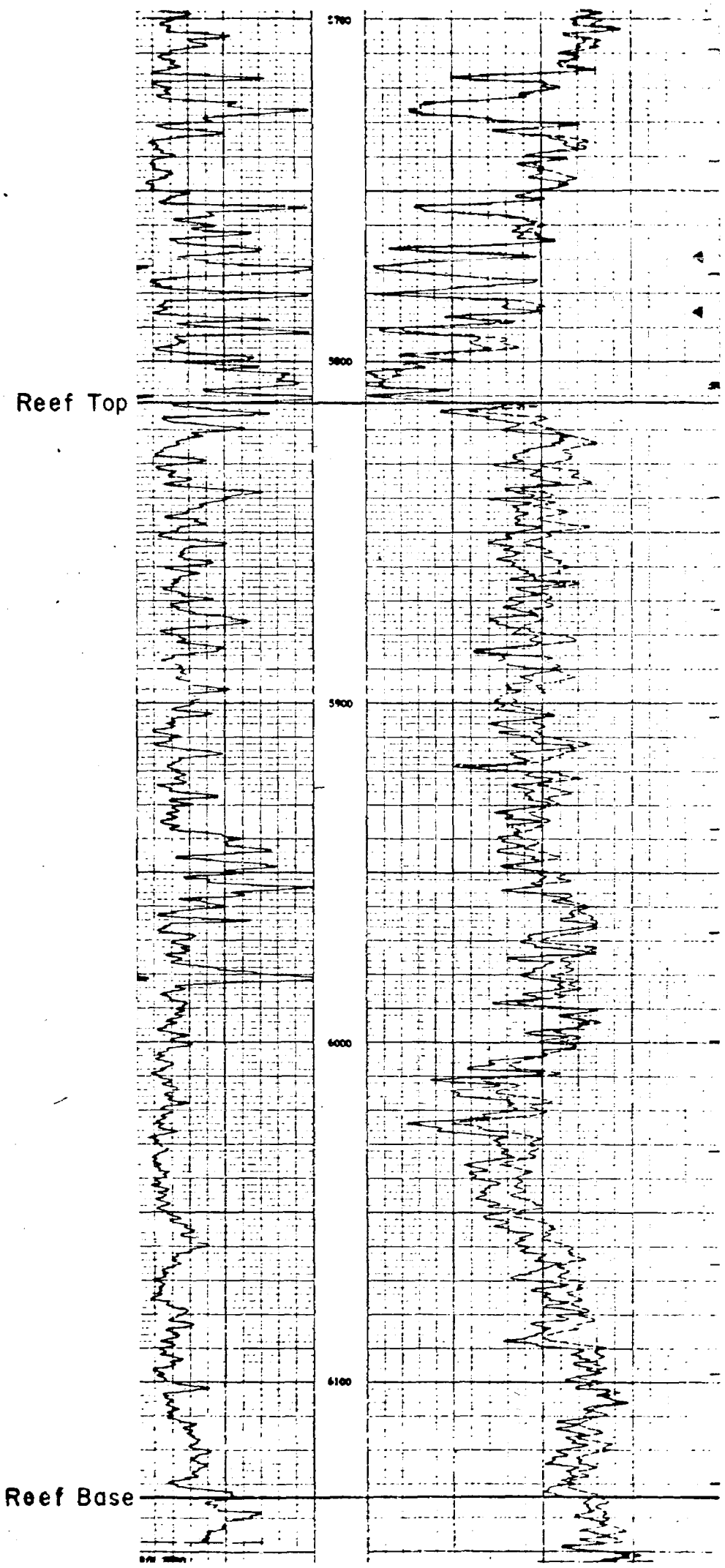
RADIOACTIVITY LOG

INITIAL PLAN OF OPN.
EXHIBIT 2



ATLANTIC RICHFIELD COMPANY
M. Yates "B" (ARC) Well No. 8
1980' FNL & 2130' FEL SEC. 33, T-17-S, R-28-E
EDDY COUNTY, NEW MEXICO
GAMMA RAY – ISOTRON

EMPIRE ABO UNIT
PLAN OF OPERATION
EXHIBIT 3



EMPIRE ABO UNIT
PLAN OF OPERATION
EXHIBIT 4

ATLANTIC RICHFIELD COMPANY
M. Yates "B" (ARC) Well No.8
1980' FNL & 2130' FEL SEC.33, T-17-S, R-28-E
EDDY COUNTY, NEW MEXICO
INJECTION WELL DIAGRAM

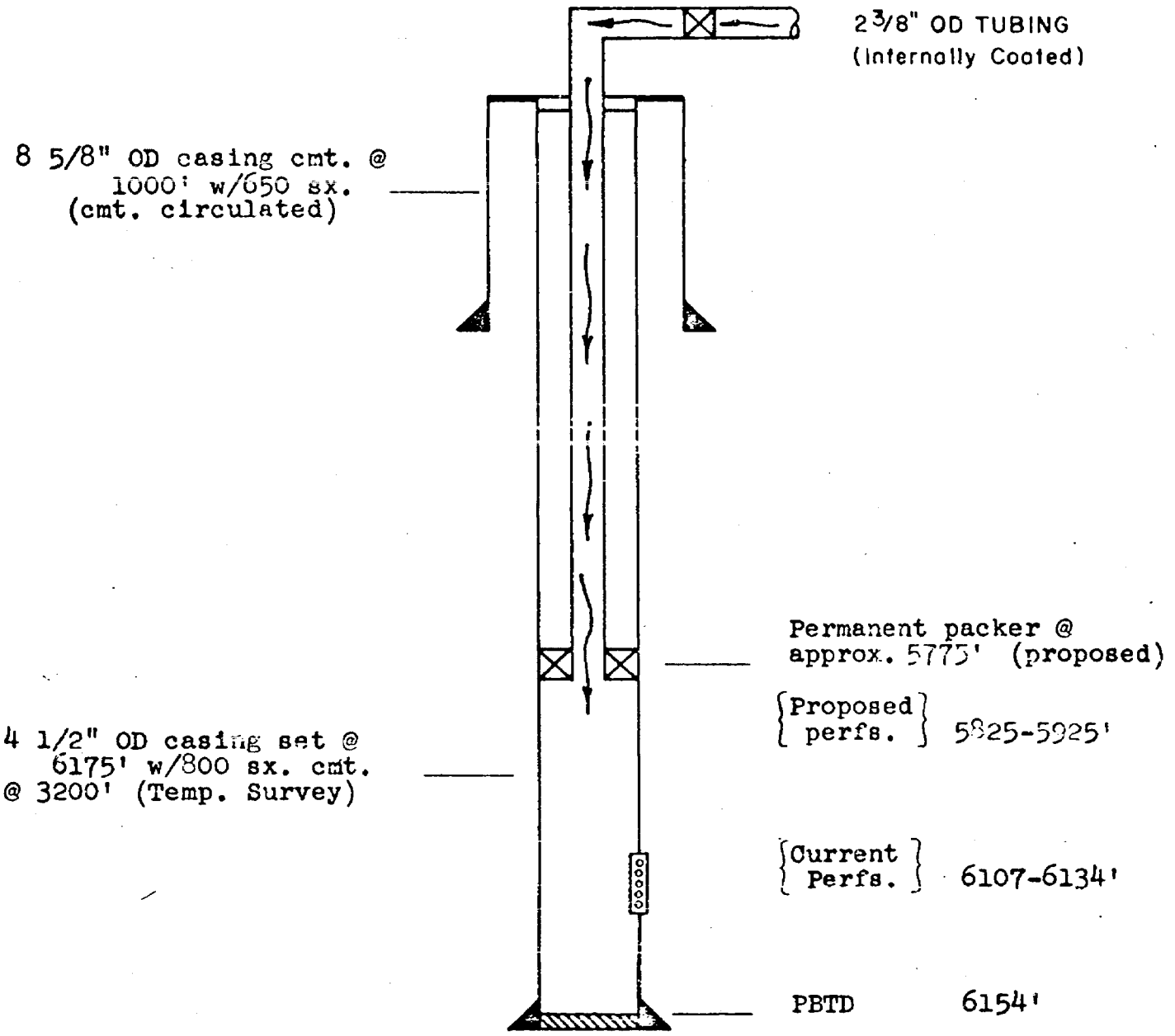


EXHIBIT NO. _____

Well Re-Designations - Empire Abo Unit

Tract No.	Present Designation	Location Unit	Sec. T-R	New Designation
1	General American Oil Company of Texas			Empire Abo Unit Tract No. 1
	Green A No. 5	G	30-17S-29E	Well No. 2
	Green A No. 6	H	30-17S-29E	Well No. 1
2	Cities Service Oil Company			Not Qualified
	Russell C No. 9	N	35-17S-27E	
	Russell C No. 10	O	35-17S-27E	
3	Cities Service Oil Company			Empire Abo Unit Tract No. 3
	Hudson B No. 1	E	3-18S-27E	Well No. 1
4	Amoco Production Company			Empire Abo Unit Tract No. 4
	Chalk Bluff Draw P No. 3	H	8-18S-27E	Well No. 1
5	Cities Service Oil Company			Empire Abo Unit Tract No. 5
	Hudson A No. 1	F	3-18S-27E	Well No. 1
6	Cities Service Oil Company			Not Qualified
	Magruder A No. 13	P	35-17S-27E	
	Magruder A No. 14	M	35-17S-27E	
7	Amoco Production Company			Empire Abo Unit Tract No. 7
	Windfohr Federal No. 1	P	4-18S-27E	Well No. 4
	Windfohr Federal No. 2	I	4-18S-27E	Well No. 1
	Windfohr Federal No. 3	O	4-18S-27E	Well No. 3
	Windfohr Federal No. 4	J	4-18S-27E	Well No. 2
8	Amoco Production Company			Empire Abo Unit Tract No. 8
	Mann Federal No. 1	M	3-18S-27E	Well No. 2
	Mann Federal No. 2	L	3-18S-27E	Well No. 1
9	DEPCO Incorporated			Empire Abo Unit Tract No. 9
	Leonard Federal No. 7	J	30-17S-29E	Well No. 1
10	Amoco Production Company			Empire Abo Unit Tract No. 10
	MALCO R Federal No. 10	D	1-18S-27E	Well No. 1
11	Amoco Production Company			Empire Abo Unit Tract No. 11
	Trigg Federal No. 1	P	34-17S-27E	Well No. 1
12A	Amoco Production Company			Empire Abo Unit Tract No. 12-A
	MALCO K Federal No. 1	P	9-18S-27E	Well No. 1
	MALCO K Federal No. 3	O	9-18S-27E	Well No. 2
12B	Amoco Production Company			Empire Abo Unit Tract No. 12-B
	MALCO H Federal No. 1	I	3-18S-27E	Well No. 2
	MALCO H Federal No. 3	N	3-18S-27E	Well No. 5
	MALCO H Federal No. 4	J	3-18S-27E	Well No. 3
	MALCO H Federal No. 5	K	3-18S-27E	Well No. 4
	MALCO H Federal No. 9	C	3-18S-27E	Well No. 1
	MALCO D Federal RAB No. 4	H	10-18S-27E	Well No. 6
	MALCO D Federal RAB No. 5	G	10-18S-27E	Well No. 7
12C	Amoco Production Company			Empire Abo Unit Tract No. 12-C
	MALCO H Federal No. 2	H	3-18S-27E	Well No. 4
	MALCO H Federal No. 6	G	3-18S-27E	Well No. 3
	MALCO H Federal No. 7	A	3-18S-27E	Well No. 1
	MALCO H Federal No. 8	B	3-18S-27E	Well No. 2

Well Redesignation - Empire Abo Unit

Tract No.	Present Designation	Location Unit	Sec. T-R	New Designation
12D	Amoco Production Company			Empire Abo Unit Tract No. 12-D
	MALCO D Federal No. 1	A	10-18S-27E	Well No. 1
	MALCO D Federal No. 2	B	10-18S-27E	Well No. 2
13A	Amoco Production Company			Empire Abo Unit Tract No. 13-A
	MALCO B Federal No. 2	D	11-18S-27E	Well No. 1
	MALCO B Federal No. 3	E	11-18S-27E	Well No. 2
13B	Amoco Production Company			Empire Abo Unit Tract No. 13-B
	MALCO A Federal No. 1	C	11-18S-27E	Well No. 1
13C	Amoco Production Company			Empire Abo Unit Tract No. 13-C
	MALCO C Federal No. 1	B	11-18S-27E	Well No. 1
13D	Amoco Production Company			Empire Abo Unit Tract No. 13-D
	MALCO J Federal No. 1	A	11-18S-27E	Well No. 1
14	Exxon Corporation			Empire Abo Unit Tract No. 14
	CBDU A No. 17	P	8-18S-27E	Well No. 1
15	Exxon Corporation			Empire Abo Unit Tract No. 15
	CBDU A No. 1	K	9-18S-27E	Well No. 1
	CBDU A No. 3	N	9-18S-27E	Well No. 4
	CBDU A No. 7	M	9-18S-27E	Well No. 3
	CBDU A No. 10	L	9-18S-27E	Well No. 2
17	Exxon Corporation			Empire Abo Unit Tract No. 17
	CBDU A No. 22	I	8-18S-27E	Well No. 1
18A	Exxon Corporation			Empire Abo Unit Tract No. 18-A
	CBDU A No. 26	K	17-18S-27E	Well No. 1
18B	Exxon Corporation			Empire Abo Unit Tract No. 18-B
	CBDU P No. 4	G	17-18S-27E	Well No. 2
	CBDU A No. 11	H	17-18S-27E	Well No. 1
18C	Exxon Corporation			Empire Abo Unit Tract No. 18-C
	CBDU A No. 24	J	17-18S-27E	Well No. 2
	CBDU A No. 25	I	17-18S-27E	Well No. 1
19	Exxon Corporation			Empire Abo Unit Tract No. 19
	Empire Abo Federal No. 1	J	1-18S-27E	Well No. 2
	Empire Abo Federal No. 2	I	1-18S-27E	Well No. 1
	Empire Abo Federal No. 4	P	1-18S-27E	Well No. 4
	Empire Abo Federal No. 5	O	1-18S-27E	Well No. 3
20	Amoco Production Company			Empire Abo Unit Tract No. 20
	MALCO L Federal No. 1	H	4-18S-27E	Well No. 1
21A	Amoco Production Company			Empire Abo Unit Tract No. 21-A
	MALCO N Federal No. 1	D	15-18S-27E	Well No. 1
22A	Amoco Production Company			Empire Abo Unit Tract No. 22-A
	MALCO G Federal No. 1	C	10-18S-27E	Well No. 3
	MALCO G Federal No. 2	D	10-18S-27E	Well No. 4
	MALCO G Federal No. 3	A	9-18S-27E	Well No. 5
	MALCO G Federal No. 4	E	10-18S-27E	Well No. 9
	MALCO G Federal No. 6	I	9-18S-27E	Well No. 12
	MALCO G Federal No. 7	F	10-18S-27E	Well No. 10
	MALCO G Federal No. 8	J	9-18S-27E	Well No. 13
	MALCO G Federal No. 9	L	10-18S-27E	Well No. 11
	MALCO G Federal No. 11	B	9-18S-27E	Well No. 6
	MALCO G Federal No. 12	M	10-18S-27E	Well No. 14
	MALCO G Federal No. 14	G	9-18S-27E	Well No. 7
	MALCO G Federal No. 15	H	9-18S-27E	Well No. 8
	MALCO E Federal No. 1	P	3-18S-27E	Well No 1
	MALCO E Federal No. 2	O	3-18S-27E	Well No. 2

Well Redesignations - Empire Abo Unit

Tract No.	Present Designation	Location Unit	Location Sec. T-R	New Designation
23	Exxon Corporation			Empire Abo Unit Tract No. 23
	CBDU A No. 5	N	4-18S-27E	Well No. 1
24A	Exxon Corporation			Empire Abo Unit Tract No. 24-A
	CBDU A No. 2	F	9-18S-27E	Well No. 3
	CBDU A No. 4	C	9-18S-27E	Well No. 1
	CBDU A No. 8	E	9-18S-27E	Well No. 2
27	Amoco Production Company			Empire Abo Unit Tract No. 27
	MALCO F Federal No. 1	L	1-18S-27E	Well No. 9
	MALCO F Federal No. 2	E	1-18S-27E	Well No. 4
	MALCO F Federal No. 3	M	1-18S-27E	Well No. 10
	MALCO F Federal No. 4	F	1-18S-27E	Well No. 5
	MALCO F Federal No. 5	K	1-18S-27E	Well No. 8
	MALCO F Federal No. 6	B	1-18S-27E	Well No. 2
	MALCO F Federal No. 7	G	1-18S-27E	Well No. 6
	MALCO F Federal No. 8	C	1-18S-27E	Well No. 3
	MALCO F Federal No. 9	H	1-18S-27E	Well No. 7
	MALCO F Federal No. 11	A	1-18S-27E	Well No. 1
	MALCO F Federal No. 12	N	1-18S-27E	Well No. 11
28	Robert G. Cox			Not Qualified
	Federal EA No. 1	D	12-18S-27E	
29-1	Amoco Production Company			Empire Abo Unit Tract No. 29-1
	Simon Federal No. 1	M	4-18S-27E	Well No. 1
29-2	General American Oil Company of Texas			Empire Abo Unit Tract No. 29-2
	Green A Tract 1 No. 7	E	29-17S-29E	Well No. 1
	Green A Tract 1 No. 9	K	29-17S-29E	Well No. 2
30	Cities Service Oil Company			Not Qualified
	Ohio B State No. 1	G	5-18S-28E	
	Ohio B State No. 2	H	5-18S-28E	
31	Amoco Production Company			Empire Abo Unit Tract No. 31
	State BE No. 1	M	31-17S-28E	Well No. 2
	State BE No. 2	L	31-17S-28E	Well No. 1
32	Martin Yates, III			Empire Abo Unit Tract No. 32
	State 647 No. 1	K	27-17S-28E	Well No. 1
34	Atlantic Richfield Company			Empire Abo Unit Tract No. 34
	M. Yates B ARC No. 1	M	33-17S-28E	Well No. 12
	M. Yates B ARC No. 2	K	33-17S-28E	Well No. 10
	M. Yates B ARC No. 3	E	33-17S-28E	Well No. 4
	M. Yates B ARC No. 4	L	33-17S-28E	Well No. 11
	M. Yates B ARC No. 5	F	33-17S-28E	Well No. 5
	M. Yates B ARC No. 6	N	33-17S-28E	Well No. 13
	M. Yates B ARC No. 7	J	33-17S-28E	Well No. 9
	M. Yates B ARC No. 8	G	33-17S-28E	Well No. 6
	M. Yates B ARC No. 9	I	33-17S-28E	Well No. 8
	M. Yates B ARC No. 10	H	33-17S-28E	Well No. 7
	M. Yates B ARC No. 11	A	33-17S-28E	Well No. 1
	M. Yates B ARC No. 12	P	33-17S-28E	Well No. 15
	M. Yates B ARC No. 13	C	33-17S-28E	Well No. 3
	M. Yates B ARC No. 14	B	33-17S-28E	Well No. 2
	M. Yates B ARC No. 15	O	33-17S-28E	Well No. 14
35	Amoco Production Company			Empire Abo Unit Tract No. 35
	State BK No. 1	C	5-18S-28E	Well No. 1
36	Amoco Production Company			Empire Abo Unit Tract No. 36
	State BU No. 1	E	34-17S-28E	Well No. 1

Well Re-Designation - Empire Abo Unit

Tract No.	Present Designation	Location Unit	Sec. T-R	New Designation
37A	Hondo Oil and Gas Company			Empire Abo Unit Tract No. 37-A
	State A No. 1	G	6-18S-28E	Well No. 36
	State A No. 2	A	6-18S-28E	Well No. 34
	State A No. 3	N	32-17S-28E	Well No. 33
	State A No. 4	M	32-17S-28E	Well No. 32
	State A No. 5	P	31-17S-28E	Well No. 31
	State A No. 6	H	6-18S-28E	Well No. 35
	State A No. 7	K	32-17S-28E	Well No. 28
	State A No. 8	L	32-17S-28E	Well No. 29
	State A No. 9	I	31-17S-28E	Well No. 30
	State A No. 10	J	34-17S-28E	Well No. 27
	State A No. 11	I	34-17S-28E	Well No. 26
	State A No. 12	F	35-17S-28E	Well No. 21
	State A No. 13	L	35-17S-28E	Well No. 25
	State A No. 14	B	35-17S-28E	Well No. 19
	State A No. 15	C	35-17S-28E	Well No. 20
	State A No. 16	M	26-17S-28E	Well No. 9
	State A No. 17	A	35-17S-28E	Well No. 18
	State A No. 18	N	26-17S-28E	Well No. 10
	State A No. 19	O	26-17S-28E	Well No. 11
	State A No. 20	M	25-17S-28E	Well No. 13
	State A No. 21	K	26-17S-28E	Well No. 7
	State A No. 22	G	35-17S-28E	Well No. 22
	State A No. 23	K	25-17S-28E	Well No. 3
	State A No. 24	J	26-17S-28E	Well No. 6
	State A No. 25	P	26-17S-28E	Well No. 12
	State A No. 26	I	26-17S-28E	Well No. 5
	State A No. 28	L	25-17S-28E	Well No. 4
	State A No. 29	N	25-17S-28E	Well No. 14
	State A No. 30	I	6-18S-28E	Well No. 37
	State A No. 31	L	26-17S-28E	Well No. 8
	State A No. 32	J	25-17S-28E	Well No. 2
	State A No. 34	O	25-17S-28E	Well No. 15
	State A No. 37	I	25-17S-28E	Well No. 1
	State A No. 39	K	35-17S-28E	Well No. 24
	State A No. 40	H	35-17S-28E	Well No. 23
	State A No. 42	D	36-17S-28E	Well No. 17
	State A No. 44	P	25-17S-28E	Well No. 16
37B	DEPCO Incorporated			Empire Abo Unit Tract No. 37-B
	State A No. 46	B	32-17S-28E	Well No. 1
37C	Hondo Oil and Gas Company			Empire Abo Unit Tract No. 37-C
	State A No. 33	H	32-17S-28E	Well No. 3
	State A No. 35	G	32-17S-28E	Well No. 2
	State A No. 38	A	32-17S-28E	Well No. 1
38	Amoco Production Company			Empire Abo Unit Tract No. 38
	State BS No. 1	F	34-17S-28E	Well No. 1
40	Exxon Corporation			Empire Abo Unit Tract No. 40
	CBDU A No. 9	D	16-18S-27E	Well No. 1
	CBDU A No. 15	K	16-18S-27E	Well No. 2
	CBDU A No. 16	L	16-18S-27E	Well No. 3
42	Cities Service Oil Company			Not Qualified
	State CE No. 5	C	2-18S-27E	
43	Amoco Production Company			Empire Abo Unit Tract No. 43
	State DC No. 1	D	4-18S-28E	Well No. 1

Well Re-Designations - Empire Abo Unit

Tract No.	Present Designation	Location Unit	Sec. T-R	New Designation
44	Martin Yates, III			Not Qualified
	Dooley Abo State No. 1	N	36-17S-27E	
	Dooley Abo State No. 2	J	36-17S-27E	
	Dooley Abo State No. 3	K	36-17S-27E	
45	Kersey and Company			Empire Abo Unit Tract No. 45
	Ramapo No. 4	P	36-17S-27E	Well No. 2
	Ramapo No. 5	I	36-17S-27E	Well No. 1
46	Cities Service Oil Company			Not Qualified
	Wright A State No. 4	B	2-18S-27E	
47	Amoco Production Company			Empire Abo Unit Tract No. 47
	State BO No. 1	P	32-17S-28E	Well No. 2
	State BO No. 2	I	32-17S-28E	Well No. 1
48	Franklin, Aston, and Fair, Incorporated			Empire Abo Unit Tract No. 48
	State BJ No. 1	O	31-17S-28E	Well No. 2
	State BJ No. 2	J	31-17S-28E	Well No. 1
49	Samedan Oil Corporation			Not Qualified
	Walker State No. 1	O	27-17S-28E	
50	Amoco Production Company			Empire Abo Unit Tract No. 50
	State BZ No. 1	P	27-17S-28E	Well No. 3
	State BZ No. 2	I	27-17S-28E	Well No. 1
	State BZ No. 3	J	27-17S-28E	Well No. 2
51	Amoco Production Company			Empire Abo Unit Tract No. 51
	State BQ No. 1	K	34-17S-28E	Well No. 1
	State BQ No. 2	L	34-17S-28E	Well No. 2
	State BQ No. 3	M	34-17S-28E	Well No. 3
	State BQ No. 4	N	34-17S-28E	Well No. 4
52	Amoco Production Company			Empire Abo Unit Tract No. 52
	State BX No. 1	H	34-17S-28E	Well No. 1
53	Amoco Production Company			Empire Abo Unit Tract No. 53
	State BH No. 1	A	5-18S-28E	Well No. 1
	State BH No. 2	B	5-18S-28E	Well No. 2
55	Penroc Oil Corporation			Not Qualified
	DELHI A State No. 1	D	33-17S-28E	
56	Penroc Oil Corporation			Not Qualified
	State No. 2	P	28-17S-28E	
58	Amoco Production Company			Empire Abo Unit Tract No. 58
	State AE No. 1	C	32-17S-28E	Well No. 1
59	Rutter and Wilbanks Brothers			Empire Abo Unit Tract No. 59
	Hudson State No. 1	G	2-18S-27E	Well No. 1
60	Franklin, Aston, and Fair, Incorporated			Empire Abo Unit Tract No. 60
	State F No. 1	F	31-17S-28E	Well No. 1
61A	Amoco Production Company			Empire Abo Unit Tract No. 61-A
	State AT No. 2	E	2-18S-27E	Well No. 1
61B	Amoco Production Company			Empire Abo Unit Tract No. 61-B
	State AT No. 3	F	2-18S-27E	Well No. 1

Well Re-Designation - Empire Abo Unit

Tract No.	Present Designation	Location Unit	Location Sec. T-R	New Designation
61C	Amoco Production Company State AT No. 1	L	2-18S-27E	Empire Abo Unit Tract No. 61-C Well No. 1
61D	Amoco Production Company State AR No. 1	N	2-18S-27E	Empire Abo Unit Tract No. 61-D Well No. 1
62	Amoco Production Company State BR No. 1	A	16-18S-27E	Empire Abo Unit Tract No. 62 Well No. 1
64	Amoco Production Company State BM No. 1	K	31-17S-28E	Empire Abo Unit Tract No. 64 Well No. 1
65	Franklin, Aston, and Fair, Incorporated State BD No. 1	N	31-17S-28E	Empire Abo Unit Tract No. 65 Well No. 1
66	Amoco Production Company State BW No. 1	M	27-17S-28E	Empire Abo Unit Tract No. 66 Well No. 1
67	Amoco Production Company State AU No. 1	K	2-18S-27E	Empire Abo Unit Tract No. 67 Well No. 1
68	Atlantic Richfield Company Hudson A State No. 1	A	2-18S-27E	Empire Abo Unit Tract No. 68 Well No. 1
69	Estate of Fred Turner, Jr. State B9391 No. 1	H	2-18S-27E	Not Qualified
70	Exxon Corporation New Mexico BF State No. 1 New Mexico BF State No. 2	B G	16-18S-27E 16-18S-27E	Empire Abo Unit Tract No. 70 Well No. 1 Well No. 2
72	Exxon Corporation CBDU A No. 14	F	16-18S-27E	Empire Abo Unit Tract No. 72 Well No. 1
73A	Amoco Production Company State CM No. 1	L	36-17S-27E	Not Qualified
73B	Amoco Production Company State BG No. 1	O	32-17S-28E	Not Qualified
73C	C & K Petroleum, Incorporated Delhi Taylor State No. 2	O	34-17S-28E	Not Qualified
74	Exxon Corporation New Mexico BE State No. 1	C	4-18S-28E	Empire Abo Unit Tract No. 74 Well No. 1
75	Sun Oil Company New Mexico V State No. 1 New Mexico V State No. 2	E D	35-17S-28E 35-17S-28E	Empire Abo Unit Tract No. 75 Well No. 2 Well No. 1
77	Reeler and Sheldon State No. 1	B	6-18S-28E	Empire Abo Unit Tract No. 77 Well No. 1
78A	Franklin, Aston, and Fair, Incorporated State BB No. 1 State BB No. 2 State BB No. 3 State BB No. 4 State BB No. 5	E F C L K	6-18S-28E 6-18S-28E 6-18S-28E 6-18S-28E 6-18S-28E	Empire Abo Unit Tract No. 78-A Well No. 2 Well No. 3 Well No. 1 Well No. 5 Well No. 4
78B	Franklin, Aston, and Fair, Incorporated State BN No. 1	D	5-18S-28E	Empire Abo Unit Tract No. 78-B Well No. 1
79	C & K Petroleum, Incorporated ABO No. 1	N	27-17S-28E	Not Qualified

Well Re-Designation - Empire Abo Unit

Tract No.	Present Designation	Location Unit	Sec. T-R	New Designation
80	Amoco Production Company			Empire Abo Unit Tract No. 80
	State EB No. 1	M	36-17S-27E	Well No. 1
81	Atlantic Richfield Company			Empire Abo Unit Tract No. 81
	Eddy 32 State No. 1	D	34-17S-28E	Well No. 1
	Eddy 32 State No. 2	F	32-17S-28E	Well No. 2
82	Exxon Corporation			Empire Abo Unit Tract No. 82
	CBDU A No. 13	E	16-18S-27E	Well No. 1
83	Amoco Production Company			Empire Abo Unit Tract No. 83
	State BP No. 1	J	32-17S-28E	Well No. 1
84	Tenneco Oil Company			Not Qualified
	State H No. 2	F	5-18S-28E	
85A	Exxon Corporation			Empire Abo Unit Tract No. 85-A
	CBDU A No. 6	C	16-18S-27E	Well No. 1
85B	Gulf Oil Corporation			Empire Abo Unit Tract No. 85-B
	Eddy BU State No. 1	J	16-18S-27E	Well No. 1
86	Continental Oil Company			Empire Abo Unit Tract No. 86
	State S 30 No. 1	E	30-17S-29E	Well No. 2
	State S 30 No. 2	F	30-17S-29E	Well No. 1
	State S 30 No. 3	L	30-17S-29E	Well No. 3
87	Gulf Oil Corporation			Empire Abo Unit Tract No. 87
	Eddy I NCT A No. 1	M	2-18S-27E	Well No. 3
	Eddy I NCT B No. 1	P	2-18S-27E	Well No. 2
	Eddy I NCT C No. 1	O	36-17S-27E	Well No. 1
88	Amoco Production Company			Empire Abo Unit Tract No. 88
	State BA No. 1	D	2-18S-27E	Well No. 1
89	Amoco Production Company			Empire Abo Unit Tract No. 89
	State BV No. 1	E	32-17S-28E	Well No. 1
90	Amoco Production Company			Empire Abo Unit Tract No. 90
	State BT No. 1	G	34-17S-28E	Well No. 3
	State BT No. 2	B	34-17S-28E	Well No. 1
	State BT No. 3	C	34-17S-28E	Well No. 2
91	Signal Oil and Gas Company			Not qualified
	State E No. 1	E	5-18S-28E	
	State M No. 2	M	6-18S-28E	
92	Amoco Production Company			Empire Abo Unit Tract No. 92
	State BY No. 1	A	34-17S-28E	Well No. 1
93	Amoco Production Company			Empire Abo Unit Tract No. 93
	State AS No. 1	O	2-18S-27E	Well No. 1
94B	Amoco Production Company			Empire Abo Unit Tract No. 94-B
	State CE No. 1	H	16-18S-27E	Well No. 1
95A	Sun Oil Company			Not Qualified
	New Mexico AU State No. 1	N	6-18S-28E	
95B	Sun Oil Company			Empire Abo Unit Tract No. 95-B
	New Mexico T State No. 1	J	6-18S-28E	Well No. 1
96	Exxon Corporation			Empire Abo Unit Tract No. 96
	New Mexico BK State No. 1	K	30-17S-29E	Well No. 1
97	Atlantic Richfield Company			Empire Abo Unit Tract No. 97
	State AO No. 1	J	2-18S-27E	Well No. 2
	State AO No. 2	I	2-18S-27E	Well No. 1
98	Amoco Production Company			Empire Abo Unit Tract No. 98
	State EA No. 1	D	6-18S-28E	Well No. 1

$$97.07 \left[2 \left(\frac{\text{MCF gas inj} \times 10}{\text{MCF gas prod}} \right)^2 + \left(\frac{\text{MCF gas inj} \times 10}{\text{MCF gas prod}} \right) \right]$$

at 30,000 max.

$$y = 97.07 \left[2 \left(\frac{37000 \times 10}{52837} \right)^2 + \left(\frac{37000 \times 10}{52837} \right) \right]$$

$$= 97.07 \left[2 \left(\frac{370000}{52837} \right)^2 + \left(\frac{370000}{52837} \right) \right]$$

$$= 97.07 \left[2 (7)^2 + 7 \right]$$

$$= 97.07 \left[2 (49) + 7 \right]$$

$$= 97.07 (98 + 7) = 97.07 \times 105$$

current GOR between 1300 & 1500
say 1400
current oil prod about 25,000 BOPD
current gas
25000 × 1400 = 10000 × 25000 = 35,000,000

increase over 30,000 max allow = $\left[2 \left(\frac{\text{MCF gas inj} \times 10}{\text{MCF gas}} \right)^2 + \left(\frac{\text{MCF gas inj} \times 10}{\text{MCF gas}} \right) \right]$

say they shall inject 5,000,000

$$y = 97.07 \left[2 \left(\frac{5000 \times 10}{35000} \right)^2 + \frac{5000 \times 10}{35000} \right]$$

$$= 97.07 \left[2 (1.43)^2 + 1.43 \right]$$

$$= 97.07 \left[2 (2.04) + 1.43 \right] = 4.08 + 1.43 = 5.51$$

$$= 97.07 \times 5.51 = 535$$