Case No.

1597

Application, Transcript,
Small Exhibits, Etc.

Memo

From

To

R-1362 in Case
1597 sent to:

Kirk Newman
Guy Buell
Jason Kellahin
Geo. Verity
J. E. Sperling
John Anderson
Phil McGrath 1-8-59

HORSESHOE - GALLUP OIL POOL

OIL PRODUCTION

MONTH & YEAR	NO. OF WELLS	OIL PRODUCTION (IN BARRELS)
1956		
OCTOBER	2	1,432
NOVEMBER	2	722
DECEMBER	2	804
TOTAL PRODUCTION		2,958
CUMULATIVE PRODUCTION		2,958
1957		
JANUARY	3	1,476
FEBRUARY	3	1,749
MARCH	3	3,706
APRIL	3	1,842
MAY	3	882
JUNE	3	1,228
JULY	12	9,658
AUGUST	12	5,178
SEPTEMBER	12	3,409
OCTOBER	14	10,046
NOVEMBER	16	8,934
DECEMBER	17	10,747
TOTAL PRODUCTION		58,855
CUMULATIVE PRODUCTION		61,813
1958		
JANUARY	17	5,536
FEBRUARY	17	7,669
MARCH	17	5,191
APRIL	17	12,370
MAY	19	24,526
JUNE	24	30,240
JULY	27	30,604
AUGUST	28	34,427
SEPTEMBER	28	33,127
OCTOBER	43	56,501
NOVEMBER	50	55,704
DECEMBER	74	96,728
TOTAL PRODUCTION		451,478
CUMULATIVE PRODUCTION		513,291

CASE NO. 1597

THE ATLANTIC REFINING COMPANY

EXHIBIT NO. 5

HORSESHOE - GALLUP OIL POOL - ATLANTIC NAVAJO LEASES

NET PAY - POROSITY & PERMEABILITY OF CORE ANALYSIS

NET PAY 1 MD OR MORE

LEASE & WELL #	NET PAY	AVERAGE POROSITY %	TOTAL MD FT	AVERAGE PERMEABILITY MD
NAVAJO #1	41	19.6	8,907.4	217.5
NAVAJO #2	33	12.5	4,356.0	132.0
NAVAJO #3	48	19.2	13,630.0	284.0
NAVAJO #4	20	14.4	2,406.5	120.3
NAVAJO #5	41	16.2	3,141.0	76.6
NAVAJO #6	29	17.5	5,882.5	202.8
NAVAJO #7	26	16.0	4,648.4	178.8
NAVAJO #8	31	17.8	6,276.3	202.5
NAVAJO #9	17	13.2	1,798.0	105.8
NAVAJO #11	27	17.4	5,337.3	197.7
NAVAJO #14	5	12.5	1,030.0	206.0

CASE NO. 1597

THE ATLANTIC REFINING COMPANY

EXHIBIT NO. 6

HORSESHOE - GALLUP OIL POOL - ATLANTIC NAVAJO LEASES

NET PAY - POROSITY & PERMEABILITY OF CORE ANALYSIS

NET PAY 1 MD OR MORE

LEASE & WELL #	NET PAY	AVERAGE POROSITY %	TOTAL MD FT	AVERAGE PERMEABILITY MD
NAVAJO #16	6	13.0	111.4	18.6
NAVAJO #18	25	15.9	3,396.0	135.8
NAVAJO #20	15	18.1	2,004.0	133.6
NAVAJO #21	7	15.4	417.0	59.5
NAVAJO #22	6	10.7	79.3	13.2
NAVAJO #23	7	14.5	395.2	56.5
NAVAJO #25	7	11.7	27.8	4.0
NAVAJO #28	11	15.5	1,582.6	143.9
NAVAJO #29	21	16.4	2,270.6	108.0
NAVAJO #30	10	15.4	951.8	95.2
NAVAJO B #2	5	14.3	336.3	67.3
NAVAJO B #3	7	16.4	994.1	14260

CASE NO. 1597

THE ATLANTIC REFINING COMPANY

EXHIBIT NO. 6

CORE ANALYSIS

HORSESHOE - GALLUP OIL POOL

ATLANTIC NAVAJO LEASES

NUMBER OF WELLS CORED	23
NUMBER OF SAMPLES INCLUDED IN AVERAGE (ALL SAMPLES WITH 1.0 MD PERMEABILITY OR MORE)	445
WEIGHTED AVERAGE POROSITY	16.4%
WEIGHTED AVERAGE PERMEABILITY	157.3
AVERAGE NET PAY	19.3
CONNATE WATER (LABORATORY)	30%

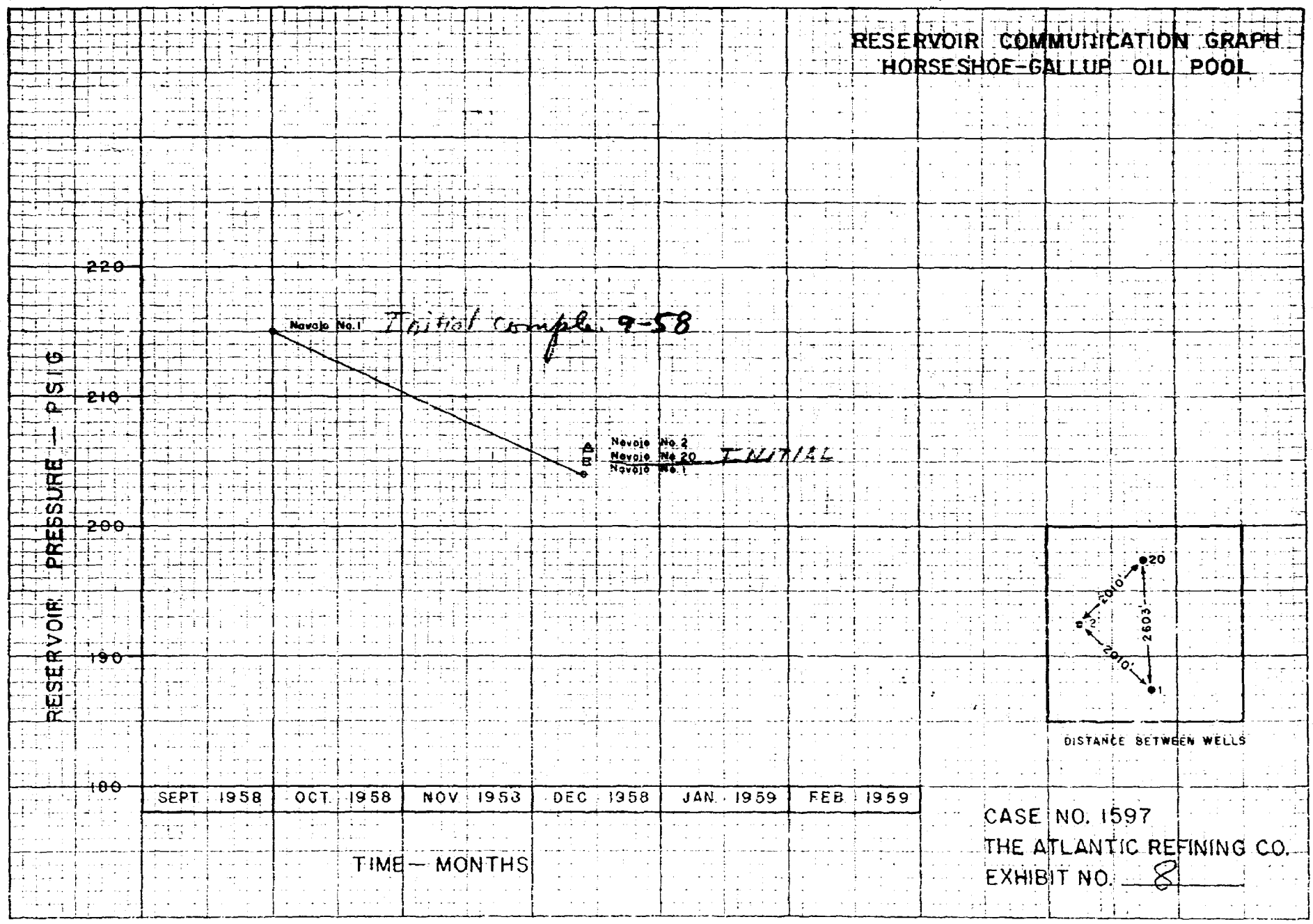
CASE NO. 1597

THE ATLANTIC REFINING COMPANY

EXHIBIT NO. 7

K&E 10 X 10 TO THE INCH 359-SUG
KEUFFEL & ESSER CO.

RESERVOIR COMMUNICATION GRAPH
HORSESHOE-GALLUP OIL POOL



CASE NO. 1597
THE ATLANTIC REFINING CO.
EXHIBIT NO. 8

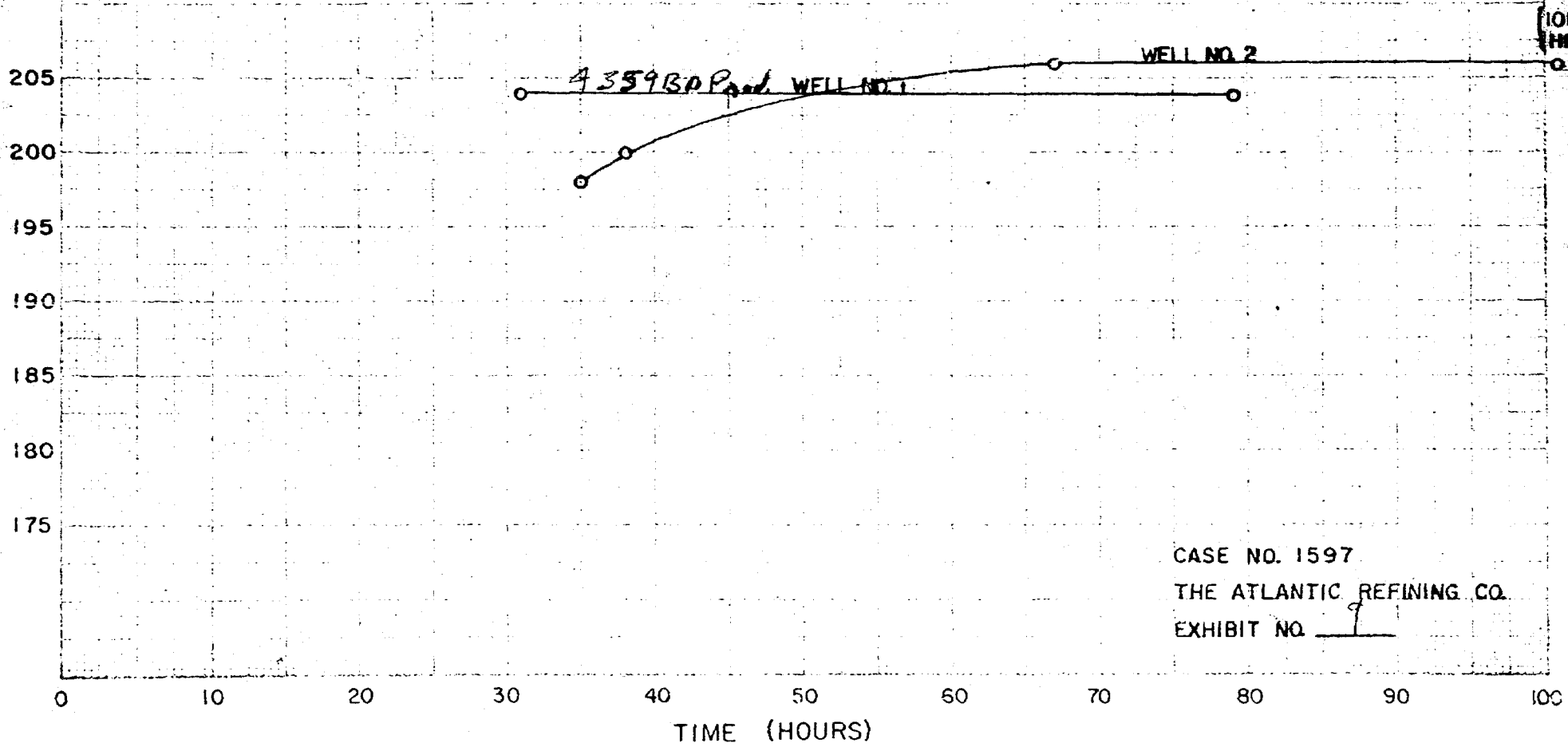
HORSESHOE – GALLUP FIELD

THE ATLANTIC REFINING CO. NAVAJO WELL NO. 1 & 2

WELL NO. 1 - 79 HOURS TOTAL SHUT IN TIME

WELL NO. 2 - 101 HOURS TOTAL SHUT IN TIME

DEC. 10, 1958



CASE NO. 1597

THE ATLANTIC REFINING CO.

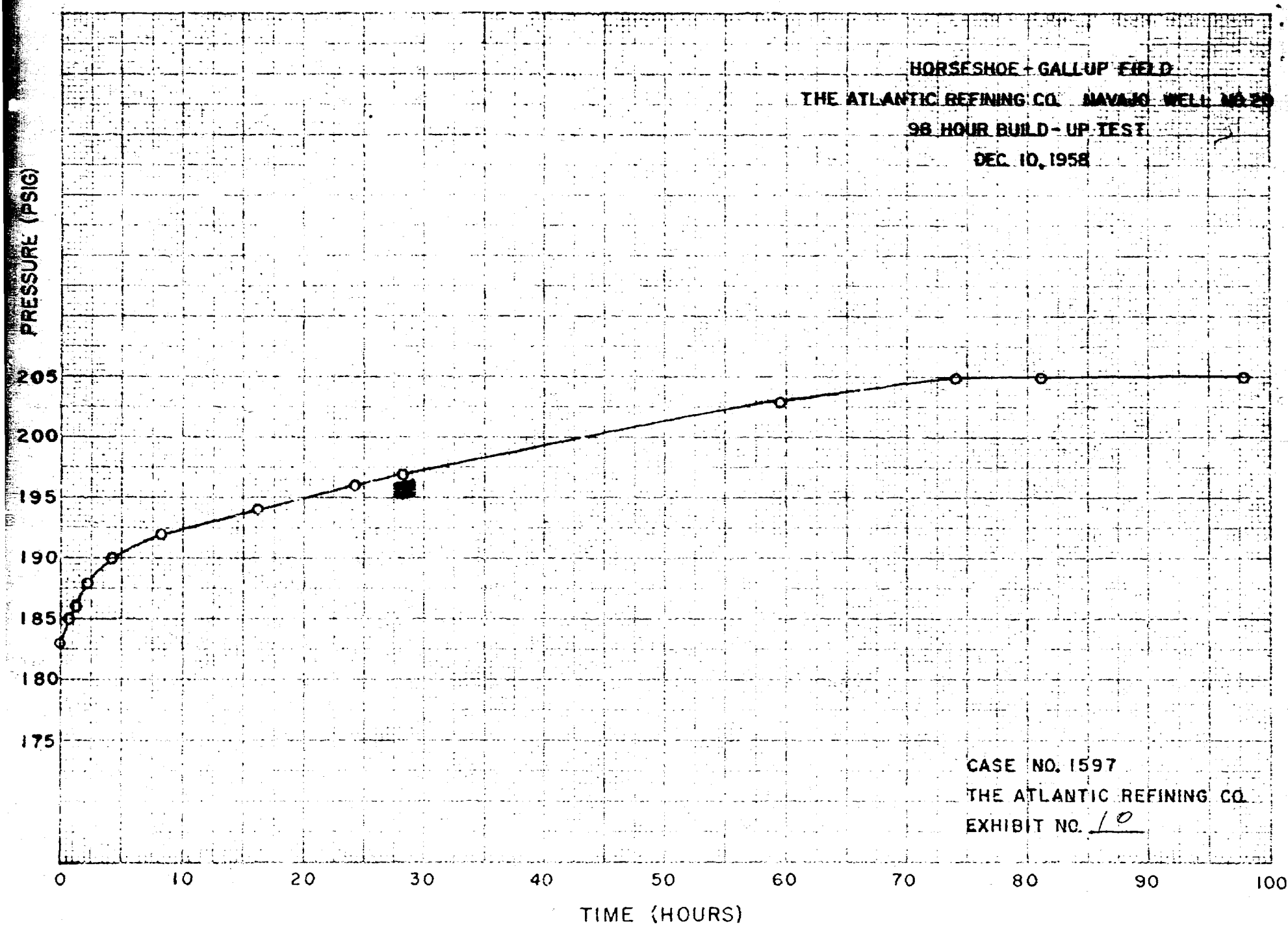
EXHIBIT NO. 4

HORSESHOE - GALLUP FIELD

THE ATLANTIC REFINING CO. NAVAJO WELL NO. 20

98 HOUR BUILD - UP TEST

DEC. 10, 1958



CASE NO. 1597

THE ATLANTIC REFINING CO.

EXHIBIT NO. 10

BEFORE THE
OIL CONSERVATION COMMISSION
SANTA FE, NEW MEXICO

IN THE MATTER OF:

CASE 1597

TRANSCIPT OF HEARING

MARCH 18, 1959

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

BEFORE THE
OIL CONSERVATION COMMISSION
SANTA FE, NEW MEXICO
MARCH 18, 1959

IN THE MATTER OF:

CASE 1597 Application of the Atlantic Refining Company for an order promulgating temporary special rules and regulations for the Horseshoe-Gallup Oil Pool in San Juan County, New Mexico. Applicant, in the above-styled cause, seeks an order promulgating temporary special rules and regulations for the Horseshoe-Gallup Oil Pool in San Juan County, New Mexico, to provide for 80-acre proration units in said pool.

BEFORE:

A. L. Porter
Murray Morgan

T R A N S C R I P T O F P R O C E E D I N G S

MR. PORTER: Pick up next Case 1597.

MR. PAYNE: Case 1597. Application of the Atlantic Refining Company for an order promulgating temporary special rules and regulations for the Horseshoe-Gallup Oil Pool in San Juan County, New Mexico.

MR. HINKLE: If the Commission please, I am Clarence Hinkle of Hervey, Dow & Hinkle of Roswell, appearing on behalf of the Atlantic Refining Company. We have two witnesses whom I would like to have sworn.

(Witnesses sworn)

MR. PORTER: At this time I would like to call for other appearances in Case 1597.

MR. NEWMAN: Kirk Newman of Atwood & Malone of Roswell, and Guy Buell, Roswell, representing Pan American Petroleum Corporation.

MR. PORTER: Do you intend to present testimony?

MR. NEWMAN: No.

MR. KELLAHIN: Jason Kellahin of Kellahin & Fox, Santa Fe, New Mexico, representing Tom Bolack. We will have no evidence to offer.

MR. VERITY: George Verity of Farmington, representing the Petro Atlas, and I think we will have one witness to present.

MR. SPERLING: J. E. Sperling, representing Magnolia Petroleum Company. We will not have any testimony.

ROBERT S. AGATSTON,

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

DIRECT EXAMINATION

BY MR. HINKLE:

Q State your name, please.

A Robert S. Agatston.

Q By whom are you employed?

A The Atlantic Refining Company.

Q In what capacity?

A I am District Geologist in Durango, Colorado.

Q Have you previously testified before the New Mexico Oil Conservation Commission?

A Yes, sir, I have, sir.

Q In what case?

A In Case 1596, which was concerned with dual completions in the Horseshoe-Gallup Field.

Q That was at the last regular hearing, was it not?

A Right.

MR. HINKLE: Are his qualifications acceptable?

MR. PORTER: Yes, sir, they are.

Q Mr. Agatston, have you made a study of the Horseshoe-Gallup Pool area?

A Yes, sir.

Q Are you familiar with all of the production history and the drilling of all the wells in the area?

A That's correct, sir. I have examined most of the wells in the area.

Q Have you prepared a map which shows all of the wells in the area, --

A That is correct.

Q -- producing area? Will you refer to Atlantic's exhibit 1 and explain to the Commission what it shows?

A Exhibit 1 is a pool map of the Horseshoe-Gallup Field. Atlantic acreage is shown in pink. The one dot is a well producing from what we have called the upper zone. The dot with a circle around it is a well producing from the upper and lower zones. A triangle represents wells that are producing from the lower zone

only. There are about a hundred and thirteen producing wells on this, within the limits of this productive area. About seventy-five of them are producing from the lower zone. Practically all of the wells are producing from the upper zone. The limits of the pool have not been defined. There is a dry hole, No. 31, in the southwestern portion of the field. There is a gas well along the northwestern portion of the field, and there is a dry hole here in the southwestern portion of the field.

Q From what depths are the wells producing?

A Anywhere from about 1300 to 1800, most of them.

Q They are all from the same reservoir and formation?

A They are all producing from the Gallup formation.

Q Has the present production extended beyond the presently defined limits of the pool?

A I believe it has, sir, particularly off in the northern end, and they are extending production to the south end.

Q Is there any possibility that it will be extended to a still greater area?

A I don't think there is any doubt that it will be extended to a greater area.

Q Approximately how many miles does it cover at the present time?

A Covers about four t. five miles in length.

Q Have you prepared cross sections of the Horseshoe-Gallup Pool?

A Yes, sir.

Q Will you refer to Atlantic's Exhibit No. 2 and explain to the Commission what it shows?

A Now here I will concern myself only with the distribution of the sands. The first, this cross section is a cross section which goes from the southeast end of the field to the northwest end of the field. It is approximately in the center. The line on top of the cross section represents a contour point that we use in making our structure contour maps. The second line is the top of the Gallup interval in the top of what we call the upper zone. The line below that represents a line in which we consider to be the base of prominent sand development in the upper zone. The next line represents the top of the lower zone, and the line below that represents the base of what we consider prominent sand development in the lower zone. The basal line is the top of the Juana Lopez senositee, which we consider to be a correlative marker throughout the Horseshoe-Gallup Field.

Q Is there a rather uniform thickness of the two zones throughout the producing area?

A You will notice that on this cross section as you go from the southwest -- southeast, rather, to the northwest, there is some variation in sand development. Sand varies from about 20 feet on to over 50 feet. There is a thinning of the upper sand at the northwestern end of the field. Since we are paralleling the development of the -- essentially paralleling the development of the

lower sand, it is a fairly consistent thickness on this particular cross section and varies from about 15 to 20 feet to nearly 40 feet in thickness.

Q Does this cross section show continuity of both zones throughout the field?

A This cross section is designed to show that the sand development of the various wells in the upper zone and lower zone is essentially continuous from the southeast end of the field to the northwest end of the field.

Q What is the thickness of the interval separating the two zones, approximately?

A This varies. It is about 50 to as much as 100 feet on this particular cross section.

Q What is the type of zone that the interval is made up of?

A The zone is made up of thin sand stringers, sandy shale and shaly sand and some thin shale streaks.

Q Is there anything else you would like to tell the Commission with respect to this cross section?

A No, sir.

Q Refer now, to Atlantic's Exhibit No. 3 and explain to the Commission what it shows.

A This is a cross section going from the northern corner of Section 29, that is, starting at Atlantic's Well No. 25 to the southwestern corner of Section 31, that is Atlantic's Well No. 28.

This cross section is designed to show that there is a continuance of sand at right angles to that of cross section AA Prime. You will note that there is some thinning of the upper sand in the northern part of the cross section where it is only about 20 feet thick, and that there is a general thinning of the sand interval to the southwest. You will also notice that the lower sand zone has shaled out to the northeast and that it becomes thicker toward the center of the field, rises in the section, and ultimately is correlative with the lower part of the upper sand.

Q Does that show a merger of the two sands or approximately so?

A Shows a merger in the lower portion of the upper sand with the upper portion of the lower sand.

Q Does it show that there is probably communication between the two zones?

A The sand zones are communicative.

Q Now, refer to Atlantic's Exhibit 4 and --

A This is a similar cross section to the one you looked at, and it is more in the southwestern portion of the field. It starts in Section 34; I believe that's El Paso's No. 11 Well, and goes from northeast to southwest, to the Petro Atlas "E" 1. Again the upper sand zone is continuous throughout the line of cross section. The lower sand is thin, absent in the northeastern portion of the cross section and thickens to as much as 40 feet and maximum development, and then thins and rises in the section until

it is correlative with the lower part of the upper sandy interval.

Q Exhibit 4, then, shows continuity of the producing zones across that particular cross section?

A This shows the continuity of sand deposition across the field from the northeast to the southwest in both zones.

Q Now, Mr. Agatston, referring back to Exhibit No. 1, can you tell the Commission approximately what percentage of the field has been so far developed on 40-acre spacing and what portion has been developed on 80-acre spacing?

A Approximately 35 percent has been developed on 80-acre spacing, 65 percent on 40-acre spacing.

Q Were all of these exhibits prepared by you or under your direction?

A That's correct.

MR. HINKLE: We would like to offer in evidence Exhibits 1 through 4 inclusive.

MR. PORTER: Without objection, the Exhibits will be admitted.

Q (By Mr. Hinkle) In regard to your last answer, it is 35 percent drilled on 40-acre location, is that what you mean?

A I mean that 35 percent of the wells are --

Q The wells?

A -- in the producing area, which I limit approximately here and down here, and up here are 80-acre locations.

Q But there is -- where is Atlantic's acreage in this

particular pool?

A Atlantic is the pinked in area; it includes these wells, all the wells in this four-section block, and additional, actually four wells in Section 19.

Q Have all of Atlantic wells been drilled on 80-acre spacing?

A That's correct. We had one slightly off location due to topography.

MR. HINKLE: That's all.

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

CROSS EXAMINATION

BY MR. KELLAHIN:

Q Dr. Agatston, has Atlantic consistently developed their acreage on 80-acre spacing pattern?

A You mean in the Horseshoe-Gallup Field?

Q Yes.

A That is correct.

Q Has any other operator followed that spacing pattern in the pool?

A Well, there are places here where 80-acre locations are apparent. For example, it would be hard to determine what the spacing pattern will be over in that area and in here. These two wells have been drilled on eighties but we are, of course, the major proponents of the 80 acres.

MR. KELLAHIN: Thank you.

MR. PORTER: Anyone else have a question? Mr.Verity.

CROSS EXAMINATION

BY MR. VERITY:

Q Doctor, with 80-acre spacing, are you recommending a pattern of development?

A Now, I prefer to let the reservoir people answer that question.

MR. HINKLE: If the Commission please, our next witness will go into that.

MR. VERITY: I withdraw the question.

MR. PORTER: Did you have any further questions?

MR. VERITY: No.

MR. PORTER: No further questions? The witness may be excused.

(Witness excused)

DIRECT EXAMINATION

BY MR. HINKLE:

Q State your name, please

A Bruce Vernor.

Q By whom are you employed, Mr. Vernor?

A The Atlantic Refining Company.

Q In what capacity?

A I am area reservoir engineer for the Atlantic,Rocky Mountain Region, headquarters in Casper, Wyoming.

Q Have you previously testified before the Oil Conservation Commission?

A Yes, sir, I have, in Case 1296.

MR. HINKLE: Are his qualifications acceptable?

MR. PORTER: Yes, sir, they are acceptable.

Q (By Mr. Hinkle) Have you made a study of the production history, well location and other data in connection with the Horseshoe-Gallup Pool?

A Yes, I have.

Q Are you acquainted with the mthods of well completion?

A Yes, I am.

Q Have you compiled information relative to the production?

A I have here Exhibit No. 5 which is a tabulation of the oil production from the Horseshoe-Gallup Field from October, 1956, showing the number of wells, the oil production by months, and the cumulative production at the end of each year.

Q Would you read the totals there, the total production?

A Yes. The total production for 1958 was 451,478 barrels. The cumulative production at the end of 1958, 513,291 barrels. And in December of 1958 there were 74 wells.

Q Have you compiled any information relative to the core data from the different wells where cores have been taken?

A Yes, I have. Exhibit No. 6, which I would like to point out, is two pages, showing the core analysis of the average,

core analysis for each of the 23 wells we have covered, showing the net pay, using a criterion of feet with permeability in excess of one milladarcey, average porosity, total milladarcy feet or capacity, and average permeability.

Exhibit 7 is a summary of this data showing that the Atlantic Refining Company covered 23 wells on our Atlantic Navajo lease and Atlantic Navajo B lease were 445 samples included in these averages. The weighted average porosity is 16.4 percent; the weighted average permeability 156.3 milladarcies; the average net pay 19.3 feet, and our estimate of connate water based on our laboratory analysis is 30 percent.

Q Have you any information relative to well pressures?

A Yes, I do.

Q Refer to Exhibit 8 and explain to the Commission what it shows.

A Exhibit No. 8 is the -- the graph which has been placed on the board. I would like to point out that on the lower right-hand corner is a scale plat showing the location of the three wells involved which are the Navajo 1, 2 and 20, and they are the three wells, two of them in the southeast quarter of Section 32, and one in the southeast northeast of 32. The Navajo No. 1 Well was pressure tested to September 30, 1958 immediately after the potential test. The initial pressure measured was 215 PSIG, the datum of plus 4175. All the pressures I will refer to are at the same datum.

December 10th, immediately after the potential test, initial pressure of 205 PSIG was measured in the Navajo No. 20 Well, which is a north offset to the Navajo No. 1. At the same time, with the pressure bomb, we measured the pressure in the Navajo No. 2 Well and the Navajo No. 1 Well. At this time the pressure in the Navajo No. 1 Well was 206 PSIG, and the -- beg your pardon -- Navajo's No. 1 pressure was 204 PSIG, and No. 2, 206. You can see that the three pressures all are very close at the right-hand side of the plot.

Q What does this graph intend to show?

A The initial reservoir pressure in the Navajo No. 20 Well was ten pounds more pressure than the initial pressure measured in the Navajo No. 1 Well. This shows the Navajo No. 20 Well was drilled within a drainage area of earlier wells. This particular pressure decline history actually shows much greater than 80-acre drainage. The nearest well to the Navajo 20 at the time it was drilled is the Navajo No. 2 Well, which is 2,010 feet away. This is the radius of the 291-acre circle.

Exhibits 9 and 10 are merely plots of the individual pressure data from the Navajo 1, 2 and 20 Wells to show that we were measuring stabilized pressures so that there is no question of further build-up on the pressures. You'll notice the Navajo 1 and 2 pressures are on Exhibit 9, and they show no pressure increase on the right-hand side of their plot, and likewise, the Navajo No. 2 Well -- No. 20 Well -- excuse me -- on Exhibit 10.

Q Do you have any further comment with respect to Exhibits 8, 9 and 10?

A No, I don't.

Q Have you made any other pressure tests other than shown by those Exhibits?

A Yes, sir. We have run two more pressure surveys, one of them on the Navajo 8 and 19. The Navajo 8 is northwest northwest of Section 30, Navajo 19 northwest southeast of Section 30, and an additional test in the Navajo "B" 1, which is in the southeast southwest of the Section 19. I might mention this block is our Navajo "B" lease. On January 31st, 1959 we measured the pressure at 212 pounds in the Navajo No. 8 after production of some 4700 barrels of oil. We at the same time measured a pressure of 214 pounds as an initial pressure on the Navajo No. 19 immediately after the potential test. These pressures don't show the striking example that we've shown on our Exhibit 8. However, they are very close together even though one of them is an initial pressure and the other pressure is measured on the No. 8 after production of 4,792 barrels of oil. On March 3rd, 1959 we ran an initial pressure test in the Navajo No. 8, measured 212 pounds and initial pressure on the Navajo "B" 1 of 21 pounds. These pressures don't show quite the same picture that we have on our Exhibit 8. However, the areaaround the Navajo "B" 1 Well based on our average permeabilities on Navajo No. 9 and "B" 2, the average permeability

around the Navajo "B" 1 is lower than around the other wells we have been discussing, and I will show later lower permeability. The time required to show the pressure drop is greater. In other words, it just hadn't happened at the time we measured it, but it will happen later.

Q Mr. Vernor, have you made a drainage calculation using average reservoir and flood characteristics from the Horse-shoe-Gallup Pool?

A Yes, I have. I regret at the moment that I only have one copy of Exhibit 11, but we have more being reproduced right now. We will be able to give them to you right after lunch.

Exhibit 11 is a reproduction of the article appearing in the August, 1956 Petroleum Engineer, starting on Page B-171 by Robert G. Nisle. He is in the research division of the Phillips Petroleum Company at Bartlesville, Oklahoma. Mr. Nisle shows his deviation of a method of calculating the producing time required to effect a given pressure drift from any given radius from a well using the reservoir properties and flood properties. His work is based on works by Muskat, D. R. Horner, and A. F. Everdigen. I have used this to determine the effect of a one-pound pressure drop at the outer boundary of an 80-acre circle. Using the following properties, a viscosity of 1.64 centerpoise, a volume factor of 1.077, a production rate of 50 barrels of oil per day, a compressibility of reservoir fluids both oil and water of 5.84 barrels change in volume per million barrels of fluid per pound

change in pressure, a 16.4 percent porosity, and oil permeability of 79 milladarcies, and 19.3 feet for the thickness. These core data are from our Exhibit 7 with the exception that I have assumed that the oil permeability would be one-half of the measurable permeability. I calculate a one-pound pressure drop would occur 1,053 feet from the well bore after 96 days production at 50 barrels of oil per day, using our average reservoir properties. 1,053 feet is a radius of an 80-acre circle. If a one-pound pressure drop can occur at this distance in a little over three months, a far greater pressure drop will occur in one or two years at this distance, or by the same reasoning, the one-pound pressure drop will occur at a far greater distance after a producing time of one or two years.

Q Is this type of calculation generally accepted in the industry?

A I believe it is. We use it quite often. Mr. Nisle's paper was published in August of '56.

Q Have you made a comparison of the permeability characteristics of the Bisti Pool with the Horseshoe-Gallup Pool?

A Yes, sir, I have.

Q What is the result of your comparison?

A I made a general comparison of the permeability shown at the hearings on the Bisti Field. The average permeability for Bisti appears to be around 10 milladarcies, some cases more, some less. We have shown on our Exhibit No. 7, we have an average

permeability of 157.3 milladarcies for the 23 wells Atlantic has cored. In Bisti, the operators were able to show, over a period of time, 80-acre drainage beyond a doubt by substantial pressure measurement or pressure decline in shut-in wells due to the production of the offset wells. Our permeability here is roughly fifteen times that in Bisti.

Q Are the characteristics of the fields otherwise quite similar, that is, general characteristics?

A They do produce from the same zone. My point here is that we have not as yet had time to show the weight and mass of data the operators were able to show; in Bisti we have much higher permeability, and there is no reason to say that one well wouldn't drain far in excess of 80 acres in the Horseshoe-Gallup Field.

Q And 80-acre spacing is in effect in the Bisti area, is it now?

A Yes, it is.

Q Now, from your study of all the information which you had available to you, what is your opinion as to whether or not one well will effectively and efficiently drain 80 acres or more?

A I feel that one well will efficiently and certainly economically drain far in excess of 80 acres.

Q Do you know of any reason why this field should be developed on 40-acre basis, 40-acre spacing?

A I know of none.

Q State whether or not substantially the same amount

of oil would be produced on 80-acre spacing as 40-acre spacing.

A Yes, substantially the same amount of oil will be produced on 80-acre spacing as would be produced on 40-acre spacing.

Q Will 80-acre spacing eliminate the drilling of unnecessary wells?

A Yes, it will.

Q From an economic standpoint, what savings, if any, will be effected by developing the pool on 80-acre spacing?

A Speaking for the moment of the Atlantic Navajo leases, we estimated that based on the presently delineated field that we would have 66 wells under 40-acre development; 68 -- excuse me -- 34 wells on 80-acre development. We estimate it will cost us $24,600 to drill, equip with pumping unit, and set the necessary surface equipment for each well. The total of $836,000 we will have to spend to drill the other 34 wells, which we say are not necessary.

Q I believe you heard the testimony of Mr. Agatston that there is a lot of the area that is undeveloped at the present time?

A Yes.

Q And it may extend over several miles and include a lot of other acreage. Is it true that if it is developed on 80 acres and it does extend over a greater area that it would save perhaps several million dollars?

A That's very possible.

Q Are the characteristics of the Horseshoe-Gallup Pool such that it will lend itself to some method of secondary recovery?

A Yes, I believe that they are. In fact, based on our preliminary work, it appears that the recovery by, for example, water flooding, would be more than twice as high as the recovery by primary.

Q Is there any reason why this field cannot be just as effectively water flooded under 80-acre spacing as under 40-acre spacing?

A No, there is not. I might speak of pattern for a moment. On 80-acre spacing, if you will look at the map, the wells run diagonally; all you have to do is rotate the map 45 degrees, and you will find you have the same square you have on 40-acre spacing, so the difference is only in degree. The relative layout is the same so far as the pattern of flooding is concerned.

Q Has Atlantic made a study at the present time of possibility of water flooding, or do you intend to make a study for that purpose?

A We have been gathering data with a water flood study in mind, and as soon as we are able to tell how much of our leases will be productive, we will start a full scale study.

Q What recommendations do you have to make to the Commission, if any, with respect to the adoption of special field

rules for the Horseshoe-Gallup Pool?

MR. PORTER: Mr. Hinkle, may I interrupt at this point? I will recess the hearing until one-thirty.

(Recess)

MR. PORTER: The meeting will come to order. Mr. Hinkle, will you proceed with your examination of the witness?

Q (By Mr. Hinkle) Mr. Vernor, before proceeding to answer my last question, I wish you would refer to Atlantic's Exhibit No. 1 and explain to the Commission what it shows with reference to the development on 80-acre spacing and 40-acre spacing.

A I would like to point out the number that Mr. Agatston gave referred to the number of wells developed on 40 or 80-acre pattern. As you can see from looking at Exhibit 1, almost half the field from the area standpoint is developed by 80-acre pattern.

Q Before we recessed, I asked you what recommendations do you have to make to the Commission with respect to the adoption of field rules for the Horseshoe-Gallup Pool.

A That 80-acre spacing and proration units should consist of 80 acres, more or less, constituting the north half, south half, east half or west half of a single governmental quarter section. That all wells shall be located within 330 feet of the center of either quarter quarter section or lot of such spacing or proration unit. I might point out that we have no objection to a fixed specification of the units, that is, that they all run

north or south or east and west. The only reason we didn't specify one was because of the nature, some of the fields down here with more wells on it. Also, we have asked for 330 foot tolerance on location because of the very rough topography that we have on the northern part of the Horseshoe-Gallup Field. We also wouldn't object to a lesser limitation. However, it would require more exception hearings because of the topography. Also, that each 80-acre spacing unit should be assigned an 80-acre proportional factor of two for allowable purposes, and in the event there is more than one well in an 80-acre proration unit, the operator should be permitted to produce the unit allowable for said wells in any proportion, and each operator shall have the right to drill a well on either or both of the components quarter quarter section or lots, of each 80-acre spacing or proration unit. That an exception should be made as to any well drilled to or completed in the Horseshoe-Gallup Oil Pool not in conformity with the spacing requirement prior to the time the order is entered establishing special rules and that where, on account of the tractal acreage involved, any quarter quarter section or lot, the 80-acre unit is more or less than 80-acre, it shall be granted an allowable in proportion to the number of acreages actually contained in the unit.

Q Are those recommendations so far substantially the same as those in effect in the Bisti area?

A They are with the exception of the two items I just

mentioned. The Bisti Field rules allow 100 foot tolerance, and they specify, I believe, east west orientation of the 80-acre unit. Those are the only differences.

Q What further recommendations do you have?

A The temporary order for one year shall be granted to allow gathering of data to further substantiate that 80-acre drainage is efficient. I recommend further that Atlantic be given permission to shut in one or more wells and transfer the allowable to other wells on the lease. This well could be used as a key well for pressure surveys run at intervals to show the resulting pressure decline even though the well is shut in while the surrounding wells are produced. Of course, we like to work out a testing program to the satisfaction of the Commission staff.

Q Is there any possibility that withdrawals over a period of a year will result in a situation where it would not be economical to go back and drill the undrilled 40-acre units, in the event it is not conclusively shown during the one-year period that one well would drain 80 acres or more?

A No, there is no possibility that that will occur. The reserves are such that they should still be sufficient to justify from an economic standpoint.

Q Were Exhibits 1 to 10 inclusive prepared by you or under your direction?

A Yes, they were.

MR. HINKLE: We would like to offer in evidence

Exhibits 5 to 11 inclusive. 11 is the article taken from the journal.

MR. PORTER: Without objection, the Exhibits will be admitted.

Does anyone have any questions of Mr. Vernor? Mr. Verity.

CROSS EXAMINATION

BY MR. VERITY:

Q Mr. Vernor, I didn't follow you real closely with your recommendation pattern. Would you give us that again, please?

A I merely left it opened that any half of a quarter section could be assigned as the proration unit, that is the east half, west half, north half or south half. Naturally, you would have to be consistent on what you assign.

Q And your spacing within that 80-acres?

A 330 from the center of either component quarter section. In other words, the same tolerance that's now in effect on statewide except that you couldn't move right to the center of the 80-acre unit.

Q In other words, if I understand you then, 330 feet from either one of the forties or either half?

A That's right.

Q Under that spacing, then, it would be possible for an individual to drill a well on approximately the south one-eighth of the 80 acres, isn't that correct?

A Yes, that would be correct. I might point out that

Petro-Atlas wells and quite a number of El Paso's are drilled in just that fashion at the moment.

Q And if you were permitted to drill on, say, the south one-half of an 80-acre tract, under certain circumstances, it could be possible. a man could be drilling only 20 acres of productive oil and have an 80-acre allocation, isn't that correct?

A That's true. However, I think the burden of proof lies on the operator to show that the unit he proposes to assign to his well is productive, and the same situation can occur on 40-acre spacing.

Q Have you made any recommendation, or do you make any recommendation as to the rule with regard to how an operator shall dedicate a full 80 acres to one well? What procedure should be followed?

A Follow the plat, I suppose, on the ordinary fashion.

Q Do you think that opinion might vary as to whether or not that tract was underlain by productive formation?

A I think that would be the subject for a hearing.

Q Do you recommend to the Commission that a hearing be held whenever it is requested with regard to whether or not a full 80 acres is?

A I think that would be automatic. if someone asked for and requested the assigning of acreage to a proration unit. Wouldn't anyone asking for a hearing be granted a hearing, Mr. Porter?

MR. PORTER: That's right.

Q (By Mr. Verity) My question is this, would you recommend it to the Commission that a hearing be granted? I gather that you would from your --

A I will be quite willing to recommend that, yes. My point is that I don't think it is necessary that I recommend. I think that is imperative.

Q Well, probably we don't have any argument, then, if you so feel, but it seems to me that there should be, under these facts which you have stated here, that it is necessary that there be some mechanics in these rules that will insure that a hearing will automatically result if anyone raises a question about it.

A Well, the Bisti seems to be operating very nicely without such a rule or regulation..

Q Well, we might have a different set of facts in Bisti. I don't think Bisti is here in question.

A That's quite true. I might point out that I think the same question could be raised about 40-acre locations as you are raising about 80-acre location; might take the four wells of Petro-Atlas on the northwest quarter of Section 5 as a case in point.

Q Of course, if you have 40 acres, the evil would only be less than half of what it might be in an 80-acre tract?

A This is possible in a situation in which both wells will be drilled at one end of the tract. For instance, take these

four wells for a moment, and take these two out, assigning 80 acres to these two wells. The two east wells in the northeast quarter of Section 5, on a uniform 80-acre pattern, any location you pick, any way you orient the units, you have the wells staggered such that you have more information than you have in the case where both wells were at the same ends of the units. And as far as that goes, we will be quite willing for a fixed pattern in a particular diagonal array for 80-acre spacing. The only reason we didn't recommend one was because of the development we would have done here. As you can see, we have developed on a uniform 80-acre spacing. The well Mr. Agatston brought this morning, No. 29, was off pattern, but still is essentially on pattern, and was moved because of the Chimney Rock, I believe they call it.

Q Well, as I understand it, you would have no objection at all to anybody being required to make proper proof, and if question arises, a hearing to be held as to whether or not they are entitled to a full 80-acre spacing?

A No, I see no objection to that.

MR. VERITY: That's all.

A I might say we don't intend to assign any acreage that is not productive to our well, so we certainly couldn't object to it.

MR. PORTER: Does that conclude --

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

QUESTIONS BY MR. PORTER:

Q Mr. Vernor, in answer to Mr. Hinkle's question this morning, I believe you said that substantially the same amount of oil would be recovered from one well in 80 that might be expected to be recovered from two wells --

A Yes, sir.

Q -- on an 80? Would you care to estimate a percentage of the reserves, recoverable reserves that might be left in the ground as a result of 80-acre proration units?

A Well, from my point of view, there wouldn't be any. I will tell you the reason I say that. All that would be required to recover the same amount of oil would be a uniform comparable pressure distribution and obviously the pressure distribution would be different in one well from two wells, but we also have the economic limits to consider for two wells. Let's say for a moment that the economic limit would be three barrels a day, which is a reasonable number in this case, one well on 80-acre spacing would be three acres for the unit; for two wells, it would be six barrels a day, so that you can actually produce the one well to the point that you have a pressure drawdown of sufficient magnitude all over the units, and I don't foresee that there would be any less oil recovered on 80-acre spacing, especially in view of your intent to secondary recovery.

Q It would be your answer that you would recover from one well as much as you would from two?

A Yes, sir, you would recover as much.

MR. PORTER: Does anyone else have a question of the witness?

QUESTIONS BY MR. NUTTER:

Q Mr. Vernor, I note on your Exhibit 6 where you have depicted the average permeability for various wells that you have covered, --

A Yes.

Q -- and also the total milladarcy feet for the various wells that there doesn't seem to be any direct correlation between the number of feet of net pay and the total milladarcy feet. What is your explanation of that? For example, Mr. Vernor, Navajo No. 1 has 41 feet of net pay and a total milladarcy feet of 8,907, whereas Navajo No. 5 also has 41 feet of pay and a total milladarcy feet of 3,141. In other words, the No. 1 has three times as many milladarcy feet for the same amount of net pay that the No. 5 has.

A That's only a reflection of the average permeability being lower for the No.5 than for the No. 1.

Q Would also the case of the No. 25 having 7 net feet of pay and 27.8 milladarcy feet as compared with the Navajo "B" 3 having 7 feet and 994 milladarcy feet, would that be a reflection of variation of permeability?

A Yes, because you will note the permeability for Navajo 25 is 4, where as 142 for Navajo "B."

Q There is a wide discrepancy in the permeability encountered in the wells?

A There is considerable variation, but even 4 milladarcies is pretty good permeability.

Q There is less likelihood when you have low permeability that you will drain a larger area than when you have low, is it not?

A My point of view on that is that once you can show continuity in a reservoir drainage over any specific area it is a question of time; permeability would be reflected in time. Yes, it is true that on a lower permeability it will take longer to drain a given area, but you can still drain it.

Q I see.

A That Exhibit 11, or at least the calculations I made based on Exhibit 11, reflect that property.

Q Now, on your Exhibit No. 3, Mr. Vernor, the pressure shown at the end of September, 1958 for the Navajo No. 1 was the initial pressure, is that true?

A Yes, sir.

Q Had any production been taken from the well at all?

A The well had been potentialed, that was all. That's true of all the initial pressures I referred to. The wells had been potentialed and immediately shut in.

Q Had some withdrawals been made from Navajo No. 20?

A It had been potentialed.

Q That's all?

A That's all.

Q Do you think that the fact that the No. 20 Well has only 15 feet of net pay as compared to the No. 1's 40 feet of net pay might have been one of the differences there in the bottom hole pressure after potential had been taken?

A No, I don't think that is likely because that would imply that our pressure was not fully built up.

Q You have less reserves in the No. 20 than you have in the No. 1, probably, haven't you?

A Yes.

Q And on a potential test you would have taken a larger percentage of the total reserves in the No. 20 than you would the No. 1?

A The difference between the percentage of 200 barrels in the reserves. true, would be greater percentage, but the percentage would still be extremely small, and with a stabilized or fully built-up pressure such as we have here, we,even with, say, a hundred barrels production momentarily drawn down to pressure, again referring to Exhibit 11, it couldn't have drawn it down very far away in that length of time.

Q So you feel that the difference in the thickness of the pay on the two wells has no bearing on this pressure relationship of the two?

A No, I don't believe it would. If we had more production out of No. 20 than just the potential, I would have to concede your point, but with just the potential test I can't see that

that would influence the pressure at all. For instance, looking at Exhibit 10, you can see it only took about 74 hours to build up from the initial measured pressure of 183 pounds to a fully stabilized pressure of 205.

Q What is the average cost of drilling one of these wells, Mr. Vernor?

A $24,600, including pumping unit and surface equipment.

Q What's the value of the reserves, primary reserves under a 40-acre tract, on the average?

A I don't have an average figure offhand, but I think I can answer your question. We are not pleading we can't afford to drill wells on 40 acres here. We are saying that drilling them would result in unnecessary wells and unnecessary expense. In other words, we can do better on 80. I don't have an average reservoir figure at hand for the whole on our whole lease.

Q Well, I noted that on your direct testimony you stated that one well would effectively and certainly economically drain 80 acres, and you underlined "certainly economically." A well would certainly economically also drain 40 acres, wouldn't it?

A It would be more economical for one well to drain 80 acres, and we cut our investment in half for the same return, essentially. That's one major course left opened to us to reduce our cost per barrel in order to compete with that bugaboo of foreign oil.

Q I see. If the pool were developed on 40-acre spac-

ing, and then in the event of water flooding -- every other well were converted to a water injection well--one injection well would then be in a position to flood 80 acres, is that right?

A You are talking about a --

Q Without drilling additional --

A Five spot flood on 40 acres?

Q Yes, yes, sir.

A Oh, I see what you are getting at. Yes, sir, that's right.

Q And if it were drilled on 80 acres, then one well would be in a position of having to flood 160 acres?

A That's what it would plot out. Let's postulate the pattern of fluid, and we haven't studied the field to the point where we can say what type of flood we could use. I mean it could be a five spot or it could be a nine spot, and a nine spot has three producers per injector, which would reduce the factor that you are referring to.

Q In view of this wide variation in permeability that you were mentioning a while ago, do you feel that there would be any more likelihood of water by-passing certain sands and streaking through more permeability areas if it were flooded on a very wide spacing pattern than on a smaller spacing pattern?

A No, I really don't, because with the variation within the field I think you have the same variation between the 40-acre wells as between the 80's. I don't think that having more wells

would, in effect, say, average out the permeability better. Our core data would be no different on 40-acre spacing than on 80 because we have covered approximately one well per quarter section. We wouldn't core any more on closer spacing, so we would have the same data.

Q And you wouldn't have any more likelihood of permeability changes --

A The permeability --

Q -- from 80-acre location than you would in 40-acre location?

A The permeability change is there on either spacing. If they are significant, they will be significant on either spacing. I mean, we would attempt to, oh, for example, make an isoporosity, rather iso-volume and iso-permeability map, and try to balance our injection rate such as to maintain a relatively uniform frontal advance on the flood.

Q One injection well flooding 160 acres, however, would be more likely to encounter drastic changes in permeability in that 160 acres than one injection well flooding 80 acres, wouldn't it?

A I don't think that one well in 160 would have any more likelihood than two injection wells in that same 160. I mean the permeability variations are there;in either case we've got the flood through them, across them or around them if there are sufficient changes. I might add that this one milladarcy criteria

for net pay is rather arbitrary. It might be we might have to go lower than that, which would change the picture again.

Q Mr. Vernor, in view of the fact of the 40-acre proportional factors as well as the 80-acre proportional factors that are set out in Commission Rule 505, based on the economics of drilling and equipping wells, do you think that there is any necessity for reviewing these proportional factors, particularly on shallow pools on 80-acre spacing to get the allowable rates more in line with the cost of development?

A I don't think I am qualified to discuss that particular subject in any great detail.

Q You have proposed acreage factor of two --

A Yes, sir.

Q -- for these 80-acre locations, is that not correct?

A Yes, sir.

A Yes, sir.

MR. NUTTER: That's all. Thank you.

MR. PORTER: Mr. Verity.

MR. VERITY: I have another question, Your Honor.

CROSS EXAMINATION

BY MR. VERITY:

Q Mr. Vernor, do you have a recommendation to the Commission as to what allowable should be given where an 80-acre tract is not all underlined by productive formation?

A I think that is taken care of in my recommendation where I said that if a proration unit was more or less an 80-acre,

its allowable should be raised or lowered accordingly.

Q One other question, then. You gave some testimony with regard to shutting in a well and transferring the allowable to another one, and I didn't quite follow you completely as to what you were recommending in that regard. Would you explain that, please?

A My idea on that is that in order to further substantiate that one well will drain in excess of 80 acres. We would like to have more pressure data. Well, one way to get the pressure data would be to shut in a well somewhere in this lease, say one well right in here some place in the center of the lease, transfer the allowable to other wells in the lease. to one well or more than one well, just spread it around, and one well shut in, we could take pressures at intervals, say every three months, or whatever number it seemed to be necessary, and I am quite sure at the end of the year we will be able to show the pressure in that well will have been reduced by production from surrounding wells even though that well has been shut in. In other words, direct measurement of well interference, and that wouldn't be shown on 80-acre drainage, it will be shown something in considerable excess of 80 acres, something like 320 acres.

Q This is recommended merely as a temporary testing measure?

A Yes.

MR. VERITY: That's all.

MR. PORTER: Anyone else have a question?

QUESTIONS BY MR. KELLAHIN:

Q Mr. Vernor, on your list of wells, are these wells numbered in chronological order as to the date of drilling?

A Not necessarily.

Q What is the order of the drilling, 1, 2 and 20?

A Wells 1 through 8 were drilled chronologically. If I remember correctly, we drilled them the next row to the northwest which would be 9, 10, 11, 12, 13 and then 20.

Q Now, that would then indicate that your No. 1 Well was drilled in 1956, is that correct?

A No, No. 1 Well was drilled in September of 1958.

Q September of 1958. Well then, your Exhibit No. 5 does not refer to your well but refers to all the wells in the pool?

A Excuse me, that's the total oil production from the Horseshoe-Gallup Oil Pool.

Q I didn't understand you.

A Beg pardon.

Q At the time you made these pressure tests referred to in Exhibit 9, had there been any production from the No. 1 Well?

A You mean Exhibit 8, you mean the Exhibit that is up here?

Q Exhibit 8.

A The No. 1, pressure taken at the end of September,

the well had been potentialed and that's all.

Q Now, referring to Exhibit No. 9 stabilized shut-in, that is referring to the same well, is it not, the No. 1 Well?

A Yes. That, however, is the second test.

Q Now, how many productions had been taken from the No. 1 Well at the time that test was made?

A I believe the figure is 4,392 -- excuse me -- 4,359.

Q And your pressure had declined, and the initial pressure was how many pounds?

A Approximately 11 pounds.

Q Had the well been stabilized prior to the time this test was made?

A You mean stabilized on production?

Q Yes, sir.

A So far as I know, it was making its allowable every day. I think that's reasonably stabilized.

Q There was no pressure buildup on the No. 1 Well?

A I see what's bothering you. That's not the case. We used one bomb to test these three wells, we ran the bomb in the No. 20 Well, and you see we show a buildup on Exhibit 10, and if I remember correctly it stayed -- the bomb stayed in until the point, just before thirty hours, I guess that would be twenty-seven hours. The bomb was then removed and used to run pressures in the No. 1 and No. 2 Wells. The wells were all shut in at the same time and you'll note that the pressure on the, first pressure

on the No. 1 was at about thirty-one hours; on the No. 2 at about thirty-five hours.

Q So then, in your opinion, that well had already stabilized prior to the time the pressures were run?

A The No. 1 Well?

Q The No. 1 Well.

A That's correct. That had been shut in for thirty-two hours, and we took two tests. Actually, we had two three-hour tests. We were running three-hour tests on each well to see if there was any pressure change in that length of time. So we have a three-hour test at each end of this line; in other words, at thirty-two hours, and from about seventy-six to seventy-nine hours.

Q Well, now, although the test on the No. 2 Well commenced at thirty-five barrels -- is that correct?

A That's right.

Q -- you got a build-up on that well, --

A That's right.

Q -- but none on the No. 1 Well?

A That is a reflection of the producing characteristics of the well and their permeabilities. As you are probably aware from full build-up data, including stabilized prodution tests, it is possible to calculate the effective permeability in the undisturbed portion of the reservoir. The way in which those wells build up is a reflection of that permeability.

Q Now, referring to your Exhibit No. 10, --

A You'll note that the Well No. 2 has approximately half the milladarcy feet Well No. 1 has, and Well No. 20 has approximately half of that that No. 2 has.

Q That accounts for the continued build-up, in your opinion, on the Well No. 20 after, say thirty-two hours or thirty-five hours?

A Yes, certainly.

Q You didn't run any production test for interference, did you?

A The distances are such -- you mean to shut in one well and produce the offsetting well?

Q That is correct.

A The time involved, you will remember my calculation from Exhibit 11, it took approximately 96 days using our average properties for the one-pound pressure drop to occur a thousand and fifty-three feet from the well, so you couldn't very well run a short duration pressure test and expect to get a drawdown on an offset well. That is why I recommended a year for that type of test in my recommendations.

MR. KELLAHIN: Thank you very much.

MR. PORTER: Anyone else have a question?

QUESTIONS BY MR. STAMETS:

Q This is just an "if," but if the Horseshoe-Gallup Oil Pool should join with the Verde-Gallup Oil Pool, which has already been decided as a 40-acre proration unit, what would you

then recommend?

A Well, there you are getting into the question of a field whether the field should be drained on 160 or 320 because the economics are so bad, apparently -- let me say that we operate no wells in what's defined as Verde-Gallup, and the only part I have seen is this extreme western part which proved to be pretty sad. I am not prepared to talk about the possible joining of Horseshoe-Gallup and Verde-Gallup Pools; I am not very familiar with what's happening out in the area between them.

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

MR. PORTER: Anyone else? Mr. Fischer.

QUESTIONS BY MR. FISCHER:

Q Mr. Vernor, what do you mean by the southeast portion of the Horseshoe-Gallup being pretty sad? Would you explain that?

A No, that wasn't -- I was talking about the southwest portion of the Verde-Gallup; judging from potentials I have seen of the wells, I think 15, 20, 25 barrels a day were the initial potential on some of the Standard of Texas wells in the southwest portion of the field of the Verde-Gallup Field.

Q Have you seen any cores or studied any core analyses of wells in the southeast of Horseshoe-Gallup?

A I have seen a few. The operators down there haven't done as much coring as we have.

Q In your opinion, don't cores that you have seen or the analyses that you have seen correlate with your core analysis?

A All those that I have seen show reasonable permeabilities, that is, as Mr. Nutter pointed out the variations from our core analysis from 4 milladarcies to 150, the four milladarcy average is still pretty good. All that I have seen will fall more or less in that range.

Q Is it your opinion that the wells down there in the southeast of the Horseshoe-Gallup would likewise -- are capable of draining 80 acres, one well on 80 acres?

A Sure.

MR. PORTER: Any further questions? Witness may be excused.

(Witness excused)

MR. HINKLE: That's all we have.

MR. PORTER: Mr. Verity, do you desire to present testimony at this time?

MR. VERITY: Your Honor, I think we will not in light of this testimony. I don't see any point in our putting on evidence to that effect. I would like to make this statement. I recommend and request to the Commission that they include in their rules on this -- let me say this to start with -- Petro-Atlas does not object to the 80-acre spacing, but we do make this request and recommendation, and that is that we have a rule that protects or reduces to the very minimum the possibility of an individual taking an 80-acre allowable or an allowable factor of two as has been recommended when he didn't have a full 80 acres of land underlain

by productive formation, and in that regard we have no objection to an 80-acre allowable being granted on an administrative ruling or merely by making application to the Commission and the Commission granting it -- the Commission granting it without hearing -- but we feel that this is necessary if this particular potential evil is to be guaranteed against, and that is when an individual asks that he be given double allowable or proration factor, or when he be given an 80-acre allowable on one well, that he file an application for that 80-acre allowable with the Commission, and that he be required to send a copy of his application and proof to the offset operators, and that then if an offset operator objects to the 80-acre allowable, that a hearing be set down in front of the Commissioner, otherwise, without objection, that this Commission could, as an administrative matter, allow the 80-acre spacing. Do I make myself clear?

MR. PORTER: Clear to me.

MR. VERITY: We feel, Your Honor, that this is necessary in order to protect correlative rights and in order to insure that equity is done in all instances out there, but there certainly can be differences of opinion as to what is productive and what is not. And we feel that if there is any controversy, then it should be a matter of full hearing not necessarily before the Commission but certainly before the Examiner.

MR. BUELL: May it please the Commission, for Pan American Petroleum Corporation. We would like to concur in

the recommendation of Atlantic that 80-acre units be adopted for this pool. We concur in that recommendation even though some of our properties are already drilled down to a density of 40 acres at the present time. Our recent development has been and will probably continue to be on an 80-acre unit basis, so Atlantic is not the only operator in this pool at this time who is developing on an 80-acre basis. Our engineers are of the conclusive opinion that one well in this pool will effectively and efficiently drain not just 80 acres but actually far in excess of 80 acres.

MR. PORTER: Mr. Kellahin.

MR. KELLAHIN: If the Commission please, on behalf of Tom Bolack.. Mr. Bolack is opposed to the application of Atlantic for 80-acre spacing, and in that connection I would like to make a few comments on the evidence which has been presented here to the Commission. In the first place, with the history and background and development of this pool, I do not feel that the testimony offered by Atlantic is the least bit impressive. We have in the field some 113 wells drilled. They have come in on, insofar as interference and drainage is concerned with evidence concerning three wells, three wells which are obviously by reference to their Exhibit No. 1, located in the main fairway of the pool, about which was heard at some length in the previous case. The pressure information is based solely upon initial pressure and some shut-in tests and build-up tests. No information given to us on none of the wells as to the pressure build-up. The fact that the pool

had been developed insofar as well density, 65 percent of the wells on 40 acres and some 35 on 80-acres leaves an inequitable situation in regard to those operators who have spent their money and drilled on 40 acres. Now, with the present development of the pool, certainly the Commission at this time must recommend some decision, but in my opinion, this case clearly points out the necessity for an application for spacing early in the life of a pool. This is a classific example of what occurs, the same thing that occurred in the West Kutz-Pictured Cliffs Pool. It has occurred in a number of other pools, to come in and have two spacing patterns within one pool, and inevitably it results in an inequitable situation, particularly as the pool grows older, and we are opposed to the application.

MR. PORTER: Mr. Sperling.

MR. SPERLING: Magnolia Petroleum Company would like to concur in Atlantic's application in this matter, and also concur in the recommendations that have been made by Mr. Vernor.

MR. PORTER: Mr. Vernor, did you have your hand up a while ago?

THE WITNESS: I just wanted to point out again that the type of pattern we have employed in our lease will in itself greatly reduce the possibility that Petro-Atlas is worried about of non-productive acreage simply because we have the wells spread out more uniformly than if they were pooled at one end of the unit, for example. We would have no objection for a fixed pattern development.

MR. VERITY: Could I question the witness again? Just on this last point is all.

MR. PORTER: Of course.

MR. MORGAN: Maybe you'd better state that again.

BRUCE VERNOR,

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

CROSS EXAMINATION (Continued)

BY MR.VERITY:

A I am saying that a uniform type of 80-acre development such as we have carried forth in our lease, the possibility of non-productive acreage -- non-productive acreage in the worse situation that could occur on 40 -- as you are postulating is greatly reduced. In a situation where, suppose we had two wells both drilled at the same end of the proration units, I think, then, Mr. Verity's point is well taken, but let's for the moment postulate east-west proration units. Certainly it would be possible that a situation Mr. Verity is bringing up could occur on this edge of the tract. However, instead of locating a well here, we put it over here, then we have a control point across this end of the lease. As I say, the only reason we propose a fixed location is because of the 40-acre development which already occurs, we already have our pattern fixed so far as this type of development is concerned. One can draw squares around these wells just like you can around 40-acre wells.

Q Mr. Vernor, of course, what you are suggesting is, if you required a fixed spacing pattern as you here suggest, all you would do would be reduce the incidence of this evil, isn't that correct, you wouldn't eliminate it?

A It should reduce it to the same magnitude that would occur on 40-acre spacing. Let me draw a couple of more wells here, draw another one down here. You have control across this end of the lease then, so that then the only acreage that is likely to be brought in that might not be productive is acreage around this well; beyond the well, there is absolutely no difference than if we have wells right across here, have 40-acre development. You still have the possibility of bringing in 40 acres that is not productive rather than, as you are worried about, the other half on the 80-acre tracts. If you try to stay west of the 40-acre tracts to this well, then the situation you are talking about is a very real problem.

Q And, of course, you need to make your recommendation that you can drill on 80 because you already have the 40-acre development?

A That is right.

Q So you can't change your recommendation to a fixed spacing on 80, it needs to be flexible to either 40 because of the previous 40-acre development?

A Well, the only reason it needs to be flexible is in the event some operator might still want to develop on 40-acre even

under an 80-acre order. We would not want to under those circumstances; someone else might.

Q Well, by giving any individual an opportunity to a hearing with regard to it, it would correct the evil, would it not?

A Yes, should do the same thing for 40.

Q The evil can't be as great on 40. I have no objection to it being done on 40, because instead of bringing in possibly 60 acres of non-productive acres on a 40, you can only bring in 20, you can keep your pattern in the center, isn't that correct?

A Yes.

Q Not only that --

A I think you are magnifying the possible evil out of all proportion.

Q Well, if it is not very great, no one will be hurt by allowing any individual to make proof, will they?

A Unless someone makes a nuisance of himself doing it, yes.

Q We also have that possibility --

A Yes.

Q -- just like lawyers and engineers.

MR. SPERLING: Mr. Porter, for the record, on behalf of Magnolia, I would like to say that they support early investigation and institution of secondary recovery methods in this particular case.

MR. PORTER: Anybody want to question Mr. Vernor

concerning his phase of his testimony? Mr. Fischer.

QUESTIONS BY MR. FISCHER:

Q Mr. Vernor, in regard to my last question and your answer that, in your opinion, you thought that one well in 80 could just as well drain 80 as two wells, you actually don't know, do you? You don't have enough -- you said previously that you didn't have enough data down there or core analyses?

A Well, let me say as far as I am concerned -- so far as Atlantic is concerned, from an engineering standpoint, this core analysis by and of itself plus the showing we have a continuous reservoir, is sufficient to show, in my mind, that we can drain 80 acres or far in excess of 80 acres. What I am saying is, to be able to show absolute proof rather than interpretative proof, I am suggesting that we shut in a well and transfer its allowable so we can record the pressure build-down in that well as the offsetting wells are produced.

Q In line with your application, or say, if your application were denied and they went back to 40, would you still want to do that?

A It would be unnecessary.

MR. FISCHER: Thank you.

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

(Witness excused)

MR. HINKLE: If the Commission please, notwithstand-

ing Mr. Kellahin's statement, I think that Atlantic has made out a good case.

MR. PORTER: You think it is impressive?

MR. HINKLE: I don't know of any evidence that has been offered in opposition to it, only Mr. Kellahin's statement. I think we have made out a good case here in that we have shown that the Horseshoe-Gallup Pool is a reservoir having two zones extending over considerable area. We have shown it's a continuous reservoir, has good permeability, and one that lends itself well to wide spacing. We have compared it to the Bisti reservoir and have shown by the evidence that it has considerably higher permeability than the Bisti area, in which 80-acre spacing has already been made permanent. We are asking only for a temporary order for one year and that the same rules apply here as have been adopted by the Commission in the Bisti area. Of course, the Commission well knows the situation of the industry as far as economics is concerned, which has largely been brought about through the excessive imports of oil. I think that the Commission should, in every instance where you have any pool that will lend itself to wider spacing, they should adopt the wider spacing until at least it is shown conclusively that it will result in waste.

MR. PORTER: Anyone else? Mr. Anderson.

MR. ANDERSON: I am John Anderson, geological survey, Roswell. We are interested in this case because almost all of the land involved are Federal or Indian. If we refer to the map on the

board, which, I believe, is Atlantic's Exhibit 1, the area in pink color is also Navajo Tribal land. The land immediately east of the pink area is Ute Mountain Tribal land, and the other quadrant is almost entirely Federal land. Now, we are interested in getting the highest practicable ultimate recovery of oil from all of it. At the same time we are interested in the rate at which this can be accomplished. We feel that the withdrawals from any classification of land should be reasonable, at the same time taking into consideration the ability of certain lands to produce oil. Under our present situation, Tribal land in the pink area is developed on 80 acres, Ute Mountain Tribal land is developed almost entirely on 40 acres, the Federal land is almost entirely on 40, and there is some Navajo Tribal land south of the pink land which is also developed on 40 acres. Where we are now, the pink area is producing oil. That is, the withdrawals on an acreage basis are about one half of what they are on the Ute Mountain reservation and on Federal land, and I think this would make the Navajo Indians most unhappy. Also, if this situation does continue, where we have withdrawals that place the rate per acre on east of the Navajo Tribal land, certainly we are going to have some drainage across the reservation boundaries. Now, how this is going to be corrected, I am not at the present time making any statements. However, something has to be done about it.

MR. HINKLE: I would like to reply just briefly to Mr. Anderson's argument there with respect to the development of

board, which, I believe, is Atlantic's Exhibit 1, the area in pink color is also Navajo Tribal land. The land immediately east of the pink area is Ute Mountain Tribal land, and the other quadrant is almost entirely Federal land. Now, we are interested in getting the highest practicable ultimate recovery of oil from all of it. At the same time we are interested in the rate at which this can be accomplished. We feel that the withdrawals from any classification of land should be reasonable, at the same time taking into consideration the ability of certain lands to produce oil. Under our present situation, Tribal land in the pink area is developed on 80 acres, Ute Mountain Tribal land is developed almost entirely on 40 acres, the Federal land is almost entirely on 40, and there is some Navajo Tribal land south of the pink land which is also developed on 40 acres. Where we are now, the pink area is producing oil. That is, the withdrawals on an acreage basis are about one half of what they are on the Ute Mountain reservation and on Federal land, and I think this would make the Navajo Indians most unhappy. Also, if this situation does continue, where we have withdrawals that place the rate per acre on east of the Navajo Tribal land, certainly we are going to have some drainage across the reservation boundaries. Now, how this is going to be corrected, I am not at the present time making any statements. However, something has to be done about it.

MR. HINKLE: I would like to reply just briefly to Mr. Anderson's argument there with respect to the development of

the pink area. I understand that Atlantic has continuously developed this area, they have had rigs running in there almost continuously. Had they drilled the same number of wells on 40 acres, they would just have about half of the area proven. The way it is, they have about twice the area that they would have otherwise that is proven and, of course, if we go to the 80-acre allowable, which we are advocating, there would be withdrawals at the same rate as if you were on 40-acre spacing because you are going to get twice the allowable.

MR. ANDERSON: I think that in Mr. Hinkle's statement -- while we are making some assumptions on which we have had no testimony, and that is whether a well drilled on 80 acres will be able to produce twice the allowable for any considerable period of time -- I believe that we are assuming, or we feel that the withdrawal from 80-acre tracts are going to be comparable to 30, 40, and I don't believe that any of the testimony has given any proof. In fact, it hasn't even been introduced.

MR. HINKLE: If the Commission please, we would like to put Mr. Vernor back on, open the case up again and give us some testimony on that point.

MR. PORTER: Mr. Vernor, will you take the witness stand, please?

BRUCE VERNOR

recalled as a witness, having been first duly sworn, testified as follows:

REDIRECT EXAMINATION (Continued)

BY MR. HINKLE:

A I am sorry I didn't answer Mr. Anderson's questions earlier. I understand what is bothering him, that the rate might decline more quickly on one well than on two. The answer to that question is that on 80-acre spacing we would institute water flooding or some other secondary recovery program sooner than a closer spacing, and consequently, the difference in the rate picture should be nill. We should have the same rate under a secondary recovery project regardless of the spacing so far as the physical operation of injection is concerned, and we feel that would more than adequately make up for the possibility that Mr. Anderson is bringing up.

Q Mr. Vernor, are most of the wells capable of producing twice their present allowable?

A With the exception of two or three, yes.

MR. HINKLE: That's all.

RECROSS EXAMINATION

BY MR. PORTER:

Q Mr. Vernor, you would expect all wells on 40-acre allowable would produce their allowables much longer than those on 80, under the present allowable system, would you not?

A In other words, if an 80-acre well has twice the allowable, it would reach its decline sooner?

Q Decline below the maximum oil?

A Well, let's say for the moment the unit allowable is 100 barrels for 80 acres, 50 for 40-acre wells, so that we would have 100 barrels a day for an 80-acre tract whether one well or two. Yes, it is quite possible that the single 80-acre well would reach its capacity sooner. However, at any given time its capacity would still be higher than either of the 40-acre wells taken separately. That is, you don't have a two to one ratio there, and we feel that our secondary recovery will more than offset that because our intent is to start secondary recovery soon enough to alleviate any such decline.

QUESTIONS BY MR. MORGAN:

Q Mr. Vernor, you are pleading this case based on economics a little bit, aren't you, somewhat?

A Well, only to the extent we are showing we can make more money by not drilling the same number of wells for the same recovery.

Q Did I understand you to say that two wells on 80- would still be probable from the standpoint of recoverability?

A We are not making a plea that we can't drill on 40.

Q Well, then, my next question is, what about the secondary recovery costs as compared to two wells in the first place?

A We much prefer to spend the money for secondary recovery sooner than to drill the additional wells.

Q It would be a lot cheaper to go through the process

of injecting water or gas or whatever agent you might use, is that right?

A You mean it would cost less?

Q Than drilling a second well?

A We are not far enough along on our studies to be able to answer that question in detail, but I don't think that the cost of secondary recovery would be any greater than the cost of drilling additional wells.

Q Would it be six of one and half a dozen of another?

A No, because when you spend the money for secondary recovery you are, in effect, you are spending money for more reserves. If you spend the money to drill extra wells, you just punch more holes in the ground, we haven't increased our reserves at all by drilling the extra well, whereas if we institute secondary recovery, we have done almost the same thing as though we extended the field, we've got more reserves.

Q I understand what you say. You are going to get more of the reserves out of the ground by secondary recovery process, but you are going into secondary recovery earlier by the use of only one well for the use of 80 acres, I believe you stated that?

A I believe we would, yes.

Q Certain oil is going to be recovered from secondary recovery activity that could have been recovered from a second well?

A No, no. I didn't make myself clear. When I speak of secondary recovery bringing at least twice as much oil based on our present estimate as by primary, I am taking all of the primary all the way out to the economic limit, even though we might produce it under secondary operation, I am subtracting all of that oil. In other words, the recovery would total three times as much with primary and secondary, roughly speaking, as by primary alone. I mean, I am not lumping any of the primary oil with what I say is incremental with secondary.

Q You would recover as much oil with one well as you would with two under the tract, that's what you are saying?

A Yes.

Q But you will just get rid of it more slowly?

A You could recover a little more slowly if you didn't institute the secondary recovery, but we plan to do that soon enough to arrest any rate decline so that we shouldn't have even that situation.

MR. PORTER: Mr. McGrath.

QUESTIONS BY MR. McGRATH:

Q I think El Paso Natural Gas Products Company is now in the process of completing wells in this little narrow section here, and one up here, and you say now -- these have 40-acre allowables -- that these wells over here -- this one will protect this one from drainage in here, if it produces twice as much?

A Well, let me say that, as you know, these locations

were a compromise. We contemplate, if we have an 80-acre order, we would ask to assign this entire strip to these two wells, which would be approximately 70 acres per well, so that they would have again allowables comparable to their acreage, so you won't have non-uniformity.

Q But if you don't get this, I mean if these wells are not staked, they are going to drain the Navajo reservoir?

A Why?

Q Because they are only producing half as much as these over here.

A I don't understand.

Q This is producing twice as much, wouldn't protect this area in here from these wells.

A You are talking about, under the circumstances an 80-acre order --

Q Yes, with the double allowable for the 80-acre?

A I don't foresee a circumstance where these wells wouldn't have their proportional allowable.

Q They only have 40 acres now?

A Sure, they've only got 36 acres assigned. We can't assign any more acreage than that until we have some kind of an order.

Q They probably have a full allowable, or close to it?

A Yes.

Q 40 acres, whatever it is.

A I am saying 80-acre allowable, we would assign a 70-acre unit to this well.

Q Take this right here, this well and this, this is on 80-acres, which would have an allowable factor of two?

A Yes.

Q This has one?

A No, it would be 1.75 with 70 acres assigned to it. Like if we make a proration unit. We have approximately 140 acres in this strip down here, --

MR. HINKLE: What section are you referring to now?

A This is the west half of the west half of Section 33.

Q 31, 16.

A It is a portion of the unit reservoir lying in the west half west half of 33, and likewise a portion of the Navajo reservoir lying in the west half west half of Section 33. There is approximately 140 acres involved in this strip, and let's see, a little more than half of it is Ute acreage, I would say maybe 85 acres, roughly speaking, 85 acres is Ute acreage, and the rest is Navajo. We don't have the line quite in the right place here. The Navajo strip is 486.1 feet; the Ute strip tapers -- it starts off at about 600 feet at the bottom. Now, we contemplate, and we contemplated it when we agreed to locate the El Paso Ute Navajo 3 and 5 at the present location rather than the strip locations, which were earlier proposed so that the wells would fit a communi-

tized situation, down the line under whatever development took place, we plan to ask to assign this entire strip to these two wells which would give us a 70-acre, approximately, unit assigned to each well, and under our proposed rule, that would give them an allowable factor of 70/40. In other words, they would have an allowable proportional to the acreage assigned to the wells. This well only has 39 acres assigned to it. On 80 it would have 79/40 of a unit allowable. I don't see how we can have any inequitable drainage under those circumstances. Well, we plan to -- it is my understanding El Paso does too -- the two companies plan to communitize this strip.

Q I was just wondering if you thought that you were going to have protection from drainage either way?

A We've got to protect -- in that sense our interest is the same as our royalty owner. We want to protect our oil too. We don't get any of these over here.

Q You get this? You will if you communitize?

A Well, what I am saying, we will try to maintain an equitable drainage.

Q And if you don't communitize, you shouldn't have drilled that?

A That's the thing we are going to stay away from. We much prefer to communitize. We do plan to communitize. The only reason we didn't before was because of the small units involved here.

Q You want to communitize on 80 instead of 40.

A Yes.

QUESTIONS BY MR. KENDRICKS:

Q Mr. Vernor, in your conversation with Mr. Anderson, you referred to instigating a secondary recovery project in the case 80-acre wells with two allowables began to drop in their production. How long will it take to initiate a secondary recovery project?

A Well, I'll say first of all, I can't predict exactly how soon it will be necessary to accomplish that end, and we intend to -- we are gathering data now for the study, and we intend to go into it full blast as soon as we can see how large the field is going to be, at least insofar as our leases are concerned.

Q Would it take considerable time to lay injection lines and drill injection wells for your secondary recovery?

A I don't foresee drilling any injection wells. I see at this point no need for drilling any injection wells. We have a uniform pattern. Those would be the same sort of wells that we are trying to avoid drilling here.

Q Will a one-year temporary order cover sufficient time to make your study and initiate your project so that you can protect the equal withdrawals across the lease line?

A You are postulating there, that we wouldn't be able to maintain it for that length of time without starting the secondary recovery project. I see no reason why we wouldn't have our

study completed in that length of time. I can't say exactly when we will start a secondary recovery project. It will depend on results of our study.

MR. KENDRICKS: That's all.

QUESTIONS BY MR. FISCHER:

Q Mr. Vernor, also in regard to Mr. Anderson's question and your answer as to secondary recovery and the imbalance between the two tribes of their mineral rights, it seems like if you had two wells on -- or one well on 80, rather, and your double allowable, therefore, if you were to instigate secondary recovery and actually did so, then the onoy reason you could be back in balance is if you kept your allowables under secondary recovery at two times the normal unit allowable?

A You mean that we didn't ask for any higher allowables than that?

Q Yes.

A Well, I don't at this time know what we will ask for in the way of allowable treatment, but I foresee the whole field on secondary at the same time. And I don't conceive that there will be any imbalance. I think you are postulating imbalance to start with, as Mr. Hinkle pointed out. I think Mr. Anderson implied that there is imbalance now. The imbalance is no different than if we had the same number of wells developed on 40-acre pattern. They just wouldn't cover nearly as much of the area, we wouldn't have as much area proven.

Q You are getting an extra advantage in being able to start your secondary recovery program sooner due to the fact that you would have more recoverable oil in the ground and have a better payout for it or shorter?

A I don't follow your reasoning, being advantageous.

Q If you start your secondary recovery program before the people on 40 do, you then, due to the fact that your wells are -- would start being marginal wells sooner, then you could start your secondary recovery program sooner and put you at an even greater advantage?

A As I said, I foresee the whole field being operated under secondary at the same time.

Q At the same time?

A Sure.

Q You think an operator with one well on 40 would want to start his secondary recovery program if he still had a top allowable well?

A That's a question that will have to be settled among the operators. I can't speak for the other operators, but my point is, I don't see the imbalance you are talking about. If the rates are proportionate to the acreage, I see no imbalance at all.

MR. FISCHER: That's all.

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

(Witness excused)

MR. KELLAHIN: I would like to make one further comment in light of the testimony that has been offered, In spite of Mr. Hinkle's comments, I am still not impressed. In answer to the questions which were posed by Mr. Anderson in regard to the drainage situation, on those Indian lands the witness has taken the stand and testified that one well would be able to make the allowable to be assigned to 80 acres. That is an unsupported conclusion by the witness. I think he himself would have to admit that. No reserve figures have been offered in this case, there is no potential figures to offer, there is no pressure information offered with the exception of three wells out of 113. The whole situation goes back to the prime questions involved in this case. The Statute says that the acreage shall be developed as can be efficiently and economically drained by one well. Well, we've had some testimony as to the efficiency based on three wells; we have had no testimony on economics whatever with the exception of the cost of the well. The conclusions stated by the witness is about as substantial as saying it is cheaper to drill dry holes on 330 as it is on 660. That is an obvious conclusion. It is cheaper to drill one well than it is two. I think this Commission is entitled to a great deal more information in reaching the conclusions that one well will economically and efficiently drain 80 acres.

MR. PORTER: Did I hear you say there were five wells involved in the pressure test?

THE WITNESS: Yes, sir.

MR. KELLAHIN: If the record so shows, I will stand corrected.

MR. PORTER: Anyone else have any comments in the case?

Take the case under advisement. Take a short recess and then take up Case 1616.

STATE OF NEW MEXICO)
: ss
COUNTY OF BERNALILLO)

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

WITNESS my Hand and Seal this, the 31st day of March, 1959, in the City of Albuquerque, County of Bernalillo, State of New Mexico.

Joseph A. Trujillo
Notary Public

My Commission Expires:

October 5, 1960

DOMESTIC SERVICE

Check the class of service desired; otherwise this message will be sent as a fast telegram

TELEGRAM

DAY LETTER

NIGHT LETTER

$ S E

WESTERN UNION TELEGRAM

1906 (4-55)

W. P. MARSHALL, PRESIDENT

INTERNATIONAL SERVICE

Check the class of service desired; otherwise the message will be sent at the full rate.

FULL RATE

LETTER TELEGRAM

SHORE-SHIP

NO. WDS.-CL. OF SVC.	PD. OR COLL.	CASH NO.	CHARGE TO THE ACCOUNT OF	TIME FILED
	COLLECT			9:40 a.m.

Send the following message, subject to the terms on back hereof, which are hereby agreed to

APRIL 2, 1959

MR. BRUCE VERNOR
THE ATLANTIC REFINING CO.
ROOM 533
WYOMING NATIONAL BANK BLDG.
CASPER, WYOMING

COMMISSION BY ORDER NO. R-1362 DATED APRIL 2, 1959, DENIED 80-ACRE SPACING IN HORSESHOE-GALLUP AND ORDERED THAT DRILLING AND SPACING IN SAID POOL SHALL CONTINUE TO BE GOVERNED BY RULE 104.

DANIEL S. NUTTER, CHIEF ENGINEER
OIL CONSERVATION COMMISSION

ALL MESSAGES TAKEN BY THIS COMPANY ARE SUBJECT TO THE FOLLOWING TERMS:

To guard against mistakes or delays, the sender of a message should order it repeated, that is, telegraphed back to the originating office for comparison. For this, one-half the unrepeated message rate is charged in addition. Unless otherwise indicated on its face, this is an unrepeated message and paid for as such, in consideration whereof it is agreed between the sender of the message and the Telegraph Company as follows:

1. The Telegraph Company shall not be liable for mistakes or delays in the transmission or delivery, or for non-delivery, of any message received for transmission at the unrepeated-message rate beyond the sum of five hundred dollars; nor for mistakes or delays in the transmission or delivery, or for non-delivery, of any message received for transmission at the repeated-message rate beyond the sum of five thousand dollars, unless specially valued; nor in any case for delays arising from unavoidable interruption in the working of its lines.

2. In any event the Telegraph Company shall not be liable for damages for mistakes or delays in the transmission or delivery, or for the non-delivery, of any message, whether caused by the negligence of its servants or otherwise, beyond the actual loss, not exceeding in any event the sum of five thousand dollars, at which amount the sender of each message represents that the message is valued, unless a greater value is stated in writing by the sender thereof at the time the message is tendered for transmission, and unless the repeated-message rate is paid or agreed to be paid and an additional charge equal to one-tenth of one per cent of the amount by which such valuation shall exceed five thousand dollars.

3. The Telegraph Company is hereby made the agent of the sender, without liability, to forward this message over the lines of any other company when necessary to reach its destination.

4. The applicable tariff charges on a message destined to any point in the continental United States listed in the Telegraph Company's Directory of Stations cover its delivery within the established city or community limits of the destination point. Beyond such limits and to points not listed in the Telegraph Company's Directory of Stations, the Telegraph Company does not undertake to make delivery but will endeavor to arrange for delivery by any available means as the agent of the sender, with the understanding that the sender authorizes the collection of any additional charge from the addressee and agrees to pay such additional charge if it is not collected from the addressee.

5. No responsibility attaches to the Telegraph Company concerning messages until the same are accepted at one of its transmitting offices; and if a messenger is sent to such office by one of the Telegraph Company's messengers, he acts for that purpose as the agent of the sender; except that when the Telegraph Company sends a messenger to pick up a message, the messenger in that instance acts as the agent of the Telegraph Company in accepting the message, the Telegraph Company assuming responsibility from the time of such acceptance.

6. The Telegraph Company will not be liable for damages or statutory penalties when the claim is not presented in writing to the Telegraph Company, (a) within ninety days after the message is filed with the Telegraph Company for transmission in the case of a message between points within the United States (except in the case of an intrastate message in Texas or between a point in the United States on the one hand and a point in Alaska, Canada, Mexico, or St. Pierre-Miquelon Islands on the other hand, or between a point in the United States and a ship at sea or in the air, (b) within 95 days after the cause of action, if any, shall have accrued in the case of an intrastate message in Texas, and (c) within 180 days after the message is filed with the Telegraph Company for transmission in the case of a message between a point in the United States and a foreign or overseas point other than the points specified above in this paragraph; provided, however, that this condition shall not apply to claims for damages or overcharges within the purview of Section 415 of the Communications Act of 1934, as amended.

7. It is agreed that in any action by the Telegraph Company to recover the tolls for any message or messages the prompt and correct transmission and delivery thereof shall be presume subject to rebuttal by competent evidence.

8. Special terms governing the transmission of messages according to their classes, as enumerated below, shall apply to messages in each of such respective classes in addition to all the foregoing terms.

9. No employee of the Telegraph Company is authorized to vary the foregoing.

4-54

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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. 1597
Order No. R-1362

APPLICATION OF THE ATLANTIC REFINING
COMPANY FOR AN ORDER ESTABLISHING
TEMPORARY SPECIAL RULES AND REGULATIONS
FOR THE HORSESHOE-GALLUP OIL POOL IN
SAN JUAN COUNTY, NEW MEXICO, TO PROVIDE
FOR 80-ACRE PRORATION UNITS.

ORDER OF THE COMMISSION

BY THE COMMISSION:

This cause came on for hearing at 9 o'clock a.m. on March 18, 1959, at Santa Fe, New Mexico, before the Oil Conservation Commission of New Mexico, hereinafter referred to as the "Commission."

NOW, on this 2nd day of April, 1959, the Commission, a quorum being present, having considered the application and the evidence adduced 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, The Atlantic Refining Company, seeks the establishment of temporary special rules and regulations for the Horseshoe-Gallup Oil Pool in San Juan County, New Mexico, to provide for 80-acre proration units in said pool.

(3) That the applicant has failed to prove that the Horseshoe-Gallup Oil Pool can be efficiently drained and developed on an 80-acre spacing pattern.

(4) That the drilling and spacing of wells in the Horseshoe-Gallup Oil Pool should continue to be governed by Rule 104 of the Commission Rules and Regulations.

(5) That continued development of said Horseshoe-Gallup Oil Pool on 40-acre proration units will not cause the drilling of unnecessary wells.

(6) That the application should be denied.

IT IS THEREFORE ORDERED:

(1) That the application of The Atlantic Refining Company for the establishment of temporary rules and regulations for the Horseshoe-Gallup Oil Pool in San Juan County, New Mexico, to provide for 80-acre proration units be and the same is hereby denied.

(2) That the drilling and spacing of wells in the Horseshoe-Gallup Oil Pool in San Juan County, New Mexico, shall continue to be governed by Rule 104 of the Commission Rules and Regulations.

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

STATE OF NEW MEXICO
OIL CONSERVATION COMMISSION

JOHN BURROUGHS, Chairman

MURRAY E. MORGAN, Member

A. L. PORTER, Jr., Member & Secretary

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OIL CONSERVATION COMMISSION

P. O. BOX 871

SANTA FE, NEW MEXICO

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April 2, 1959

Mr. Clarence Hinkle
Hervey, Dow & Hinkle
P.O. Box 547
Roswell, New Mexico

Dear Mr. Hinkle:

On behalf of your client, The Atlantic Refining Company, we enclose two copies of Order R-1362 issued April 2, 1959, by the Oil Conservation Commission in Case 1597, which was heard on March 18th.

Very truly yours,

A. L. Porter, Jr.
Secretary - Director

bp
Encls.

BEFORE THE
OIL CONSERVATION COMMISSION
SANTA FE, NEW MEXICO

IN THE MATTER OF:

Case No. 1597

TRANSCRIPT OF HEARING

Feb. 19,
~~January 19~~, 1959

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

BEFORE THE
OIL CONSERVATION COMMISSION
SANTA FE, NEW MEXICO

IN THE MATTER OF:

CASE 1597 Application of the Atlantic Refining Company for an order promulgating temporary special rules and regulations for the Horseshoe-Gallup Oil Pool in San Juan County, New Mexico. Applicant, in the above-styled cause, seeks an order promulgating temporary special rules and regulations for the Horseshoe-Gallup Oil Pool in San Juan County, New Mexico, to provide for 80-acre proration units in said pool.

Mabry Hall
Santa Fe, New Mexico
~~January 19~~, 1959
February 18,

BEFORE:

A. L. Porter
John Burroughs

TRANSCRIPT OF HEARING

MR. PORTER: Let's go back on the record.

At this time, we will call Case 1597.

MR. PAYNE: Case 1597, "Application of the Atlantic Refining Company for an order promulgating temporary special rules and regulations for the Horseshoe-Gallup Oil Pool in San Juan County, New Mexico."

MR. PORTER: Mr. Verity?

MR. VERITY: May it please the Commission, George Verity appearing for Petro-Atlas. At this time, I would like to move that the matter be continued until such time as the Commission has made its determination in the application of El Paso Products

Company for a declaration in the Horseshoe Canyon Pool as to common sources of supply, and in support of this motion, your honor, we feel that it is impossible for the Commission to intelligently hear a spacing application on a pool wherein the engineers that are going to present testimony on it don't know whether it is twenty feet thick or roughly thirty to forty feet thick. The thickness of a sand body does determine whether or not one well will efficiently and economically drain 80 acres. If it were purely a matter of physics and no economics entered into it, you might make a determination here as to whether or not one well would drain every driplet of oil out of an 80-acre tract, but we are not speaking purely of a physical formula here, but rather economics enters into it and I submit that this Commission cannot intelligently listen to economics and economic theories with regard to drainage when they don't know what the thickness of this sand body is going to be, and certainly if we don't know whether we are talking about one or two common sources of supply here, then we don't know the thickness of either one of them. Until we know that, well, it's absolutely impossible for [illegible] to know what their position is in this case, and I think that as much time as they have that information and that common [illegible] until the Commission makes its determination.

MR. HINKLE: If the Commission please, Atlantic is opposed to the continuance of this case. We are prepared, we have the witnesses, it's been advertised for the hearing today, we want to

to ahead with it. I see no inconsistency [illegible] Commission considering the case which we have just been through in the 80-acre spacing. In fact, I think it is a good time for the Commission to have it under consideration, have both of them under consideration at the same time. I don't see any inconsistency in it at all. It is a matter of determining whether one well will effectively and efficiently drain 80 acres and that doesn't make any difference whether the area that's going to be drained is in two separate intervals or in one sand thickness. That's the only question involved in my mind, I don't think that it ought to be continued.

MR. BUELL: May it please the Commission, Pan American Petroleum Corporation is opposed to the motion for continuance. We don't feel the application is premature; actually, it is about a year and a half late because, unfortunately, we have already drilled some 40-acre wells. We would like to get this matter resolved now so that we will not have to drill any more unnecessary wells. We have an active development program commencing in the field now and we would like to have the issue resolved.

MR. VERITY: Your honor, I would like to underscore again and say that you don't know whether you can efficiently drain 80 acres or 40 acres. You are talking about which is the most efficient from an economic standpoint and if you don't know what your reservoir is going to produce, then you can't come up with intelligent formula as to whether or not 40 acres or 80 acres is the most efficient from the standpoint of economics in drainage.

your honor, I would like to understand that again.

MR. HINKLE: I don't agree with the statement that you don't know what it's going to produce. I think everybody knows what it's going to produce from the reservoir, whether you call it two reservoirs or one reservoir.

MR. VERITY: Mr. Hinkle, if you've got two reservoirs--if you don't know whether there are two reservoirs or one reservoir, you don't know what it's going to produce. If your engineer doesn't know whether he is talking about just this Zone A or Zones A and B, he certainly can't tell you what Zone A is going to produce.

MR. PORTER: The Commission has decided to continue this case to the regular March docket, by which time we will have an order out on Case 1596. In all fairness, I think that I erred in having the two cases advertised for the same docket. We feel that we cannot determine whether one well will efficiently and economically drain a certain area in the pool until we know what pool we are talking about or whether we are talking about one pool or two pools, so this case will be continued to the regular March docket.

STATE OF NEW MEXICO)
: ss
COUNTY OF BERNALILLO)

I, JERRY MARTINEZ, Notary Public in and for the County of Bernalillo, State of New Mexico, do hereby certify that the foregoing and attached Transcript of Hearing were reported by me in Stenotype at the time and place aforesaid; that the same was reduced to typewritten transcript by me and contains a true and correct record of said proceedings, to the best of my knowledge, skill and ability.

I FURTHER CERTIFY that I am not employed by or related to any attorney or party of interest in this matter; and, further, that I have no financial interest in the outcome thereof.

DATED this 6th day of March, 1959, in the City of Albuquerque, County of Bernalillo, State of New Mexico.

Jerry Martinez
Notary Public

My Commission Expires:

January 24, 1962

EXHIBIT 11

Case 1597

In Reservoir Calculations . . .

How to use the EXPONENTIAL INTEGRAL

No more difficult than logarithms, Ei-functions solve problems of well interference and effective permeability. Use is demonstrated, abbreviated tables included with examples and simplified curve

Robert G. Nisle

Research Division,
Phillips Petroleum Company,
Bartlesville, Oklahoma

THE Exponential Integral, abbreviated Ei, appears in a mathematical solution of problems involving the flow of a single phase compressible fluid through a homogeneous, infinite porous medium under non steady state conditions. This solution is based on two assumptions: (1) the porous medium has cylindrical symmetry, and (2) the well radius is very small compared to the effective radius of the porous medium.

This solution has been widely used in recent years, and provides a more realistic answer than is provided by the so-called steady-state solutions.

Exponential Integrals are no more difficult to use than logarithms, or the trignometric functions. There is nothing mysterious or difficult about them. The Exponential Integral arises in the solution of the differential equation for the flow of a single liquid phase of constant compressibility in a homogeneous porous medium. The resulting equation for the case of a constant production rate in a system having cylindrical symmetry is:

$$(1)\quad p_o - p(r, T) = \frac{q_o\, n\, B}{0.0141\, kh}\left[-Ei\left(\frac{948.4\, cufr^2}{kT}\right)\right]$$

where p_o = formation pressure in psi.
$p(r, T)$ = pressure, in psi, at a radial distance, r, from the well at time T.
T = time in hours after opening up the well.
r = radial distance in feet from the well.
q_o = production rate in stock tank barrels per day.
u = viscosity, centipoises.
B = formation volume factor (dimensionless).
k = permeability in millidarcys.
h = thickness of producing formation in feet.
c = compressibility of the reservoir fluid in $\frac{1}{psi}$.
f = porosity, fractional.

The Exponential Integral in Equation (1) is the term in the brackets.

$$\left[-Ei\left(\frac{948.4\, cufr^2}{kT}\right)\right]$$

The Exponential Integral is defined as

$$(2)\quad -Ei(-x) = \int_x^{\infty} \frac{e^{-v}}{v}\, dv$$

In this definition, x is a dummy variable and disappears upon integration and substitution of the limits. Ei(−x) is thus a function of x only. The Exponential Integral can also be expressed by means of infinite series, thus:

$$(3)\quad -Ei(-x) = e^{-x}\left(\frac{1}{x} - \frac{1}{x^2} + \frac{2!}{x^3} - \frac{3!}{x^4} + \cdots\right)$$

$$(4)\quad -Ei(-x) = -0.5772 - 2.303 \log_{10} x + x - \frac{x^2}{4} + \frac{x^3}{18} - \cdots + \frac{x^n}{n.n!}$$

The form given in Equation (4) is particularly useful since it permits a simple evaluation of the Ei function for values of x outside the range of tables, or if no tables are available. It is also used to determine the range of x over which the logarithmic approximation may be used.

Example 1. Calculate −Ei(−0.25). By Equation (4).

$$-Ei(-0.25) = -0.5772 - 2.303 \log_{10}(0.25) + 0.25 - \frac{(0.25)^2}{4} + \frac{(0.25)^3}{18} - \cdots$$

$$= -0.5772 - 2.303(-0.6021) + 0.25 - \frac{0.0625}{4} + \frac{0.015625}{18} - \cdots$$

$$= -0.5772 + 1.3866 + 0.25 - 0.0156 + 0.0008$$

$$= 0.5928 + 1.6366$$

$$= 1.0438$$

The value 1.0438 may be rounded to the value 1.044 which is usually sufficient for most reservoir problems. It will be noted that the last term in the series (0.0008) was not used. A set of tables, Ref. (4), gives the value of 1.0443. The difference between 1.0443 and 1.0438 is 0.0005 which is less than the value of the last term calculated, but not used. This illustrates the rule that for series of the type of Equation (4) the error resulting from omitting all terms after a certain selected one is less than the first term neglected. In this example all terms after the term $\frac{x^2}{4}$ were neglected and the error is shown to be less than the value of the term $\frac{x^3}{18}$, which is (0.0008). Here the term $\frac{x^3}{18}$ is the first of the terms neglected.

Example 2. Assume that it is desirable to use the logarithmic approximation. Assume further that a value of −Ei(−x) accu-

rate to 0.01 is acceptable. In other words, all terms in Equation (4) are to be neglected after the logarithmic term. What is the largest value that x can have in order that the error in $-Ei(-x)$ shall not exceed 0.01? It was shown in the previous example that the error does not exceed the value of the first term neglected. In this case, the first term neglected is x. Hence, if x does not exceed 0.01, then the error in $-Ei(-x)$ resulting from the use of the logarithmic approximation will not exceed 0.01.

Tables of the Ei function are available and are used in the same manner as logarithmic, or trigonometric tables. A condensed table is given in Appendix A. More complete tables may be purchased from the Superintendent of Documents (4), Washington 25, D. C. For most reservoir work, however, the tables given in Appendix A are sufficiently accurate. For rougher work, a graph based on equation (1) has been prepared and is given in Appendix B.

The two previous examples illustrated the method of calculating the value of the function $-Ei(-x)$. Two more examples are presented illustrating the use of the Exponential Integral in Equation (1).

Example 3. This example applies to the problem of well interference. Assume two wells are separated by a distance of 1100 ft. Both wells have been shut-in for a sufficient length of time that the pressure in each is the static reservoir pressure. Also, assume that the common formation in which these wells are completed is homogeneous and continuous. The problem is to calculate how many hours it will take for a pressure drop of 5 psi to occur in well B after well A commences to produce at a rate of 250 stock tank bbl per day.

Assume further, that the following quantities have previously been determined

$k = 133$ md

$h = 33$ feet

$kh = 4389$ md-ft

$u = 0.38$ cp

$B = 1.47$

$f = 0.02$

$c = 1.59 \times 10^{-5} \frac{1}{psi}$

The remaining quantities in Equation (1) as previously specified are $r = 1100$ ft, $q_o = 250$ STB/D, $p_o - p(r,T) = \Delta P = 5$ psi.

Substitution of these quantities in Equation (1) gives:

$$\frac{5 \times 0.0141 \times 4389}{250 \times 0.38 \times 1.47} = -Ei\left(\frac{948.4 \times 1.59 \times 10^{-5} \times 0.38 \times 0.02 \times (1100)^2}{33\,T}\right)$$

$$2.218 = -Ei\left(-\frac{4.202}{T}\right)$$

Thus, $\frac{4.202}{T}$ is the x in $-Ei(-x)$ and 2.218 is the value of the Ei-function. The next step is to find the value of x from the tables. The quantity in the body of the table nearest 2.218 is 2.20. Hence, the value of x, to three decimals, read from the table, is 0.065.

$$\frac{4.202}{T} = 0.065$$

$$T = \frac{4.202}{0.065} = 64.6 \text{ hours}$$

Example 4. Two wells, A and B, are separated by a distance of 1100 ft. A well pressure build-up test on A has yielded an effective reservoir productivity of 4400 md.-ft (kh). When A is produced at a constant rate of 275 STB/day, a pressure drop of 10 psi is observed at B after 108 hours. Fluid and [illegible] constants are:

$u = 0.40$ cp.

$B = 1.47$

$f = 0.02$

$c = 1.59 \times 10^{-5} \frac{1}{psi}$

What is the effective permeability of the intervening formation?

Substituting these values in Equation (1).

$$\frac{10 \times 0.0141 \times 4400}{275 \times 0.40 \times 1.47} = -Ei\left(\frac{948.4 \times 1.59 \times 10^{-5} \times 0.4 \times 0.02 \times (1100)^2}{k \times 108}\right)$$

$$4.039 = -Ei\left(-\frac{1.35}{k}\right)$$

$$\frac{1.35}{k} = 0.010 \text{ (from the tables)}$$

$$k = 135. \text{ md. (effective)}$$

Acknowledgment

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APPENDIX A

Table of the Exponential Integral

$f(x) = -Ei(-x)$

$0.00 < x < 0.209$, Interval $= 0.001$

X	0	1	2	3	4	5	6	7	8	9
0.00	- .00	6.332	5.639	5.235	4.948	4.726	4.545	4.392	4.259	4.142
0.01	4.038	3.944	3.856	3.779	3.705	3.637	3.574	3.514	3.458	3.405
0.02	3.355	3.307	3.261	3.218	3.176	3.137	3.099	3.062	3.026	2.992
0.03	2.959	2.927	2.897	2.867	2.838	2.810	2.783	2.756	2.731	2.706
0.04	2.681	2.658	2.634	2.612	2.590	2.568	2.547	2.527	2.507	2.487
0.05	2.468	2.449	2.431	2.413	2.395	2.377	2.360	2.344	2.327	2.311
0.06	2.295	2.279	2.264	2.249	2.235	2.220	2.206	2.192	2.178	2.164
0.07	2.151	2.138	2.125	2.112	2.099	2.087	2.074	2.062	2.050	2.038
0.08	2.027	2.015	2.004	1.992	1.982	1.971	1.960	1.950	1.939	1.929
0.09	1.919	1.909	1.899	1.888	1.879	1.869	1.860	1.850	1.841	1.832
0.10	1.823	1.814	1.805	1.796	1.788	1.779	1.770	1.762	1.754	1.745
0.11	1.737	1.729	1.721	1.713	1.705	1.697	1.689	1.682	1.674	1.667
0.12	1.660	1.652	1.645	1.638	1.631	1.623	1.616	1.609	1.603	1.596
0.13	1.589	1.582	1.576	1.569	1.562	1.556	1.549	1.543	1.537	1.530
0.14	1.524	1.518	1.512	1.506	1.500	1.494	1.488	1.482	1.476	1.470
0.15	1.464	1.459	1.453	1.447	1.442	1.436	1.431	1.425	1.420	1.415
0.16	1.409	1.404	1.399	1.393	1.388	1.383	1.379	1.373	1.368	1.363
0.17	1.358	1.353	1.349	1.344	1.339	1.334	1.329	1.324	1.319	1.314
0.18	1.310	1.305	1.301	1.296	1.291	1.287	1.282	1.278	1.274	1.269
0.19	1.265	1.261	1.256	1.252	1.248	1.243	1.239	1.235	1.231	1.227
0.20	1.223	1.219	1.215	1.210	1.206	1.202	1.198	1.195	1.191	1.187

X	0	1	2	3	4	5	6	7	8	9
0.0	- .00	4.038	3.355	2.959	2.681	2.468	2.295	2.151	2.027	1.919
0.1	1.823	1.737	1.660	1.589	1.524	1.464	1.409	1.358	1.309	1.265
0.2	1.223	1.183	1.145	1.110	1.076	1.044	1.014	0.985	0.957	0.931
0.3	0.906	0.882	0.859	0.838	0.815	0.794	0.774	0.755	0.737	0.719
0.4	0.702	0.686	0.670	0.655	0.640	0.627	0.611	0.598	0.585	0.572
0.5	0.560	0.548	0.536	0.525	0.514	0.503	0.493	0.483	0.473	0.464
0.6	0.454	0.445	0.437	0.428	0.420	0.412	0.404	0.396	0.388	0.381
0.7	0.374	0.367	0.360	0.353	0.347	0.340	0.334	0.328	0.322	0.316
0.8	0.311	0.306	0.300	0.295	0.289	0.284	0.279	0.274	0.269	0.265
0.9	0.260	0.256	0.251	0.247	0.243	0.239	0.235	0.231	0.227	0.223
1.0	0.219	0.215	0.212	0.209	0.205	0.202	0.198	0.195	0.192	0.189
1.1	0.186	0.183	0.180	0.177	0.174	0.173	0.169	0.166	0.164	0.161
1.2	0.158	0.156	0.153	0.151	0.149	0.146	0.144	0.142	0.140	0.138
1.3	0.135	0.133	0.131	0.129	0.127	0.125	0.124	0.122	0.120	0.118
1.4	0.116	0.114	0.113	0.111	0.109	0.108	0.106	0.105	0.103	0.102
1.5	0.1000	0.0985	0.0971	0.0957	0.0943	0.0929	0.0915	0.0902	0.0889	0.0876
1.6	0.0863	0.0851	0.0838	0.0826	0.0814	0.0802	0.0791	0.0780	0.0768	0.0757
1.7	0.0747	0.0736	0.0725	0.0715	0.0705	0.0695	0.0685	0.0675	0.0666	0.0656
1.8	0.0647	0.0638	0.0629	0.0620	0.0612	0.0603	0.0595	0.0586	0.0578	0.0570
1.9	0.0562	0.0554	0.0546	0.0539	0.0531	0.0524	0.0517	0.0510	0.0503	0.0496
2.0	0.0489	0.0482	0.0476	0.0469	0.0463	0.0456	0.0450	0.0444	0.0438	0.0432

APPENDIX A (Concluded)

Table of Exponential Integral

$f(x) = -Ei(-x)$

$2.0 < x < 10.9$, Interval = 0.1

x	0	1	2	3	4	5	6	7	8	9
2	4.89x10⁻²	4.36x10⁻²	3.92x10⁻²	3.55x10⁻²	3.24x10⁻²	2.98x10⁻²	2.75x10⁻²	2.55x10⁻²	2.38x10⁻²	2.23x10⁻²
3	1.30x10⁻²	1.18x10⁻²	1.07x10⁻²	9.74x10⁻³	8.86x10⁻³	8.07x10⁻³	7.35x10⁻³	6.70x10⁻³	6.11x10⁻³	5.58x10⁻³
4	[illegible]	[illegible]	[illegible]	2.64x10⁻³	2.34x10⁻³	2.07x10⁻³	1.84x10⁻³	1.64x10⁻³	1.46x10⁻³	1.30x10⁻³
5	1.15x10⁻³	1.02x10⁻³	9.09x10⁻⁴	[illegible]	[illegible]	[illegible]	7.14x10⁻⁴	6.38x10⁻⁴	5.70x10⁻⁴	5.09x10⁻⁴
6	4.54x10⁻⁴	4.06x10⁻⁴	3.63x10⁻⁴	3.25x10⁻⁴	2.91x10⁻⁴	2.61x10⁻⁴	2.34x10⁻⁴	2.10x10⁻⁴	1.89x10⁻⁴	1.70x10⁻⁴
7	1.54x10⁻⁴	1.39x10⁻⁴	1.25x10⁻⁴	1.13x10⁻⁴	1.02x10⁻⁴	9.22x10⁻⁵	8.32x10⁻⁵	7.51x10⁻⁵	6.78x10⁻⁵	6.12x10⁻⁵
8	5.52x10⁻⁵	4.99x10⁻⁵	4.51x10⁻⁵	4.08x10⁻⁵	3.69x10⁻⁵	3.34x10⁻⁵	3.02x10⁻⁵	2.73x10⁻⁵	2.47x10⁻⁵	2.23x10⁻⁵
9	2.02x10⁻⁵	1.82x10⁻⁵	1.65x10⁻⁵	1.49x10⁻⁵	1.35x10⁻⁵	1.22x10⁻⁵	1.10x10⁻⁵	9.97x10⁻⁶	9.02x10⁻⁶	8.16x10⁻⁶
10	4.15x10⁻⁶	3.76x10⁻⁶	3.40x10⁻⁶	3.08x10⁻⁶	2.79x10⁻⁶	2.52x10⁻⁶	2.28x10⁻⁶	2.06x10⁻⁶	1.87x10⁻⁶	1.69x10⁻⁶

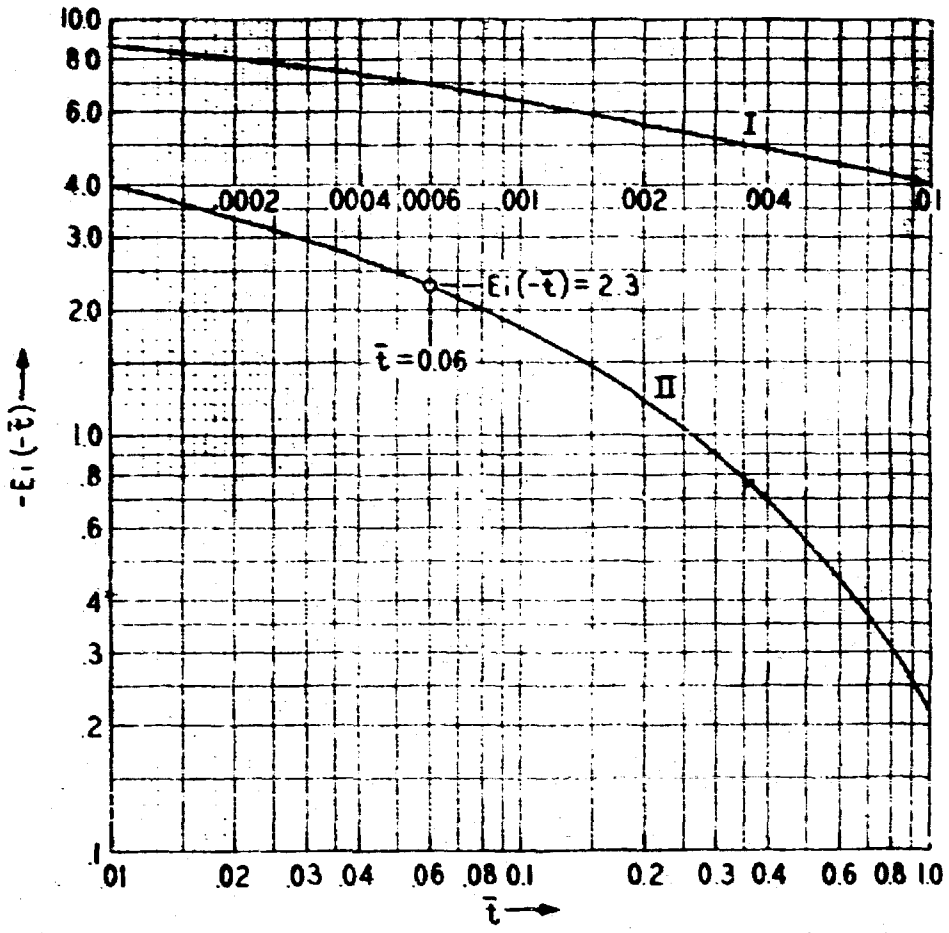


Fig. 1. Graph of the function $f(\bar{t}) = -Ei(-\bar{t})$ can be used when accuracy to two significant figures is adequate.

APPENDIX B

Chart for the Calculation of the Exponential Integral

By rearranging Equation (1) and introducing dimensionless variables, the calculation of Exponential Integrals is simplified. This chart may be used whenever accuracy to two significant figures is adequate for the problem at hand.

Let $\Delta P = p_o - p(r,T)$

$$\bar{P} = \frac{q_o u B}{0.0141 k h}$$

$$\bar{t} = 948.4 \frac{c u f r^2}{k T}$$

Then, Equation (1) may be written

$$\Delta P = \bar{P}[-Ei(-\bar{t})]$$

The chart consists of two branches of the Ei-curve plotted on double logarithmic paper. Values of $\bar{t}$ are plotted along the x-axis. Values of $-Ei(-\bar{t})$ are plotted along the Y-axis.

The first branch, marked I, covers the range of $\bar{t}$ from 0.0001 to 0.01; the second branch, marked II, covers the range of $\bar{t}$ from 0.01 to 1.0. Values of $\bar{t}$ are indicated along these curves for convenience in reading. Values of $-Ei(-\bar{t})$ covers the range from 0.22 to 8.6. These are indicated at the left of the chart.

Example 1, Consider the point O_1 $(\bar{t})$ located on Branch II.

$$\bar{t} = 0.06, \quad -Ei(-\bar{t}) = 2.3$$

HORSESHOE - GALLUP OIL POOL

OIL PRODUCTION

MONTH & YEAR	NO. OF WELLS	OIL PRODUCTION (IN BARRELS)
1956		
OCTOBER	2	1,432
NOVEMBER	2	722
DECEMBER	2	804
TOTAL PRODUCTION		2,958
CUMULATIVE PRODUCTION		2,958
1957		
JANUARY	3	1,476
FEBRUARY	3	1,749
MARCH	3	3,706
APRIL	3	1,842
MAY	3	882
JUNE	3	1,228
JULY	12	9,658
AUGUST	12	5,178
SEPTEMBER	12	3,409
OCTOBER	14	10,046
NOVEMBER	16	8,934
DECEMBER	17	10,747
TOTAL PRODUCTION		58,855
CUMULATIVE PRODUCTION		61,813
1958		
JANUARY	17	5,536
FEBRUARY	17	7,669
MARCH	17	5,191
APRIL	17	12,370
MAY	19	24,526
JUNE	24	30,240
JULY	27	30,604
AUGUST	28	34,427
SEPTEMBER	28	33,127
OCTOBER	43	56,501
NOVEMBER	50	55,704
DECEMBER	74	96,728
TOTAL PRODUCTION		451,478
CUMULATIVE PRODUCTION		513,291

CASE NO. 1597

THE ATLANTIC REFINING COMPANY

EXHIBIT NO. 5

HORSESHOE - GALLUP OIL POOL - ATLANTIC NAVAJO LEASES

NET PAY - POROSITY & PERMEABILITY OF CORE ANALYSIS

NET PAY 1 MD OR MORE

LEASE & WELL #	NET PAY	AVERAGE POROSITY %	TOTAL MD FT	AVERAGE PERMEABILITY MD
NAVAJO #1	41	19.3	8,907.4	217.5
NAVAJO #2	33	12.5	4,356.0	132.0
NAVAJO #3	48	19.2	13,630.0	284.0
NAVAJO #4	20	14.4	2,406.5	120.3
NAVAJO #5	41	16.2	3,141.0	76.6
NAVAJO #6	29	17.5	5,882.5	202.8
NAVAJO #7	26	16.0	4,648.4	178.8
NAVAJO #8	31	17.8	6,276.3	202.5
NAVAJO #9	17	13.2	1,798.0	105.8
NAVAJO #11	27	17.4	5,337.3	197.7
NAVAJO #14	5	12.5	1,030.0	206.0

CASE NO. 1597

THE ATLANTIC REFINING COMPANY

EXHIBIT NO. 6

HORSESHOE - GALLUP OIL POOL - ATLANTIC NAVAJO LEASES

NET PAY - POROSITY & PERMEABILITY OF CORE ANALYSIS

NET PAY 1 MD OR MORE

LEASE & WELL #	NET PAY	AVERAGE POROSITY %	TOTAL MD FT	AVERAGE PERMEABILITY MD
NAVAJO #16	6	13.0	111.4	18.6
NAVAJO #18	25	15.9	3,396.0	135.8
NAVAJO #20	15	18.1	2,004.0	133.6
NAVAJO #21	7	15.4	417.0	59.5
NAVAJO #22	6	10.7	79.3	13.2
NAVAJO #23	7	14.5	395.2	56.5
NAVAJO #25	2	11.7	27.8	4.0
NAVAJO #28	11	15.5	1,582.6	143.9
NAVAJO #29	21	16.4	2,270.6	108.0
NAVAJO #30	10	15.4	951.8	95.2
NAVAJO B #2	5	14.3	336.3	67.3
NAVAJO B #3	7	16.4	994.1	142.0

CASE NO. 1597

THE ATLANTIC REFINING COMPANY

EXHIBIT NO. 6

CORE ANALYSIS

HORSESHOE - GALLUP OIL POOL

ATLANTIC NAVAJO LEASES

NUMBER OF WELLS CORED	23
NUMBER OF SAMPLES INCLUDED IN AVERAGE (ALL SAMPLES WITH 1.0 MD PERMEABILITY OR MORE)	445
WEIGHTED AVERAGE POROSITY	16.4%
WEIGHTED AVERAGE PERMEABILITY	157.3
AVERAGE NET PAY	19.3
CONNATE WATER (LABORATORY)	30%

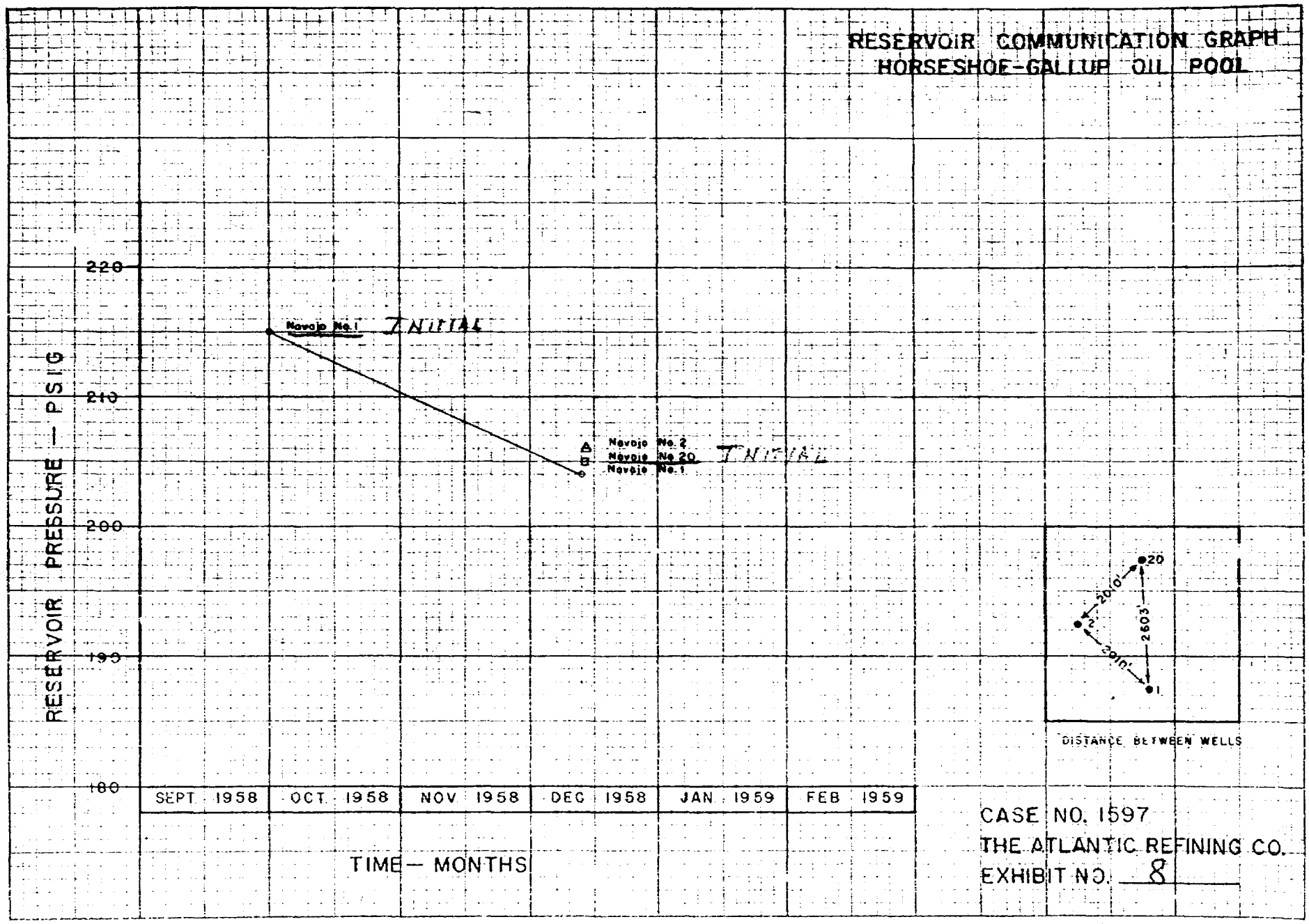
CASE NO. 1597

THE ATLANTIC REFINING COMPANY

EXHIBIT NO. 7

KEUFFEL & ESSER CO. 10 X 10 TO THE INCH 359-5DG

RESERVOIR COMMUNICATION GRAPH
HORSESHOE-GALLUP OIL POOL



CASE NO. 1597
THE ATLANTIC REFINING CO.
EXHIBIT NO. 8

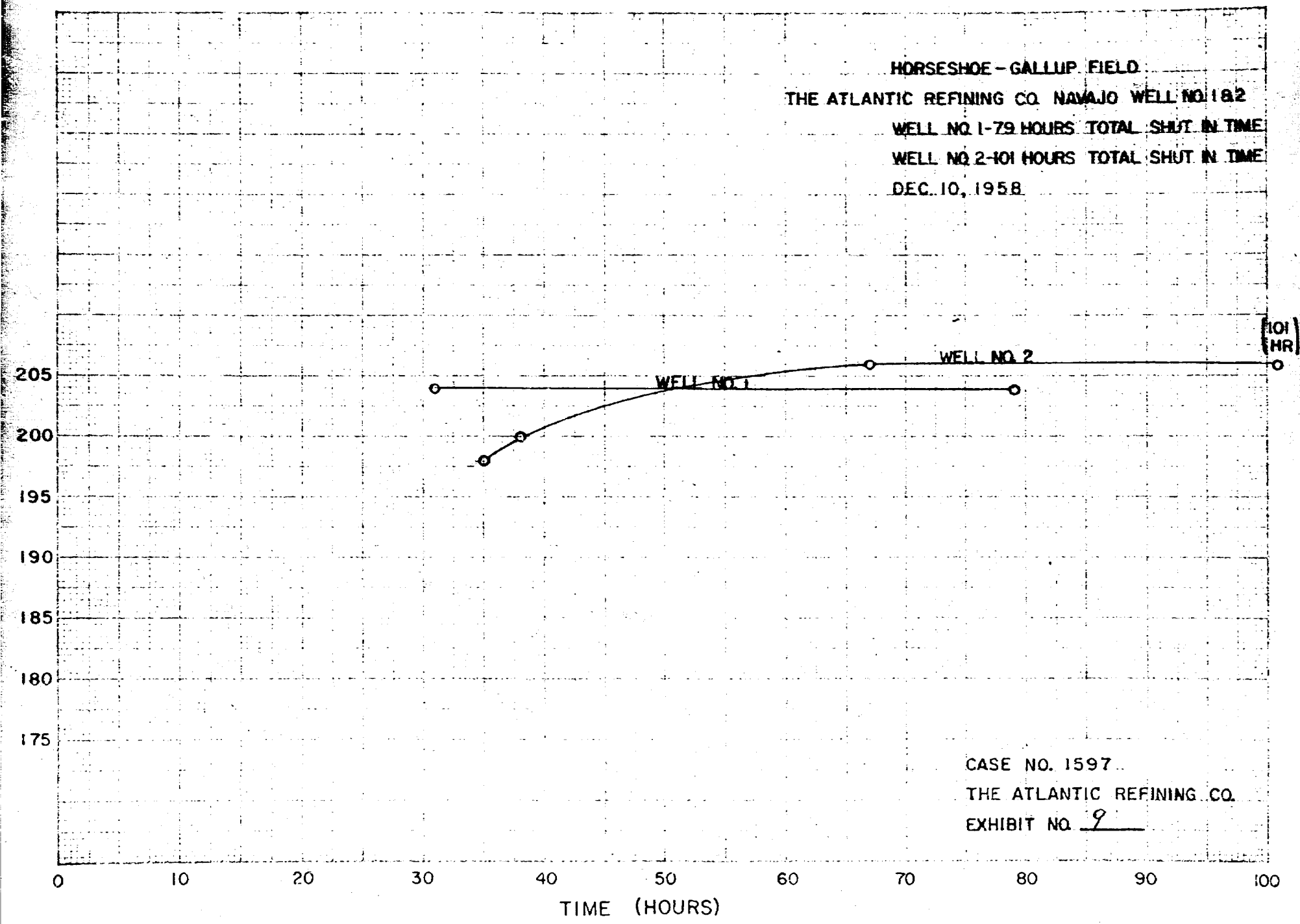
HORSESHOE - GALLUP FIELD

THE ATLANTIC REFINING CO. NAVAJO WELL NO. 1 & 2

WELL NO. 1 - 79 HOURS TOTAL SHUT IN TIME

WELL NO. 2 - 101 HOURS TOTAL SHUT IN TIME

DEC. 10, 1958



CASE NO. 1597

THE ATLANTIC REFINING CO.

EXHIBIT NO. 9

HORSESHOE - GALLUP FIELD
THE ATLANTIC REFINING CO. NAVAJO WELL NO. 20
98 HOUR BUILD - UP TEST
DEC. 10, 1958

PRESSURE (PSIG)

205
200
195
190
185
180
175

0 10 20 30 40 50 60 70 80 90 100

TIME (HOURS)

CASE NO. 1597
THE ATLANTIC REFINING CO.
EXHIBIT NO. 10

Case 1397

NEW MEXICO OIL CONSERVATION COMMISSION

SANTA FE, NEW MEXICO

APPLICATION OF THE ATLANTIC REFINING COMPANY FOR AN ORDER ESTABLISHING TEMPORARY 80-ACRE WELL SPACING AND PRORATION UNITS AND PROMULGATING SPECIAL RULES AND REGULATIONS FOR THE HORSESHOE-GALLUP POOL, SAN JUAN COUNTY, NEW MEXICO

To New Mexico Oil Conservation Commission
Santa Fe, New Mexico

Comes The Atlantic Refining Company and hereby makes application to the New Mexico Oil Conservation Commission for an order establishing 80-acre well spacing and proration units and promulgating special rules and regulations for the Horseshoe-Gallup Pool, San Juan County, New Mexico, and in support of said application respectfully shows:

1. That The Atlantic Refining Company is the owner of oil and gas leases embracing a substantial amount of acreage embraced within the limits of the Horseshoe-Gallup Oil Pool or Field as defined by the New Mexico Oil Conservation Commission.

2. That all of the leasehold interests of applicant situated within the Horseshoe-Gallup Pool have been developed by the drilling of wells on a uniform 80-acre spacing pattern while some of the lands situated in the Southeast portion of the Field have been developed by wells on a regular 40-acre spacing pattern. That all of said wells are producing from a common reservoir, and it is believed that there are additional lands covering a considerable area which, by further development, will be proven productive from the same reservoir.

By reason of a study made by applicant of the Horseshoe-Gallup Pool, including tests and other available data as well as production experience, applicant believes that 80 acres, or more, can

Docket Mailed
2-5-59
BP

March 18th Docket Mailed To:
Lea, Kenley, Clarence Hinkle, +
Guy Buell.
3-6-59
B.P.

be efficiently and economically drained and developed by one well and that it is in the interest of conservation and the prevention of waste that temporary 80-acre spacing and proration units be established for the Horseshoe-Gallup Pool for a period of at least one year until the limits of the producing area have been more definitely established and that unless the further production experience and development of said area definitely establishes that one well will not efficiently and economically drain 80 acres that after said one-year period the establishment of such units be made permanent.

3. That the 80-acre spacing and proration units should consist of a unit containing 80-acres more or less constituting either the North half, the South half, the East half or the West half of a single governmental quarter section and that all wells should be located within 330 feet of the center of either component quarter-quarter section of such spacing or proration unit.

4. That each 80-acre spacing and proration unit situated within the Horseshoe-Gallup Pool should be assigned an 80-acre proportional factor of two (2) for allowable purposes and that in the event there is more than one well on an 80-acre proration unit the operator should be permitted to produce the unit allowable for said wells in any proportion and each operator should have the right to drill a well on either or both of the component quarter-quarter sections of each 80-acre spacing or proration unit.

5. That any well drilled to or completed in the Gallup Reservoir of the Horseshoe-Gallup Pool not in conformity with the foregoing, prior to the entering of an order herein establishing 80-acre spacing and proration units, should be granted an exception to such 80-acre spacing and well location requirements and that each such well should be assigned an allowable bearing the same proportion

to the standard 80-acre allowable so adopted that the acreage dedicated to such well bears to 80 acres; however, the allowable for any such excepted well should be increased to that of a standard 80-acre unit by the dedication to the well of additional acreage sufficient to constitute a standard 80-acre proration unit.

6. That applicant believes that the establishment of temporary 80-acre spacing and proration units as set forth above will prevent the economic loss caused by the drilling of unnecessary wells and will protect correlative rights, including those of royalty owners and will avoid risks arising from the drilling of an excessive number of wells and will tend to promote the greatest ultimate recovery of oil and gas in that such 80-acre spacing will be in the interest of and will facilitate the establishment of an early pressure maintenance or secondary recovery program designed to maintain the over-all production curve at a higher level during the productive life of the Pool than would otherwise be the case.

WHEREFORE, applicant prays that the Oil Conservation Commission after due notice and hearing as provided by law and the rules and regulations of the Oil Conservation Commission enter an order herein establishing temporary 80-acre well spacing and proration units and promulgating special rules and regulations for the Horseshoe-Gallup Pool, San Juan County, New Mexico.

Respectfully submitted,

THE ATLANTIC REFINING COMPANY

By _____
Attorney

HERVEY, DOW & HINKLE

By _____
Roswell, New Mexico
Attorneys for
The Atlantic Refining Company

No. 9-59

DOCKET: REGULAR HEARING MARCH 18, 1959

Oil Conservation Commission 9 a.m., Mabry Hall, State Capitol, Santa Fe

ALLOWABLE: (1) Consideration of the oil allowable for April 1959

(2) Consideration of the allowable production of gas for April 1959 from six prorated pools in Lea County, New Mexico; also consideration of the allowable production of gas from seven prorated pools in San Juan and Rio Arriba Counties, New Mexico, for April 1959.

NEW CASES

CASE 1603: In the matter of the application of Gulf Oil Corporation for an order authorizing it to prorate the purchase of sour crudes only from twenty-five pools in Lea and Eddy Counties, New Mexico, during the course of the Port Arthur Refinery strike.

CASE 1615: Application of Stanley Jones, et al, for an order requiring Malco Refineries, Inc., to purchase oil produced from the Dayton-Abo Pool in Eddy County, New Mexico. Applicants, in the above-styled cause, seek an order requiring Malco Refineries, Inc., to purchase oil produced from wells in the Dayton-Abo Pool in Eddy County, New Mexico, under the provisions of the Common Purchaser Act.

CASE 1616: In the matter of the hearing called by the Oil Conservation Commission on its own motion to consider the reclassification of the Angels Peak-Gallup Pool in San Juan County, New Mexico, from a gas pool to an oil pool.

CASE 1617: In the matter of the hearing called by the Oil Conservation Commission on its own motion to consider the extension of the Ballard-Pictured Cliffs Pool in San Juan and Rio Arriba Counties, New Mexico, a prorated gas pool, to include the Canyon Largo-Pictured Cliffs Pool and the Otero-Pictured Cliffs Pool, both in Rio Arriba County, New Mexico, and both of which are non-prorated gas pools, and to include such other adjacent acreage in Rio Arriba County, New Mexico, as is necessary to form a common boundary.

CASE 1618: Southeastern New Mexico nomenclature case calling for an order creating, abolishing, extending and redefining certain pools in Lea, Eddy, and Roosevelt Counties, New Mexico:

(a) Create a new oil pool for San Andres production, designated as the Bishop Canyon-San Andres Pool, and described as:

TOWNSHIP 18 SOUTH, RANGE 38 EAST, NMPM
Section 11: NE/4

(b) Create a new oil pool for Pennsylvanian production, designated as the Bluitt-Pennsylvanian Pool, and described as:

TOWNSHIP 8 SOUTH, RANGE 37 EAST, NMPM
Section 20: NW/4

(c) Create a new oil pool for Delaware production, designated as the Bradley-Delaware Pool, and described as:

TOWNSHIP 26 SOUTH, RANGE 34 EAST, NMPM
Section 19: NW/4

(d) Create a new oil pool for Delaware production, designated as the Brushy Draw-Delaware Pool, and described as:

TOWNSHIP 26 SOUTH, RANGE 29 EAST, NMPM
Section 13: SW/4

(e) Create a new oil pool for Devonian production, designated as the Crosby-Devonian Oil Pool, and described as:

TOWNSHIP 25 SOUTH, RANGE 37 EAST, NMPM
Section 21: SW/4

(f) Create a new oil pool for Wolfcamp production, designated as the Leamex-Wolfcamp Pool, and described as:

TOWNSHIP 17 SOUTH, RANGE 33 EAST, NMPM
Section 22: NE/4

(g) Abolish the East Leo-Grayburg Pool described as:

TOWNSHIP 18 SOUTH, RANGE 31 EAST, NMPM
Section 20: SE/4

(h) Abolish the North Shugart-Grayburg Pool described as:

TOWNSHIP 18 SOUTH, RANGE 31 EAST, NMPM
Section 9: SE/4
Section 10: S/2
Section 15: N/2 NW/4

(i) Extend the vertical limits of the North Shugart-Queen Pool in Eddy County, New Mexico, to include the Grayburg formation and to rename said pool North Shugart Queen-Grayburg Pool. Further, to extend the horizontal limits of said North Shugart Queen-Grayburg Pool to include therein:

TOWNSHIP 18 SOUTH, RANGE 31 EAST, NMPM
Section 22: SW/4

(j) Extend the Dayton-Abo Pool to include:

TOWNSHIP 18 SOUTH, RANGE 26 EAST, NMPM
Section 35: NW/4 NW/4

(k) Extend the Empire-Abo Pool to include:

TOWNSHIP 18 SOUTH, RANGE 27 EAST, NMPM
Section 2: NW/4
Section 10: NW/4

(l) Extend the Eumont Gas Pool to include:

TOWNSHIP 21 SOUTH, RANGE 35 EAST, NMPM
Section 3: S/2

(m) Extend the Grayburg-Jackson Pool to include:

TOWNSHIP 17 SOUTH, RANGE 31 EAST, NMPM
Section 3: SE/4, N/2 SW/4 & SE/4 SW/4

(n) Extend the Harkey-Pennsylvanian Gas Pool to include:

TOWNSHIP 24 SOUTH, RANGE 27 EAST, NMPM
Section 27: SW/4

(o) Extend the Justis-Drinkard Pool to include:

TOWNSHIP 25 SOUTH, RANGE 37 EAST, NMPM
Section 25: S/2

(p) Extend the Justis-Fusselman Pool to include:

TOWNSHIP 25 SOUTH, RANGE 37 EAST, NMPM
Section 25: S/2

(q) Extend the Lynch Pool to include:

TOWNSHIP 20 SOUTH, RANGE 34 EAST, NMPM
Section 28: SE/4

(r) Extend the East Millman Queen-Grayburg Pool to include:

TOWNSHIP 19 SOUTH, RANGE 28 EAST, NMPM
Section 14: N/2

(s) Extend the Pearl-Queen Pool to include:

TOWNSHIP 19 SOUTH, RANGE 35 EAST, NMPM
Section 32: N/2

(t) Extend the Roberts Pool to include:

TOWNSHIP 17 SOUTH, RANGE 33 EAST, NMPM
Section 9: E/2 SW/4

(u) Extend the Robinson Pool to include:

TOWNSHIP 17 SOUTH, RANGE 31 EAST, NMPM
Section 2: SW/4

(v) Extend the Tubb Gas Pool to include:

TOWNSHIP 22 SOUTH, RANGE 38 EAST, NMPM
Section 31: NW/4

(w) Extend the Wantz-Abo Pool to include:

TOWNSHIP 21 SOUTH, RANGE 37 EAST, NMPM
Section 21: NE/4

CASE 1619: Northwestern New Mexico nomenclature case calling for an order extending existing pools in San Juan and Rio Arriba Counties, New Mexico:

(a) Extend the Aztec-Pictured Cliffs Pool to include:

TOWNSHIP 29 NORTH, RANGE 9 WEST, NMPM
Section 32: All
Section 33: W/2

(b) Extend the West Kutz-Pictured Cliffs Pool to include:

TOWNSHIP 27 NORTH, RANGE 11 WEST, NMPM
Section 20: NW/4

(c) Extend the Bisti-Lower Gallup Oil Pool to include:

TOWNSHIP 24 NORTH, RANGE 10 WEST, NMPM
Section 3: SE/4

TOWNSHIP 25 NORTH, RANGE 11 WEST, NMPM
Section 14: SW/4

(d) Extend the Gallegos-Gallup Oil Pool to include:

TOWNSHIP 26 NORTH, RANGE 11 WEST, NMPM
Section 4: SW/4
Section 8: NE/4
Section 9: NW/4 & SE/4
Section 10: S/2
Section 11: S/2

(e) Extend the Horseshoe-Gallup Oil Pool to include:

TOWNSHIP 30 NORTH, RANGE 16 WEST, NMPM
Section 3: SE/4
Section 4: SE/4 SW/4

TOWNSHIP 31 NORTH, RANGE 16 WEST, NMPM
Section 30: SW/4
Section 31: NW/4
Section 34: SW/4 SE/4

TOWNSHIP 31 NORTH, RANGE 17 WEST, NMPM
Section 24: NE/4 & SW/4

(f) Extend the Otero-Gallup Oil Pool to include:

TOWNSHIP 25 NORTH, RANGE 5 WEST, NMPM
Section 31: W/2
Section 33: SW/4

(g) Extend the Verde-Gallup Oil Pool to include:

TOWNSHIP 31 NORTH, RANGE 14 WEST, NMPM
Section 29: NE/4

TOWNSHIP 31 NORTH, RANGE 15 WEST, NMPM
Section 33: E/2

(h) Extend the West Kutz-Dakota Pool to include:

TOWNSHIP 28 NORTH, RANGE 12 WEST, NMPM
Section 26: N/2

CONTINUED CASES

CASE 1569: In the matter of the hearing called by the Oil Conservation Commission on its own motion to consider the promulgation of an order prohibiting the flaring of casinghead gas from oil wells in San Juan, Rio Arriba, McKinley and Sandoval Counties, New Mexico.

CASE 1597: Application of the Atlantic Refining Company for an order promulgating temporary special rules and regulations for the Horseshoe-Gallup Oil Pool in San Juan County, New Mexico. Applicant, in the above-styled cause, seeks an order promulgating temporary special rules and regulations for the Horseshoe-Gallup Oil Pool in San Juan County, New Mexico, to provide for 80-acre proration units in said pool.

CASE 1600: In the matter of the application of M. A. Romero and Robert Critchfield concerning the operation of gas prorationing in the Blanco Mesaverde Gas Pool and the ratable taking of gas from said Blanco Mesaverde Gas Pool in Rio Arriba and San Juan Counties, New Mexico, as well as from the Chacra Mesa-Pictured Cliffs Gas Pool in Rio Arriba County, New Mexico.

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No. 6-59

DOCKET: REGULAR HEARING FEBRUARY 18, 1959

Oil Conservation Commission 9 a.m., Mabry Hall, State Capitol, Santa Fe

ALLOWABLE: (1) Consideration of the oil allowable for March 1959

(2) Consideration of the allowable production of gas for March 1959 from six prorated pools in Lea County, New Mexico; also consideration of the allowable production of gas from seven prorated pools in San Juan and Rio Arriba Counties, New Mexico, for March 1959.

NEW CASES

CASE 1596: Application of El Paso Natural Gas Products Company for the establishment of two separate common sources of supply, for administrative procedure for dual completions, and for commingling of production from separate oil pools. Applicant, in the above-styled cause, seeks an order segregating the producing interval of the Gallup formation in the Horseshoe-Gallup Field, San Juan County, New Mexico, into two separate common sources of supply. Applicant further seeks the establishment of an administrative procedure for approval of wells dually completed in said common sources of supply utilizing a certain type of mechanical installation in exception to Rule 112 (A) of the Commission Rules and Regulations. Applicant further seeks permission to commingle the production from said separate pools after metering the production from each.

CASE 1597: Application of the Atlantic Refining Company for an order promulgating temporary special rules and regulations for the Horseshoe-Gallup Oil Pool in San Juan County, New Mexico. Applicant, in the above-styled cause, seeks an order promulgating temporary special rules and regulations for the Horseshoe-Gallup Oil Pool in San Juan County, New Mexico, to provide for 80-acre proration units in said pool.

CASE 1598: Application of Phillips Petroleum Company for an order establishing 80-acre spacing units in the Ranger Lake-Pennsylvanian Pool, Lea County, New Mexico, and for extension of the horizontal limits of said pool. Applicant, in the above-styled cause, seeks an order promulgating special rules and regulations for the Ranger Lake-Pennsylvanian Pool, Lea County, New Mexico, to provide for 80-acre spacing units. Applicant further seeks an order extending said pool to include the following described acreage: W/2 W/2 of Section 13; All of Sections 14, 15, 22, 23, 26, and 27; W/2 NW/4 and SW/4 SW/4 of Section 24; and W/2 W/2 of Section 25, all in Township 12 South, Range 34 East, Lea County, New Mexico.

CASE 1599: Application of El Paso Natural Gas Company for 320-acre spacing, promulgation of special rules and regulations and for a redetermination of the vertical limits of the Angels Peak-Dakota Gas Pool, San Juan County, New Mexico. Applicant, in the above-styled cause, seeks an order establishing 320-acre spacing in the Angels Peak-Dakota Gas Pool in San Juan County, New Mexico, and for the promulgation of special rules and regulations for said pool. Applicant further seeks to change the vertical limits of the Angels Peak-Dakota Gas Pool to include the interval lying between the base of the Greenhorn limestone and the base of the upper productive portion of the Morrison formation.

CASE 1600: Application of M. A. Romero and Robert Critchfield concerning the operation of gas prorationing in the Blanco Mesa-verde Gas Pool and the Choza Mesa-Pictured Cliffs Gas Pool in Rio Arriba County, New Mexico, and the ratable taking of gas from said pools.

CASE 1601: Southeastern New Mexico nomenclature case calling for an order for the extension of existing pools in Lea, Eddy, Chaves, and Roosevelt Counties, New Mexico.

(a) Extend the Acme Pool to include:

TOWNSHIP 7 SOUTH, RANGE 27 EAST, NMPM
Section 32: SE/4
Section 33: SW/4

(b) Extend the North Allison-Pennsylvanian Pool to include:

TOWNSHIP 8 SOUTH, RANGE 36 EAST, NMPM
Section 35: NE/4

(c) Extend the Atoka-Pennsylvanian Gas Pool to include:

TOWNSHIP 18 SOUTH, RANGE 26 EAST, NMPM
Section 15: SE/4

(d) Extend the Caprock-Queen Pool to include:

TOWNSHIP 14 SOUTH, RANGE 31 EAST, NMPM
Section 29: E/2 NE/4

(e) Extend the West Henshaw-Grayburg Pool to include:

TOWNSHIP 16 SOUTH, RANGE 30 EAST, NMPM
Section 7: SE/4

(f) Extend the Justis-Ellenburger Pool to include:

TOWNSHIP 25 SOUTH, RANGE 37 EAST, NMPM
Section 24: SW/4
Section 25: NE/4

(g) Extend the Justis-Montoya Pool to include:

TOWNSHIP 25 SOUTH, RANGE 37 EAST, NMPM
Section 24: SE/4
Section 25: NE/4

(h) Extend the Maljamar Pool to include:

TOWNSHIP 18 SOUTH, RANGE 33 EAST, NMPM
Section 2: NW/4

(i) Extend the Red Lake-Pennsylvanian Gas Pool to include:

TOWNSHIP 18 SOUTH, RANGE 27 EAST, NMPM
Section 8: NE/4

CASE 1602: Northwestern New Mexico nomenclature case calling for an order for the extension of existing pools in San Juan and Rio Arriba Counties, New Mexico:

(a) Extend the Aztec-Fruitland Pool to include:

TOWNSHIP 29 NORTH, RANGE 10 WEST, NMPM
Section 30: N/2

TOWNSHIP 29 NORTH, RANGE 11 WEST, NMPM
Section 25: NE/4

(b) Extend the Aztec-Pictured Cliffs Pool to include:

TOWNSHIP 29 NORTH, RANGE 10 WEST, NMPM
Section 19: SE/4
Section 30: NE/4

(c) Extend the Blanco-Pictured Cliffs Pool to include:

TOWNSHIP 29 NORTH, RANGE 9 WEST, NMPM
Section 8: E/2

(d) Extend the Gavilan-Pictured Cliffs Pool to include:

TOWNSHIP 25 NORTH, RANGE 1 WEST, NMPM
Section 30: NE/4

(e) Extend the South Blanco-Pictured Cliffs Pool to include:

TOWNSHIP 25 NORTH, RANGE 6 WEST, NMPM
Section 22: SE/4
Section 23: W/2

TOWNSHIP 27 NORTH, RANGE 7 WEST, NMPM
Section 3: All

TOWNSHIP 28 NORTH, RANGE 7 WEST, NMPM
Section 15: SW/4
Section 21: SE/4
Section 22: N/2 & SW/4
Section 28: All
Section 31: E/2
Section 32: All
Section 33: All
Section 34: All
Section 35: SW/4

TOWNSHIP 28 NORTH, RANGE 8 WEST, NMPM
Section 29: All

(f) Extend the Tapacito-Pictured Cliffs Pool to include:

TOWNSHIP 25 NORTH, RANGE 3 WEST, NMPM
Section 23: SW/4

TOWNSHIP 26 NORTH, RANGE 3 WEST, NMPM
Section 27: SW/4

TOWNSHIP 27 NORTH, RANGE 4 WEST, NMPM
Section 19: S/2
Section 20: E/2 & SW/4
Section 29: NW/4

(g) Extend the Blanco-Mesaverde Pool to include:

TOWNSHIP 26 NORTH, RANGE 2 WEST, NMPM
Section 17: W/2
Section 18: All (partial)

(h) Extend the South Blanco-Dakota Pool to include:

TOWNSHIP 27 NORTH, RANGE 6 WEST, NMPM
Section 19: E/2

(i) Extend the Bisti-Lower Gallup Oil Pool to include:

TOWNSHIP 24 NORTH, RANGE 10 WEST, NMPM
Section 2: SE/4

TOWNSHIP 25 NORTH, RANGE 11 WEST, NMPM
Section 7: S/2 SE/4
Section 16: NW/4
Section 30: N/2 NW/4

TOWNSHIP 25 NORTH, RANGE 12 WEST, NMPM
Section 11: NW/4

(j) Extend the Chimney Rock-Gallup Oil Pool to include:

TOWNSHIP 31 NORTH, RANGE 17 WEST, NMPM
Section 5: NE/4 SE/4

(k) Extend the Escrito-Gallup Oil Pool to include:

TOWNSHIP 24 NORTH, RANGE 7 WEST, NMPM
Section 24: SW/4 & NW/4 SE/4
Section 25: NW/4

(l) Extend the Horseshoe-Gallup Oil Pool to include:

TOWNSHIP 30 NORTH, RANGE 16 WEST, NMPM
Section 9: E/2 NW/4 & SE/4 NE/4
Section 10: S/2 NW/4

TOWNSHIP 31 NORTH, RANGE 16 WEST, NMPM
Section 29: SE/4 & SE/4 NE/4
Section 31: SE/4
Section 32: SW/4
Section 34: E/2 SW/4

TOWNSHIP 31 NORTH, RANGE 17 WEST, NMPM
Section 24: SE/4
Section 25: NE/4

(m) Extend the Verde-Gallup Oil Pool to include:

TOWNSHIP 30 NORTH, RANGE 15 WEST, NMPM
Section 5: N/2 SW/4

CONTINUED CASE

CASE 1526: Northwestern New Mexico nomenclature case calling for an order for the extension of an existing pool in San Juan County, New Mexico.

(h) Extend the Angels Peak-Dakota Pool to include:

TOWNSHIP 26 NORTH, RANGE 10 WEST, NMPM
Section 2: NW/4

TOWNSHIP 27 NORTH, RANGE 10 WEST, NMPM
Section 35: SW/4

TOWNSHIP 28 NORTH, RANGE 10 WEST, NMPM
Section 27: W/2
Section 28: E/2

ir/

(OVER)

No. 6-59

SUPPLEMENTAL DOCKET: REGULAR HEARING FEBRUARY 18, 1959

Oil Conservation Commission 9 a.m., Mabry Hall, State Capitol, Santa Fe, NM

CASE 1603: **In the matter of the application of Gulf Oil Corporation for an order authorizing it to prorate the purchase of sour crudes only from twenty-five pools in Lea and Eddy Counties, New Mexico, during the course of the Port Arthur Refinery strike.**