CASE NO.

6609

APPLICATION,

TRANSCRIPTS,

SMALL EXHIBITS,

ETC.

S. P. YATES
PRESIDENT
MARTIN YATES, III
VICE PRESIDENT
JOHN A. YATES
VICE PRESIDENT
B. W. HARPER
SEC.-TREAS

YATES PETROLEUM CORPORATION
207 SOUTH FOURTH STREET
ARTESIA, NEW MEXICO 88210
TELEPHONE (505) 746-3558

October 8, 1980

6609

Mr. Joe Ramey, Director
Oil Conservation Division
Energy and Minerals Department
P. O. Box 2088
Santa Fe, New Mexico 87501

Dear ~~Mr.~~ Ramey:

Your order R-6129-A dated May 14, 1980, required the applicant, NAPECO, Inc., as operator of the ~~Benson Deep Unit~~, to conduct and file certain ~~producing~~ rate tests on the Benson Deep Unit Well No. 1. Yates Petroleum Corporation became the successor operator effective October 1, 1980.

Attached is a copy of production tests conducted by Tefteller, Inc. for the former unit operator on June 27, 28 and 29, 1980 and daily gauge reports for April 16 through June 17, 1980. This information is submitted herewith in compliance with the above identified requirement. We can obtain the daily gauge reports subsequent to June, 1980, from the former operator if these would be of interest to your office. The latest daily gauge we have on the well was 50 barrels of oil and 121 mcf of gas with 2000 psi flowing tubing pressure on a 4/64" choke with 290 psi line pressure.

We are initiating a fracture treatment design study and plan to conduct specialized testing on the well after the fracture treatment is completed. The results of these tests will be furnished your office when available as a supplement to the attached information in order to more adequately comply with the requirement of order R-6129-A.

RECEIVED
OCT 14 1980
OIL CONSERVATION DIVISION
SANTA FE

Yours truly,

Peyton Yates

xc: Oil Conservation Division, Artesia

TEFTELLER, INC.
RESERVOIR ENGINEERING DATA
Midland, Texas

Well : BENSON DEEP UNIT NO. 1

Field : WILDCAT

File 3-10800-ST

CHRONOLOGICAL PRESSURE AND PRODUCTION DATA

1980 Date	Status of Well	Time	Elapsed Time Hrs.	Min.	LOG T + dt / dt	Daily Rate Oil B/D	Gas MCF/D	GOR	Wellhead Pressure Tubing	BHP @ 10600' Psig	BHP @ 10683' Psig
6-27	Arrived on location										
"	flowing 4/64" adj.										
"	choke	11:30									
"	Shut-in - install swab										
"	valve	11:35									
"	Open 4/64" adj. ck.	11:45									
"	Start test	12:00	0	00							
"	"	16:00	4	00							
6-28	"	20:00	8	00		30.01	108.74	3623	1852		
"	"	00:00	12	00		25.01	110.36	4413	1852		
"	"	04:00	16	00		21.25	110.65	5207	1852		
"	"	08:00	20	00		20.00	110.98	5547	1852		
"		12:00	24	00		28.76	110.98	3859	1852		
	AVERAGE RATE FIRST 24 HOURS					24.47	109.86	3999	1852		
"	"					25.42	110.26	4338	1877		
"	"	16:00	28	00							
6-29	"	20:00	32	00		30.01	114.24	3807			
"	"	00:00	36	00		25.00	107.68	4307	1860		
"		04:00	40	00		30.01	110.58	3678	1880		
"	Collect separator samples					42.50	134.34	3161	1878		
"	Inst. @ 10600'	08:00	44	00					1829		
"	"	10:24				25.00	110.77	4431			
"		12:00	48	00					1869		
	AVERAGE DAILY RATE					17.50	100.71	5760	1889	4361	4390
	Shut-in for build up	12:00	0	00		26.88	111.66	4154		4362	4391

BENSON DEEP UNIT #1, EDDY COUNTY, NEW MEXICO

PRODUCTION DATA

JUNE	FTP	CHOKE SIZE	OIL	GAS	
1	2100 psi	4/64"	34.55 BOPD	.119 MMCFD	
2	2100 psi	4/64"	29.97 BOPD	.119 MMCFD	0 b
3	2100 psi	4/64"	30.39 BOPD	.112 MMCFD	0 BWPL
4	2100 psi	4/64"	34.97 BOPD	.114 MMCFD	0 BWPD
5	2100 psi	4/64"	33.31 BOPD	.110 MMCFD	0 BWPD
6	2100 psi	4/64"	29.09 BOPD	.108 MMCFD	0 BWPD
7	2100 psi	4/64"	30.13 BOPD	.110 MMCFD	0 BWPD
8	2100 psi	4/64"	33.31 BOPD	.105 MMCFD	0 BWPD
9	2100 psi	4/64"	28.31 BOPD	.100 MMCFD	0 BWPD
10	2100 psi	4/64"	28.31 BOPD	.105 MMCFD	0 BWPD
11	2100 psi	4/64"	33.31 BOPD	.117 MMCFD	0 BWPD
12	2090 psi	4/64"	33.30 BOPD	.113 MMCFD	0 BWPD
13	2100 psi	4/64"	35.55 BOPD	.113 MMCFD	0 BWPD
14	2100 psi	4/64"	31.63 BOPD	.113 MMCFD	0 BWPD
15	2100 psi	4/64"	30.81 BOPD	.113 MMCFD	0 BWPD
16	2100 psi	4/64"	27.00 BOPD	.113 MMCFD	0 BWPD
17	2100 psi	4/64"	41.00 BOPD	.113 MMCFD	0 BWPD

BENSON DEEP UNIT #1, EDDY COUNTY, NEW MEXICO

PRODUCTION DATA

MAY	FTP	CHOKE SIZE	OIL	GAS	WATER
1	2300 psi	4/64"	28.31 BOPD	.102 MMCFD	0 BWPD
2	2350 psi	4/64"	26.64 BOPD	.098 MMCFD	0 BWPD
3	2375 psi	4/64"	23.32 BOPD	.089 MMCFD	0 BWPD
4	2200 psi	4/64"	38.00 BOPD	.111 MMCFD	0 BWPD
5	2200 psi	4/64"	35.00 BOPD	.110 MMCFD	0 BWPD
6	2175 psi	4/64"	34.14 BOPD	.110 MMCFD	0 BWPD
7	2130 psi	4/64"	36.64 BOPD	.115 MMCFD	0 BWPD
8	2100 psi	4/64"	34.96 BOPD	.118 MMCFD	0 BWPD
9	2100 psi	4/64"	36.64 BOPD	.067 MMCFD	0 BWPD
10	2100 psi	4/64"	33.31 BOPD	.118 MMCFD	0 BWPD
11	2100 psi	4/64"	33.30 BOPD	.118 MMCFD	0 BWPD
12	2100 psi	4/64"	34.97 BOPD	.123 MMCFD	0 BWPD
13	2100 psi	4/64"	33.31 BOPD	.123 MMCFD	0 BWPD
14	2100 psi	4/64"	38.30 BOPD	.123 MMCFD	0 BWPD
15	2100 psi	4/64"	29.97 BOPD	.121 MMCFD	0 BWPD
16					
17	2100 psi	4/64"	34.07 BOPD	.119 MMCFD	0 BWPD
18	2100 psi	4/64"	36.63 BOPD	.121 MMCFD	0 BWPD
19	2100 psi	4/64"	31.64 BOPD	.119 MMCFD	0 BWPD
20	2100 psi	4/64"	34.97 BOPD	.119 MMCFD	0 BWPD
21	2100 psi	4/64"	32.47 BOPD	.119 MMCFD	0 BWPD
22	2100 psi	4/64"	33.30 BOPD	.119 MMCFD	0 BWPD
23	2100 psi	4/64"	36.63 BOPD	.119 MMCFD	0 BWPD
24	2110 psi	4/64"	43.30 BOPD	.116 MMCFD	0 BWPD
25					
26	2300 psi	4/64"	23.31 BOPD	.090 MMCFD	0 BWPD

BENSON DEEP UNIT #1, EDDY COUNTY, NEW MEXICO

PRODUCTION DATA

MAY (Cont'd)	FTP	CHOKE SIZE	OIL	GAS	WATER
27	2180 psi	4/64"	24.15 BOPD	.114 MMCFD	0 BWPD
28	2150 psi	4/64"	34.97 BOPD	.114 MMCFD	0 BWPD
29	2150 psi	4/64"	38.03 BOPD	.114 MMCFD	0 BWPD
30	2150 psi	4/64"	23.32 BOPD	.114 MMCFD	0 BWPD
31	2100 psi	4/64"	36.63 BOPD	.114 MMCFD	0 BWPD

BENSON DEEP UNIT #1, EDDY CO., NEW MEXICO

PRODUCTION DATA

APRIL	FTP	CHOKE SIZE	OIL	GAS	WATER
16	2920 psi SITP				
17	2550 psi	4/64"	27 BOPD	.96 MMCFD	0 BWPD
18					
19					
20					
21					
22					
23	2320 psi	4/64"	32 BOPD	113 MMCFD	0 BWPD
24	2300 psi	4/64"	35 BOPD	113 MMCFD	0 BWPD
25	2290 psi	4/64"	27 BOPD	113 MMCFD	0 BWPD
26	2275 psi	4/64"	38 BOPD	113 MMCFD	0 BWPD
27	2275 psi	4/64"	26.64 BOPD	.111 MMCFD	0 BWPD
28	2280 psi	4/64"	34.97 BOPD	.111 MMCFD	0 BWPD
29	2280 psi	4/64"	30 BOPD	.111 MMCFD	0 BWPD
30	2300 psi	4/64"	28.31 BOPD	.104 MMCFD	0 BWPD

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION

BRUCE KING
GOVERNOR

LARRY KEHOE
SECRETARY

POST OFFICE BOX 2088
STATE LAND OFFICE BUILDING
SANTA FE, NEW MEXICO 87501
(505) 827-2434

October 11, 1979

Mr. Joel Carson
Losee, Carson & Dickerson
Attorneys at Law
Post Office Box 239
Artesia, New Mexico 88210

Re: CASE NO. 6609
ORDER NO. R-6129

Applicant:

Napeco Inc.

Dear Sir:

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

Yours very truly,

JOE D. RAMEY
Director

JDR/fd

Copy of order also sent to:

Hobbs OCD x
Artesia OCD x
Aztec OCD

Other

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION

IN THE MATTER OF THE HEARING
CALLED BY THE OIL CONSERVATION
DIVISION FOR THE PURPOSE OF
CONSIDERING:

CASE NO. 6609
Order No. R-6129

APPLICATION OF NAPECO INC. FOR
POOL CREATION AND SPECIAL RULES,
EDDY COUNTY, NEW MEXICO.

ORDER OF THE DIVISION

BY THE DIVISION:

This cause came on for hearing at 9 a.m. on July 25, 1979, at Santa Fe, New Mexico, before Examiner Daniel S. Nutter.

NOW, on this 10th day of October, 1979, the Division Director, having considered the testimony, the record, and the recommendations of the Examiner, and being fully advised in the premises,

FINDS:

(1) That due public notice having been given as required by law, the Division has jurisdiction of this cause and the subject matter thereof.

(2) That the applicant, Napeco Inc., seeks the creation of a new pool for Strawn production, said pool having been discovered by applicant's Benson Deep Unit Well No. 1, located in Unit O of Section 33, Township 18 South, Range 30 East, NMPM, Eddy County, New Mexico, which well was completed in the Strawn formation on May 9, 1979, with an initial potential of 104 barrels of oil per day from perforations 10,648 feet to 10,718 feet.

(3) That the applicant further seeks the promulgation of special rules for said pool, including provision for 160-acre spacing and proration units and standard well locations.

(4) That the applicant has failed to establish that one well can efficiently and effectively drain 160 acres.

(5) That the evidence adduced at the hearing would indicate that the Strawn formation in the subject well is of poor permeability, and that approval of 160-acre spacing, even on a temporary basis, might cause waste.

(6) That the creation of a new oil pool for the subject well should be handled in a regular nomenclature case by the Division.

(7) That the application in the subject case should be denied.

IT IS THEREFORE ORDERED:

(1) That the application of Napeco Inc. for creation of a new oil pool for Strawn production and the promulgation of special rules therefor, including a provision for 160-acre spacing and proration units and standard well locations, is hereby denied.

(2) That jurisdiction of this cause is retained for the entry of such further orders as the Division may deem necessary.

DONE at Santa Fe, New Mexico, on the day and year herein-above designated.

STATE OF NEW MEXICO
OIL CONSERVATION DIVISION

JOE D. RAMEY
Director

S E A L

fd/

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION
State Land Office Building
Santa Fe, New Mexico
25 July 1979

EXAMINER HEARING

IN THE MATTER OF:

Application of Napeco Inc. for pool creation and special pool rules, Eddy County, New Mexico. CASE 6609

BEFORE: Daniel S. Nutter

TRANSCRIPT OF HEARING

A P P E A R A N C E S

For the Oil Conservation Division: Ernest L. Padilla, Esq.
Legal Counsel for the Division
State Land Office Bldg.
Santa Fe, New Mexico 87503

For the Applicant: Joel CArson, Esq.
LOSEE, CARSON & DICKERSON
Artesia, New Mexico

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I N D E X

CURTIS ANDERSON

Direct Examination by Mr. Carson 3

Cross Examination by Mr. Nutter 11

PAUL T. HUGHES, JR.

Direct Examination by Mr. Carson 15

Cross Examination by Mr. Nutter 24

E X H I B I T S

Applicant Exhibit One, Plat 5

Applicant Exhibit Two, Montage 6

Applicant Exhibit Three, Plat 9

Applicant Exhibit Four, Cross Section 9

Applicant Exhibit Five, Document 17

Applicant Exhibit Six, Document 19

Applicant Exhibit Seven, Graph 20

MR. NUTTER: We'll call next Case Number 6609.

MR. PADILLA: Application of Napeco, Inc. for pool creation and special pool rules, Eddy County, New Mexico.

MR. CARSON: Mr. Examiner, my name is Joel Carson, Losee, Carson and Dickerson, P. A., Artesia, New Mexico, appearing here on behalf of the applicant. I'll have two witnesses.

(Witnesses sworn.)

CURTIS ANDERSON

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

DIRECT EXAMINATION

BY MR. CARSON:

Q. Would you state your name, please?

A. Curtis Anderson.

Q. Mr. Anderson, by whom are you employed?

A. Napeco, Incorporated.

Q. And in what capacity are you employed?

A. Geologist.

Q. Mr. Anderson, have you ever testified be-

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fore the Commission before?

A. No, I haven't.

MR. CARSON: Mr. Examiner, I have a couple of written resumes, professional credentials of these gentlemen. Would it be preferable to let them testify or could I just have these introduced?

MR. NUTTER: You can introduce those but if you'd just have them state the degree or what their educational background is, and years of experience in what field.

Q. Mr. Anderson, would you state briefly what your educational background is and what your -- what kind of experience you've had.

A. I received a Bachelor of Arts degree from the University of Minnesota, Duluth Branch, with a major in geology in 8th of '74; a Master of Arts in 5 of '76 from the University of North Dakota, also with a major in geology.

I've worked for Napeco, Incorporated in Houston, Texas from 6-76 to 6-'77 and returned to Napeco in 5-'78 in the Midland, Texas office.

MR. CARSON: Mr. Examiner, I'd also add that the written resume is included in the record as part of his statement of qualifications and ask if his qualifications are accepted.

MR. NUTTER: He is qualified and this will be part of the record.

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Q. Mr. Anderson, would you please state the purpose of this application?

A. Napeco, Incorporated seeks the creation of a new Strawn oil pool for its Benson Deep Well No. 1, located in Unit O of Section 33, Township 18 South, Range 30 East, and special rules therefore, including 160-acre spacing and standard well locations.

Q. And would you like these pool rules to cover that area shown in your Exhibit Number One, is that correct?

A. Yes, sir.

Q. I would refer you to Applicant's Exhibit Number One and ask you to identify that.

A. This is a land plat of the Benson Deep Unit area. The acreage colored in yellow is the Benson Deep Unit. Cross hached areas indicate potash restrictions and orange dots indicate possible development locations. The blue dot represents the Napeco No. 1 Benson Deep Unit Well.

Q. And the possible development locations are based on 160-acre spacing, is that correct?

A. Yes, that's correct.

Q. Was this exhibit prepared by you or under your supervision?

A. Yes, it was.

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Q. I refer you to Applicant's Exhibit Number Two and ask you to identify that exhibit.

A. Exhibit Number Two is a montage including four illustrations, a Strawn structure map combination production map, and upper Strawn litho facies map, stratigraphic cross section A-A', and diagrammatic fence diagram.

Q. I would refer you to that portion of the exhibit entitled Structure Map and ask you to explain that to the Examiner.

A. The structure map is contoured on the top of the Strawn limestone. Control points are circles. The colors of the control points that are producing wells, red being Morrow wells and blue being Strawn wells. The Benson Deep Unit area is on regional dip with the down-dip direction to the southeast.

Hydrocarbon accumulation in the upper Strawn are stratigraphic against regional dip.

Q. I refer you to that portion that you call a lithofacies map. Will you tell us what it shows?

A. In order to --

Q. Or would you prefer to talk about the stratigraphic section first?

A. In order to describe the map, I would like to work through the cross section.

Q. Please do.

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A. Well, beginning at the left end of the cross section, Petroleum Reserve -- Petroleum Corporation No. 1 Petco State, the line of trace cross section is on the lithofacies map, here at the southwest corner of the map.

The Petco State is a Strawn well completed in the lower Strawn. It has produced 32,499 barrels of oil plus water cumulative to 3-'79.

The upper Strawn section in that well, which is the section that Napeco wants -- the Napeco No. 1 Benson Deep is producing out of, is a bedded biostromal limestone deposited on a continental shelf, abundant with bottom growing organisms.

It was tested, the upper Strawn was tested in that well and rapidly declining flow rates of gas indicated low permeability.

Going down-dip to the second well in the cross section, to the H. L. Brown No. 1 Yates Federal, this well originally completed in the Morrow, depleted that zone, and attempts to complete in the upper Strawn were made.

The well flowed 7-million cubic feet of gas plus condensate for seven days and declined to zero pounds.

In going from the Petco State No. 1 to the

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No. 1 Yates Federal, the upper Strawn changes facies from a biostromal limestone to a limestone detrital.

Moving over to the Napeco No. 1 Benson Deep Unit, we encountered in the upper Strawn the carbonate detrital and during initial penetration encountered a drilling break near the top of the section. A flare burnt while drilling ahead to approximately 11,500 feet. A drill stem test of the Strawn and upper part of the Atoka in the Napeco No. 1 Benson Deep resulted in an average flow rate of 509,000 cubic feet of gas per day plus 309 barrels of condensate per day. This was for 137 minute flow period.

The upper Strawn and top part of the lower Strawn were perforated and testing yielded a COAF of 629,000 cubic feet of gas per day plus 110 barrels of oil per day.

Going up-dip from the Benson Deep, this is in the upper Strawn, to the Petroleum Reserve Corporation No. 1 Elliott Federal, we have again a change in facies to a biostromal limestone. The Strawn in the Elliott Federal wasn't tested or no reports of a test were found.

The diagrammatic fence diagram is just a picture of the environment as I see it. The light blue indicates the detrital changes facies into the darker blue, which is biostrome. Now it's this facies change, the light blue on the lithofacies map indicates the detrital. This facies change represents a permeability barrier, thus

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providing our trapping mechanism.

Also important in production from the Strawn is the presence of fractures, which I will get into in the next exhibit.

Q. I will refer you to Applicant's Exhibit Number Three and ask if that was prepared by you or under your supervision?

A. Yes, it was.

Q. Would you briefly explain what that exhibit purports to show?

A. This is a land plat of the Lusk Strawn Oil Field. The blue dots represent Strawn producers. Lusk Strawn cross section A-A', which is Exhibit Number Four, is indicated on this map.

Q. Now I'll refer you to Applicant's Exhibit Number Four and ask you --

MR. NUTTER: Well, while you're on this exhibit, Mr. Anderson, where is this area with respect to the area we're talking about today?

A. Yes, sir, it is one township southeast, east southeast of our Benson Deep Unit.

MR. NUTTER: This Lusk is in 19, 31, and your well is in 18, 30.

A. Yes, sir.

MR. NUTTER: So that would put it up here

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to the northwest.

A. Yes. Our unit is northwest, yes.

MR. NUTTER: Okay.

Q. Now referring you to Applicant's Exhibit Four, was that prepared by you or under your supervision?

A. Yes, it was.

Q. Would you explain to the Examiner what that purports to shows the Strawn that is being produced in the Lusk Field. I am showing an analogy here in type of environment.

The production here is from the lower Strawn but the environments are similar, and what this cross section shows is the change in facies from bioherm to detrital and biostrome with production being mainly where there is effective fracture systems.

Now the Lusk Strawn Field is on a large anticlinal feature; production is stratigraphic and structural.

Q. Now the Lusk Field is actually better than you expect your field to be, is that correct?

A. Yes, sir.

May I refer back to Exhibit Number Three?

Q. Sure.

A. Indicates 160-acre spacing in the Lusk Strawn Field. Of the 64 wells drilled to the Strawn, aver-

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age total depth was 11,602 feet. Strawn wells, development wells, in the Benson Deep area would be to approximately 11,000 feet.

MR. CARSON: Mr. Examiner, I would like to move the introduction of Applicant's Exhibits Number One through Four.

MR. NUTTER: Applicant's Exhibits One through Four will be entered in evidence.

Q. Mr. Anderson, in your opinion can you adequately drain this acreage with 160-acre spacing?

A. Yes.

Q. And would the granting of this application in your opinion prevent waste and prevent the drilling of an unnecessary number of wells?

A. Yes, sir.

MR. CARSON: I have no further questions of this witness, Mr. Examiner.

CROSS EXAMINATION

BY MR. NUTTER:

Q. Mr. Anderson, what do you base that conclusion on that you can drain 160 acres with these wells in here?

A. Based on the analogy in the similar geological environments, the similar production from fractured

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reservoirs, as the Lusk Strawn Field and based on engineering and economical -- economic data that will be presented by the second witness, we feel that the 160-acre spacing is drainable.

Q. Well now, you said based on the fracturing and the similarity to the Lusk, you did also state that the Lusk was better than this area that you've got here.

A. Better -- excuse me.

Q. The potentials of the wells in the Lusk Pool were considerably higher than the potential of the wells that you've got here, weren't they?

A. Yes.

Q. For the most part?

A. I think that is due to the size of the reservoir, the thickness of the section in the Lower Strawn there is more than we have, and the fracture system quite possibly there related to structure is somewhat better developed.

Q. What evidence do you have that permeability is present in your reservoir that's going contribute oil from 160 acres to a well?

A. Our porosity logs indicate 2 to 3 percent porosity, which would be inadequate for production.

Our duolateral log indicated deep invasion which would indicate fracture permeability and the test

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information and the production tests that we ran through perforations and drill stem tests would indicate that a permeability through fractures would have to be present.

Q. You don't have any pressure buildup tests that you've offered here, do you?

A. That will be the next witness.

Q. The next witness, all right.

Now, on your cross section, I think -- or on your structure map on Exhibit Number Two.

A. Yes, sir.

Q. I believe there's only two blue wells on this exhibit. Now, the other blue well besides the subject well is this Petco Company well that's on here in Section 26 about six or seven miles to the southwest, and that is the lefthand well on your cross section then, right?

A. Yes, sir.

Q. And its perforations are at about 10,650 to 60, I believe, is that correct?

A. Yes, sir.

Q. And the perforations in your well are from 10,650 to 10,700, but due to the structural difference, you are producing from a completely different interval from the well in Section 26.

A. Yes, sir.

Q. That interval would be some 10,800, or

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somewhere in that neighborhood, I believe.

A. Yes, sir.

Q. How much oil did you say that this Petco State has produced to date?

A. To 3 of '79 it has produced 32,499 barrels cumulative.

Q. How much gas has it made?

A. None reported.

Q. Now, you gave a number of potentials on the Napeco Benson Deep Unit while you were testifying from this exhibit. Has it ever gone on production yet?

A. No, sir.

Q. So what is the latest test that you have, this calculated absolute open flow?

A. Yes, sir.

Q. Shown here?

A. Yes.

Q. 629 Mcf and 110 barrels.

A. Yes.

Q. Okay, what about the characteristics of the liquids, what are you producing?

A. The gravity is 47.1 API, with a gas/oil ratio of 5720-to-1

Q. What's the color of the liquid?

A. It's distillate, pale yellow.

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Q Now, this -- this well down here in Section 26, I notice on the map there's the word Parkway here. Is this down here in this Parkway Strawn Pool?

A That's the Parkway Strawn Field, yes.

Q I believe at one time there was some question as to whether this was indeed an oil field or a gas field. Are you acquainted with that?

A I'm not acquainted with that particular aspect.

Q And I think the gas -- that there was some limitation placed on gas production from individual wells in that pool because of the possibility of effecting ultimate recovery of the liquids in the reservoir.

MR. NUTTER: Are there any further questions of this witness? He may be excused.

PAUL T. HUGHES, JR.

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

DIRECT EXAMINATION

BY MR. CARSON:

Q Would you please state your name, please?

A Yes. My name is Paul T. Hughes, Junior.

Q And Mr. Hughes, by whom are you employed?

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A. Napeco, Incorporated, Houston, Texas.

Q. And in what capacity?

A. I'm Manager, Drilling and Production.

Q. Have you ever testified before the -- this Commission?

A. No, I haven't.

Q. Would you tell the Examiner a little bit about your educational and experience background?

A. I received a Bachelor of Science in Natural Gas Engineering from Texas A&I University, Kingsville, Texas, in 1973. I've had -- I've taken numerous seminars and technical courses on various subjects since that time.

I have been, in my capacity as Manager for approximately a year. Prior to that time I was Division Engineer of Drilling and Production.

I've been with Napeco, Incorporated, since January, 1976. Prior to that point I was with Mitchell Energy Corporation out of Houston.

MR. CARSON: And I have furnished the Commission with a more extensive resume of your background, is that correct, as far as your professional --

A. Yes, that is correct.

MR. CARSON: Mr. Examiner, is this witness considered to be qualified?

MR. NUTTER: Yes, he is.

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Q. Mr. Hughes, I refer you to Applicant's Exhibit Number Five and ask if that exhibit was prepared by you or under your supervision?

A. Yes, it was.

Q. The Examiner asked a few minutes ago about pressure buildups, and so forth. Can you, from that exhibit explain to him --

A. Yes.

Q. -- about that?

A. The completion drilling data sheet, which is Exhibit Five, had certain general data on it relative to the drilling of the well, completion of the well, and of course, certain physical properties of the reservoir rock and fluids.

Attached with that is certain information hermatigraphic analysis of the gas, ASTM distillation tests, Form C-122, which shows how the calculated absolute open flow was calculated and on what basis, the appropriate curve that showed what the absolute open flow was in terms of the gas, and also the pressure data which we had run while we were testing the well.

When we perforated the well and subsequent to cleaning the well up, we put a bottom hole pressure bomb in the hole prior to the 4-point test or single point test, during the 4-point test, and then we left the bomb

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in the hole after we had tested the well to get an appropriate buildup to help us on reservoir parameters.

MR. NUTTER: This bottom hole pressure chart that's in here, Mr. Hughes, shows pressures running from a little over 2800 pounds to some 50-some hundred, but the depths did not Xerox on this particular copy. Could you read those to me, please?

A. Yes, sir. On the upper righthand corner it shows those depths appropriately.

MR. NUTTER: Okay, so this first point, then, is zero.

A. Yes, sir.

MR. NUTTER: That's 2800 pounds.

A. Yes, sir.

MR. NUTTER: The next one is 1500. Or is that where the pressure was read, at 1500?

A. Yes, sir, the information in the upper righthand corner is simply what we have shown here in the curve. TD, or 10,720, we have a bottom hole pressure of 5440 pounds.

MR. NUTTER: Well, what would the points where I see these zeros be, that first one, I guess, would be 2000?

A. Probably we're -- I don't have it either on mine, but it's probably zero, one, two, three, four, five

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thousand,in terms of thousand -- no, that's not right, that's depth.

Let's see, two, four, six, eight, ten, those are 2000 foot intervals.

MR. NUTTER: Okay, it's two, four, six, eight, ten.

A. Yes, sir, it's zero, two thousand, 4000, 6000, 8000, 10,000.

That should be feet on the left side corner of that curve.

MR. NUTTER: Okay, go ahead.

A. We also have attached with Exhibit Five, like I said earlier, the plots of the drawdown and plots of the buildup after we performed the 4-point test or 7-point test.

Q. I refer you to Applicant's Exhibit Number Six and ask if that was prepared by you or under your supervision?

A. Yes, it was.

Q. What does that purport to show, Mr. Hughes?

A. What we were -- what we're trying to show is based on a volumetric calculation of the oil, what the amount of stock tank recoverable oil, in other words, based on several drainage areas, using average parameters that

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we feel might exist in the field.

We're showing on 20-acre drainage, we're showing 3560 barrels of recoverable oil, stock tank oil.

On 40 we have so much; 80 acres we have so much, and on down the line. We did not show our estimate of gas in place. We do feel like there is some associated gas, naturally, with the reservoir, but at this time we do feel like it is an oil reservoir.

Q. And this is all based on assumption that your average pay will be 25 feet of pay.

A. Yes, sir, we've got -- we're assuming an average porosity, average salt water saturation, formation volume factors, and a recovery factor of 40 percent for each of those drainage acres, which is very important from the volumetric calculation.

Q. I refer you to Applicant's Exhibit Number Seven and ask you to -- if that was prepared by you or under your supervision?

A. Yes, it was.

Q. Would you explain to the Examiner what that purports to show?

A. Yes, sir.

What we were trying to do, of course, was to support on an engineering basis our logic in wanting the 160-acre spacing at first. What we did come up with

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this graph, or curve, was to assume one 640-acre reservoir, one well within that 640, two wells within that 640, basically to come down to the four lines that you see, which are 40-acre spacing, 80-acre spacing, 160-acre spacing, and 320-acre spacing.

We have the bottom hole pressure that is found in the tabulation on Exhibit Five as being approximately 5400 pounds. We attempted to see what the effect from an economic standpoint would be, given the cost of the well, the operating expense, parameters that we use on our program, price for the oil and gas, and so forth. We have come up with this curve. At this time it's no doubt subjective, as little as we know about the reservoir at this point, but what we're trying to show is that, number one, from an economic standpoint we cannot afford to drill the wells on 20-acre, 40-acre, 80-acre spacing.

We feel like the 160-acre spacing, and possibly 320 spacing, can be justified. Naturally we would like to have a certain amount of performance history to support the data that you see on the curve. It is estimated. We used, naturally, on the 40-acre spacing, you're going to drill so many wells per 640. You've got -- you had to assume a certain withdrawal rate, which we did, and basically the data is presented here.

It is not a linear function. The recovery

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factor, if you use one well in a 640-acres, is not going to be the same if you use, say, four wells per 640.

We feel like the 160-acre spacing can more than adequately drain the reservoir properly and put us in a position to where we can economically justify it.

Q. For the information of the Examiner, Mr. Hughes, what is the -- your No. 1 Well cost? To complete?

A. We AFE'd the dry hole cost being about $650,000. Completed well costs was approximately $960,000, roughly $1-million.

That does include the tank battery. A tank battery has been installed, and that looks like what the total amount would end up at.

MR. NUTTER: How much?

A. $1-million.

MR. NUTTER: That includes the battery.

A. That includes the battery, yes, sir. Of course, that well was drilled to a total depth of 12, roughly 12,000 feet, yes, sir, 12,065 feet.

That was a Morrow test. We made our completion in the -- in the Strawn at approximately 10,700 feet.

Q. What do you expect the cost of the development wells to be?

A. Well, I feel like the first well was

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engineered as best as we can engineer it. I do feel like we can probably improve in some of our techniques, drilling techniques, but all in all, inflation rate going up, price indexes going up, over all I feel like more than likely the subsequent wells will probably increase in price rather than go down.

Q. And, Mr. Hughes, is it your belief that this upper Strawn is oil field rather than a gas field?

A. At this point, yes, we do think that it is an oil well. We hope to get the well on production, take certain samples of the fluid at reservoir conditions over a period of time, perform some PVT analysis on those samples and confirm that it is oil in the reservoir.

MR. CARSON: Mr. Examiner, if I didn't do it, I would like to move the introduction of Applicant's Exhibits Numbers Five, Six, and Seven.

MR. NUTTER: Applicant's Exhibits Five through Seven will be admitted in evidence.

Q. Mr. Hughes, I think you've already stated this, but in your professional opinion, based on the geological and engineering data, will 160-acre spacing adequately drain this area?

A. Yes, sir.

Q. And was it also your testimony that it is uneconomical to develop it on anything less than 160-acre

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spacing?

A. At this time, yes, sir.

Q. And is it your opinion that the granting of this application will also prevent waste and prevent the drilling of unnecessary number of wells?

A. That is correct.

MR. CARSON: Mr. Examiner, I'm not sure I understood the significance of the question regarding the Parkway Pool. Is that --

MR. NUTTER: I don't know. I don't recall sufficiently the characteristics of that reservoir, but it was the only Strawn reservoir that was shown on that map besides the subject well. That's the reason I brought that up.

Of course, I realize the Lusk Strawn is about the same distance in the opposite direction, and I know that's a gas -- an oil reservoir.

MR. CARSON: We have no further questions of this witness, Mr. Examiner.

CROSS EXAMINATION

BY MR. NUTTER:

Q. Mr. Hughes, inspection of your Exhibit Five would indicate that the average permeability in this well is .036 millidarcies. That's based on log analysis,

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is that correct?

A. No, sir, that is based on the drill stem test that was performed in the STrawn. The way they arrived at the millidarcy figure was basically a millidarcy feet, and then we assumed we had 40 feet, the interval of a drill stem test was 40 feet, and worked backwards and calculated the permeability to be .036. We did not do any quantitative interpretation of the logs to give us a permeability reading.

Q. Okay. Then another indication of permeability would be on the last sheet of your tabulation. Is this a pressure buildup taken on the subject well?

A. That's correct, yes,sir. What we do, we find it a good policy to have a pressure bomb in the hole while we're performing the drawdown test or the single point test or both those tests. We also find it very useful to have the bomb in the hole after we shut the well in and perform the buildup test. That gives our reservoir people good engineering data that they can use to calculate reserves and other information such as how we wish to -- of course the drawdown data would give you that -- as to how you would want to flow the well, what rates.

We believe, I believe, as was stated by Curtis Anderson, that we believe we do have a rather substantial fracture system here. I believe --

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Q. Well, if I'm reading this tabulation correctly, your first pressure is here at 7:45 p. m. on 5-10 with a pressure of 3528 at the datum.

A. That's correct, yes.

Q. And three days later at 7:45 p. m. on 5-13, when the chart ran down, you had reached 5436, and the pressure apparently was still building, so at the end of 72 hours you had not reached stabilization in the well.

A. that's correct, yes, sir. At that point our clock ran out. We had a 72-hour clock in the hole. The curve showing what the buildup is, is also attached in there. We felt like at the time the on-site inspection of the charts indicated the appropriate data in time was there to where we could extrapolate that buildup curve to outer limits reservoir pressure, which we feel like we can.

Q. But this would still indicate a rather low permeability, the fact that the pressure is still building up after 72 hours.

A. It does look like it could be relatively small permeability, which .036 is relatively small permeability.

Q. And normally we would expect to have rather a good permeability if we're going to go to 160-acre spacing in an oil reservoir, wouldn't we?

A. Possibly, yes, sir. Again, I think there

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is an important relationship there relative to the fracture system you have there.

Q. Uh-huh.

A. There are several oil zones that have a rather well established fracture system, no porosity, no permeability in it, but have recovered many millions of barrels of oil in certain places.

Q. Now in Mr. Anderson's Exhibit Number One in this case, we have the area that's colored yellow. I believe he stated that that was the outline of the North Benson Deep Unit, is that right?

A. Yes, sir, that's correct.

Q. Does Napeco operate the North Benson Deep Unit, or the Benson DEep Unit?

A. the Benson Deep Unit, yes, sir.

Q. You operate that.

A. Yes, sir, not -- not the North Benson, that's the --

Q. Well, that was a mistake. I didn't mean North Benson. I meant Benson Deep Unit.

A. Yes, sir. Yes, sir.

Q. The area in yellow is the area that you operate.

A. Yes, sir, we are operator on record.

Q. So actually Napeco is operating all of the

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acreage within more than a mile to the south, almost a mile to the north, a mile to the east, and most of a mile to the west of the subject well.

A. That is correct, yes, sir. Whether or not that is all reservoir, we don't plan on predicting that right now. We feel like future development and performance history on the Benson Deep No. 1 will give us the support and justification that we feel like we need. Right now probably everything we had is purely subjective, but we do feel like we have some data that can support our request.

Q. But you do control the acreage all around the well.

A. That is correct, yes, sir.

MR. NUTTER: Are there any further questions of the witness? He may be excused.

Do you have anything further, Mr. Carson?

MR. CARSON: We have no further witnesses.

MR. NUTTER: Does anyone have anything they wish to offer in Case Number 6609?

We'll take the case under advisement.

(Hearing concluded.)

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REPORTER'S CERTIFICATE

I, SALLY WALTON BOYD, a Court Reporter, DO HEREBY CERTIFY that the foregoing and attached Transcript of Hearing before the Oil Conservation Division was reported by me; that said transcript is a full, true, and correct record of the hearing, prepared by me to the best of my ability, knowledge, and skill, from my notes taken at the time of the hearing.

Sally W. Boyd C.S.R.
Sally W. Boyd, C.S.R.

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 6609 heard by me on 7/25 1974.

Oil Conservation Division, Examiner

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JOEL M. CARSON
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October 7, 1980

Ms. Florene Davidson
Administrative Secretary
Energy and Minerals Department
Oil Conservation Division
P. O. Box 2088
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Dear Ms. Davidson:

Enclosed, please find the Transcript of Case No. 6609, which was checked out to us on November 16, 1979. We apologize for the delay in returning this document. We are checking with our clients for the exhibits, and will let you know the results of our search.

Very truly yours,

LOSEE, CARSON & DICKERSON, P.A.

A. J. Losee

AJL:pvm
Enclosure

P.S. We are still looking for the Transcript in Case No. 6555.

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION
State Land Office Building
Santa Fe, New Mexico
25 July 1979

EXAMINER HEARING

IN THE MATTER OF:

Application of Napeco Inc. for pool creation and special pool rules, Eddy County, New Mexico. CASE 6609

BEFORE: Daniel S. Nutter

TRANSCRIPT OF HEARING

APPEARANCES

For the Oil Conservation Division:	Ernest L. Padilla, Esq. Legal Counsel for the Division State Land Office Bldg. Santa Fe, New Mexico 87503
For the Applicant:	Joel CArson, Esq. LOSEE, CARSON & DICKERSON Artesia, New Mexico

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E X H I B I T S

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Applicant Exhibit Two, Montage 6

Applicant Exhibit Three, Plat 9

Applicant Exhibit Four, Cross Section 9

Applicant Exhibit Five, Document 17

Applicant Exhibit Six, Document 19

Applicant Exhibit Seven, Graph 20

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MR. NUTTER: We'll call next Case Number 6609.

MR. PADILLA: Application of Napeco, Inc. for pool creation and special pool rules, Eddy County, New Mexico.

MR. CARSON: Mr. Examiner, my name is Joel Carson, Losee, Carson and Dickerson, P. A., Artesia, New Mexico, appearing here on behalf of the applicant. I'll have two witnesses.

(Witnesses sworn.)

CURTIS ANDERSON

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

DIRECT EXAMINATION

BY MR. CARSON:

Q. Would you state your name, please?

A. Curtis Anderson.

Q. Mr. Anderson, by whom are you employed?

A. Napeco, Incorporated.

Q. And in what capacity are you employed?

A. Geologist.

Q. Mr. Anderson, have you ever testified be--

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fore the Commission before?

A. No, I haven't.

MR. CARSON: Mr. Examiner, I have a couple of written resumes, professional credentials of these gentlemen. Would it be preferable to let them testify or could I just have these introduced?

MR. NUTTER: You can introduce those but if you'd just have them state the degree or what their educational background is, and years of experience in what field.

Q. Mr. Anderson, would you state briefly what your educational background is and what your -- what kind of experience you've had.

A. I received a Bachelor of Arts degree from the University of Minnesota, Duluth Branch, with a major in geology in 8th of '74; a Master of Arts in 5 of '76 from the University of North Dakota, also with a major in geology.

I've worked for Napeco, Incorporated in Houston, Texas from 6-76 to 6-'77 and returned to Napeco in 5-'78 in the Midland, Texas office.

MR. CARSON: Mr. Examiner, I'd also add that the written resume is included in the record as part of his statement of qualifications and ask if his qualifications are accepted.

MR. NUTTER: He is qualified and this will be part of the record.

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Q. Mr. Anderson, would you please state the purpose of this application?

A. Napeco, Incorporated seeks the creation of a new Strawn oil pool for its Benson Deep Well No. 1, located in Unit O of Section 33, Township 18 South, Range 30 East, and special rules therefore, including 160-acre spacing and standard well locations.

Q. And would you like these pool rules to cover that area shown in your Exhibit Number One, is that correct?

A. Yes, sir.

Q. I would refer you to Applicant's Exhibit Number One and ask you to identify that.

A. This is a land plat of the Benson Deep Unit area. The acreage colored in yellow is the Benson Deep Unit. Cross hached areas indicate potash restrictions and orange dots indicate possible development locations. The blue dot represents the Napeco No. 1 Benson Deep Unit Well.

Q. And the possible development locations are based on 160-acre spacing, is that correct?

A. Yes, that's correct.

Q. Was this exhibit prepared by you or under your supervision?

A. Yes, it was.

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Q. I refer you to Applicant's Exhibit Number Two and ask you to identify that exhibit.

A. Exhibit Number Two is a montage including four illustrations, a Strawn structure map combination production map, and upper Strawn lithofacies map, stratigraphic cross section A-A', and diagrammatic fence diagram.

Q. I would refer you to that portion of the exhibit entitled Structure Map and ask you to explain that to the Examiner.

A. The structure map is contoured on the top of the Strawn limestone. Control points are circles. The colors of the control points that are producing wells, red being Morrow wells and blue being Strawn wells. The Benson Deep Unit area is on regional dip with the down-dip direction to the southeast.

Hydrocarbon accumulation in the upper Strawn are stratigraphic against regional dip.

Q. I refer you to that portion that you call a lithofacies map. Will you tell us what it shows?

A. In order to --

Q. Or would you prefer to talk about the stratigraphic section first?

A. In order to describe the map, I would like to work through the cross section.

Q. Please do.

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A. Well, beginning at the left end of the cross section, Petroleum Reserve -- Petroleum Corporation No. 1 Petco State, the line of trace cross section is on the lithofacies map, where at the southwest corner of the map.

The Petco State is a Strawn well completed in the lower Strawn. It has produced 32,499 barrels of oil plus water cumulative to 3-'79.

The upper Strawn section in that well, which is the section that Napeco wants -- the Napeco No. 1 Benson Deep is producing out of, is a bedded biostromal limestone deposited on a continental shelf, abundant with bottom growing organisms.

It was tested, the upper Strawn was tested in that well and rapidly declining flow rates of gas indicated low permeability.

Going down-dip to the second well in the cross section, to the H.. L. Brown No. 1 Yates Federal, this well originally completed in the Morrow, depleted that zone, and attempts to complete in the upper Strawn were made.

The well flowed 7-million cubic f..t of gas plus condensate for seven days and declined to zero pounds.

In going from the Petco State No. 1 to the

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No. 1 Yates Federal, the upper Strawn changes facies from a biostromal limestone to a limestone detrital.

Moving over to the Napeco No. 1 Benson Deep Unit, we encountered in the upper Strawn the carbonate detrital and during initial penetration encountered a drilling break near the top of the section. A flare burnt while drilling ahead to approximately 11,500 feet. A drill stem test of the Strawn and upper part of the Atoka in the Napeco No. 1 Benson Deep resulted in an average flow rate of 509,000 cubic feet of gas per day plus 309 barrels of condensate per day. This was for 137 minute flow period.

The upper Strawn and top part of the lower Strawn were perforated and testing yielded a COAF of 629,000 cubic feet of gas per day plus 110 barrels of oil per day.

Going up-dip from the Benson Deep, this is in the upper Strawn, to the Petroleum Reserve Corporation No. 1 Elliott Federal, we have again a change in facies to a biostromal limestone. . The Strawn in the Elliott Federal wasn't tested or no reports of a test were found.

The diagrammatic fence diagram is just a picture of the environment as I see it. The light blue indicates the detrital changes facies into the darker blue, which is biostrome. Now it's this facies change, the light blue on the lithofacies map indicates the detrital. This facies change represents a permeability barrier, thus

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providing our trapping mechanism.

Also important in production from the Strawn is the presence of fractures, which I will get into in the next exhibit.

Q. I will refer you to Applicant's Exhibit Number Three and ask if that was prepared by you or under your supervision?

A. Yes, it was.

Q. Would you briefly explain what that exhibit purports to show?

A. This is a land plat of the Lusk Strawn Oil Field. The blue dots represent Strawn producers. Lusk Strawn cross section A-A', which is Exhibit Number Four, is indicated on this map.

Q. Now I'll refer you to Applicant's Exhibit Number Four and ask you --

MR NUTTER: Well, while you're on this exhibit, Mr. Anderson, where is this area with respect to the area we're talking about today?

A. Yes, sir, it is one township southeast, east southeast of our Benson Deep Unit.

MR. NUTTER: This Lusk is in 19, 31, and your well is in 18, 30.

A. Yes, sir.

MR. NUTTER: So that would put it up here

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to the northwest.

A. Yes. Our unit is northwest, yes.

MR. NUTTER: Okay.

Q. Now referring you to Applicant's Exhibit Four, was that prepared by you or under your supervision?

A. Yes, it was.

Q. Would you explain to the Examiner what that purports to shows the Strawn that is being produced in the Lusk Field. I am showing an analogy here in type of environment.

The production here is from the lower Strawn but the environments are similar, and what this cross section shows is the change in facies from bioherm to detrital and biostrome with production being mainly where there is effective fracture systems.

Now the Lusk Strawn Field is on a large anticlinal feature; production is stratigraphic and structural.

Q. Now the Lusk Field is actually better than you expect your field to be, is that correct?

A. Yes, sir.

May I refer back to Exhibit Number Three?

Q. Sure.

A. Indicates 160-acre spacing in the Lusk Strawn Field. Of the 64 wells drilled to the Strawn, aver-

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age total depth was 11,602 feet. Strawn wells, development wells, in the Benson Deep area would be to approximately 11,000 feet.

MR. CARSON: Mr. Examiner, I would like to move the introduction of Applicant's Exhibits Number One through Four.

MR. NUTTER: Applicant's Exhibits One through Four will be entered in evidence.

Q Mr. Anderson, in your opinion can you adequately drain this acreage with 160-acre spacing?

A Yes.

Q And would the granting of this application in your opinion prevent waste and prevent the drilling of an unnecessary number of wells?

A Yes, sir.

MR. CARSON: I have no further questions of this witness, Mr. Examiner.

CROSS EXAMINATION

BY MR. NUTTER:

Q Mr. Anderson, what do you base that conclusion on that you can drain 160 acres with these wells in here?

A Based on the analogy in the similar geological environments, the similar production from fractured

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reservoirs, as the Lusk Strawn Field and based on engineering and economical -- economic data that will be presented by the second witness, we feel that the 160-acre spacing is drainable.

Q. Well now, you said based on the fracturing and the similarity to the Lusk, you did also state that the Lusk was better than this area that you've got here.

A. Better -- excuse me.

Q. The potentials of the wells in the Lusk Pool were considerably higher than the potential of the wells that you've got here, weren't they?

A. Yes.

Q. For the most part?

A. I think that is due to the size of the reservoir, the thickness of the section in the Lower Strawn there is more than we have, and the fracture system quite possibly there related to structure is somewhat better developed.

Q. What evidence do you have that permeability is present in your reservoir that's going contribute oil from 160 acres to a well?

A. Our porosity logs indicate 2 to 3 percent porosity, which would be inadequate for production.

Our duolateral log indicated deep invasion which would indicate fracture permeability and the test

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information and the production tests that we ran through perforations and drill stem tests would indicate that a permeability through fractures would have to be present.

Q. You don't have any pressure buildup tests that you've offered here, do you?

A. That will be the next witness.

Q. The next witness, all right.

Now, on your cross section, I think -- or on your structure map on Exhibit Number Two.

A. Yes, sir.

Q. I believe there's only two blue wells on this exhibit. Now, the other blue well besides the subject well is this Petco Company well that's on here in Section 26 about six or seven miles to the southwest, and that is the lefthand well on your cross section then, right?

A. Yes, sir.

Q. And its perforations are at about 10,650 to 60, I believe, is that correct?

A. Yes, sir.

Q. And the perforations in your well are from 10,650 to 10,700, but due to the structural difference, you are producing from a completely different interval from the well in Section 26.

A. Yes, sir.

Q. That interval would be some 10,800, or

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somewhere in that neighborhood, I believe.

A. Yes, sir.

Q. How much oil did you say that this Petco State has produced to date?

A. To 3 of '79 it has produced 32,499 barrels cumulative.

Q. How much gas has it made?

A. None reported.

Q. Now, you gave a number of potentials on the Napeco Benson Deep Unit while you were testifying from this exhibit. Has it ever gone on production yet?

A. No, sir.

Q. So what is the latest test that you have, this calculated absolute open flow?

A. Yes, sir.

Q. SHown here?

A. Yes.

Q. 629 Mcf and 110 barrels.

A. Yes.

Q. Okay, what about the characteristics of the liquids, what are you producing?

A. The gravity is 47.1 API, with a gas/oil ratio of 5720-to-1

Q. What's the color of the liquid?

A. It's distillate, pale yellow.

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Q. Now, this -- this well down here in Section 26, I notice on the map there's the word Parkway here. Is this down here in this Parkway Strawn Pool?

A. That's the Parkway Strawn Field, yes.

Q. I believe at one time there was some question as to whether this was indeed an oil field or a gas field. Are you acquainted with that?

A. I'm not acquainted with that particular aspect.

Q. And I think the gas -- that there was some limitation placed on gas production from individual wells in that pool because of the possibility of effecting ultimate recovery of the liquids in the reservoir.

MR. NUTTER: Are there any further questions of this witness? He may be excused.

PAUL T. HUGHES, JR.

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

DIRECT EXAMINATION

BY MR. CARSON:

Q. Would you please state your name, please?

A. Yes. My name is Paul T. Hughes, Junior.

Q. And Mr. Hughes, by whom are you employed?

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A. Napeco, Incorporated, Houston, Texas.

Q. And in what capacity?

A. I'm Manager, Drilling and Production.

Q. Have you ever testified before the -- this Commission?

A. No, I haven't.

Q. Would you tell the Examiner a little bit about your educational and experience background?

A. I received a Bachelor of Science in Natural Gas Engineering from Texas A&I University, Kingsville, Texas, in 1973. I've had -- I've taken numerous seminars and technical courses on various subjects since that time.

I have been, in my capacity as Manager for approximately a year. Prior to that time I was Division Engineer of Drilling and Production.

I've been with Napeco, Incorporated, since January, 1976. Prior to that point I was with Mitchell Energy Corporation out of Houston.

MR. CARSON: And I have furnished the Commission with a more extensive resume of your background, is that correct, as far as your professional --

A. Yes, that is correct.

MR. CARSON: Mr. Examiner, is this witness considered to be qualified?

MR. NUTTER: Yes, he is.

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Q. Mr. Hughes, I refer you to Applicant's Exhibit Number Five and ask if that exhibit was prepared by you or under your supervision?

A. Yes, it was.

Q. The Examiner asked a few minutes ago about pressure buildups, and so forth. Can you, from that exhibit explain to him --

A. Yes.

Q. -- about that?

A. The completion drilling data sheet, which is Exhibit Five, had certain general data on it relative to the drilling of the well, completion of the well, and of course, certain physical properties of the reservoir rock and fluids.

Attached with that is certain information hermatigraphic analysis of the gas, ASTM distillation tests, Form C-122, which shows how the calculated absolute open flow was calculated and on what basis, the appropriate curve that showed what the absolute open flow was in terms of the gas, and also the pressure data which we had run while we were testing the well.

When we perforated the well and subsequent to cleaning the well up, we put a bottom hole pressure bomb in the hole prior to the 4-point test or single point test, during the 4-point test, and then we left the bomb

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in the hole after we had tested the well to get an appropriate buildup to help us on reservoir parameters.

MR. NUTTER: This bottom hole pressure chart that's in here, Mr. Hughes, shows pressures running from a little over 2300 pounds to some 50-some hundred, but the depths did not Xerox on this particular copy.

Could you read those to me, please?

A. Yes, sir. On the upper righthand corner it shows those depths appropriately.

MR. NUTTER: Okay, so this first point, then, is zero.

A. Yes, sir.

MR. NUTTER: That's 2800 pounds.

A. Yes, sir.

MR. NUTTER: The next one is 1500. Or is that where the pressure was read, at 1500?

A. Yes, sir, the information in the upper righthand corner is simply what we have shown here in the curve. TD, or 10,720, we have a bottom hole pressure of 5440 pounds.

MR. NUTTER: Well, what would the points where I see these zeros be, that first one, I guess, would be 2000?

A. Probably we're -- I don't have it either on mine, but it's probably zero, one, two, three, four, five

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thousand,in terms of thousand -- no, that's not right, that's depth.

Let's see, two, four, six, eight, ten, those are 2000 foot intervals.

MR. NUTTER: Okay, it's two, four, six, eight, ten.

A. Yes, sir, it's zero, two thousand, 4000, 6000, 3000, 10,000.

That should be feet on the left side corner of that curve.

MR. NUTTER: Okay, go ahead.

A. We also have attached with Exhibit Five, like I said earlier, the plots of the drawdown and plots of the buildup after we performed the 4-point test or 7-point test.

Q. I refer you to Applicant's Exhibit Number Six and ask if that was prepared by you or under your supervision?

A. Yes, it was.

Q. What does that purport to show, Mr. Hughes?

A. What we were -- what we're trying to show is based on a volumetric calculation of the oil, what the amount of stock tank recoverable oil, in other words, based on several drainage areas, using average parameters that

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we feel might exist in the field.

We're showing on 20-acre drainage, we're showing 3560 barrels of recoverable oil, stock tank oil.

On 40 we have so much; 80 acres we have so much, and on down the line. We did not show our estimate of gas in place. We do feel like there is some associated gas, naturally, with the reservoir, but at this time we do feel like it is an oil reservoir.

Q. And this is all based on assumption that your average pay will be 25 feet of pay.

A. Yes, sir, we've got -- we're assuming an average porosity, average salt water saturation, formation volume factors, and a recovery factor of 40 percent for each of those drainage acres, which is very important from the volumetric calculation.

Q. I refer you to Applicant's Exhibit Number Seven and ask you to -- if that was prepared by you or under your supervision?

A. Yes, it was.

Q. Would you explain to the Examiner what that purports to show?

A. Yes, sir.

What we were trying to do, of course, was to support on an engineering basis our logic in wanting the 160-acre spacing at first. What we did come up with

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this graph, or curve, was to assume one 640-acre reservoir, one well within that 640, two wells within that 640, basically to come down to the four lines that you see, which are 40-acre spacing, 80-acre spacing, 160-acre spacing, and 320-acre spacing.

We have the bottom hole pressure that is found in the tabulation on Exhibit Five as being approximately 5400 pounds. We attempted to see what the effect from an economic standpoint would be, given the cost of the well, the operating expense, parameters that we use on our program, price for the oil and gas, and so forth. We have come up with this curve. At this time it's no doubt subjective, as little as we know about the reservoir at this point, but what we're trying to show is that, number one, from an economic standpoint we cannot afford to drill the wells on 20-acre, 40-acre, 80-acre spacing.

We feel like the 160-acre spacing, and possibly 320 spacing, can be justified. Naturally we would like to have a certain amount of performance history to support the data that you see on the curve. It is estimated. We used, naturally, on the 40-acre spacing, you're going to drill so many wells per 640. You've got -- you had to assume a certain withdrawal rate, which we did, and basically the data is presented here.

It is not a linear function. The recovery

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factor, if you use one well in a 640-acres, is not going to be the same if you use, say, four wells per 640.

We feel like the 160-acre spacing can more than adequately drain the reservoir properly and put us in a position to where we can economically justify it.

Q. For the information of the Examiner, Mr. Hughes, what is the -- your No. 1 Well cost? To complete?

A. We AFE'd the dry hole cost being about $650,000. Completed well costs was approximately $960,000, roughly $1-million.

That does include the tank battery. A tank battery has been installed, and that looks like what the total amount would end up at.

MR. NUTTER: How much?

A. $1-million.

MR. NUTTER: That includes the battery.

A. That includes the battery, yes, sir. Of course, that well was drilled to a total depth of 12, roughly 12,000 feet, yes, sir, 12,065 feet.

That was a Morrow test. We made our completion in the -- in the Strawn at approximately 10,700 feet.

Q. What do you expect the cost of the development wells to be?

A. Well, I feel like the first well was

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engineered as best as we can engineer it. I do feel like we can probably improve in some of our techniques, drilling techniques, but all in all, inflation rate going up, price indexes going up, over all I feel like more than likely the subsequent wells will probably increase in price rather than go down.

Q. And, Mr. Hughes, is it your belief that this upper Strawn is oil field rather than a gas field?

A. At this point, yes, we do think that it is an oil well. We hope to get the well on production, take certain samples of the fluid at reservoir conditions over a period of time, perform some PVT analysis on those samples and confirm that it is oil in the reservoir.

MR. CARSON: Mr. Examiner, if I didn't do it, I would like to move the introduction of Applicant's Exhibits Numbers Five, Six, and Seven.

MR. NUTTER: Applicant's Exhibits Five through Seven will be admitted in evidence.

Q. Mr. Hughes, I think you've already stated this, but in your professional opinion, based on the geological and engineering data, will 160-acre spacing adequately drain this area?

A. Yes, sir.

Q. And was it also your testimony that it is uneconomical to develop it on anything less than 160-acre

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spacing?

A. At this time, yes, sir.

Q. And is it your opinion that the granting of this application will also prevent waste and prevent the drilling of unnecessary number of wells?

A. That is correct.

MR. CARSON: Mr. Examiner, I'm not sure I understood the significance of the question regarding the Parkway Pool. Is that --

MR. NUTTER: I don't know. I don't recall sufficiently the characteristics of that reservoir, but it was the only Strawn reservoir that was shown on that map besides the subject well. That's the reason I brought that up.

Of course, I realize the Lusk Strawn is about the same distance in the opposite direction, and I know that's a gas -- an oil reservoir.

MR. CARSON: We have no further questions of this witness, Mr. Examiner.

CROSS EXAMINATION

BY MR. NUTTER:

Q. Mr. Hughes, inspection of your Exhibit Five would indicate that the average permeability in this well is .036 millidarcies. That's based on log analysis,

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is that correct?

A. No, sir, that is based on the drill stem test that was performed in the STrawn. The way they arrived at the millidarcy figure was basically a millidarcy feet, and then we assumed we had 40 feet, the interval of a drill stem test was 40 feet, and worked backwards and calculated the permeability to be .036. We did not do any quantitative interpretation of the logs to give us a permeability reading.

Q. Okay. Then another indication of permeability would be on the last sheet of your tabulation. Is this a pressure buildup taken on the subject well?

A. That's correct, yes,sir. What we do, we find it a good policy to have a pressure bomb in the hole while we're performing the drawdown test or the single point test or both those tests. We also find it very useful to have the bomb in the hole after we shut the well in and perform the buildup test. That gives our reservoir people good engineering data that they can use to calculate reserves and other information such as how we wish to -- of course the drawdown data would give you that as to how you would want to flow the well, what rates.

We believe, I believe, as was stated by Curtis Anderson, that we believe we do have a rather substantial fracture system here. I believe --

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Q. Well, if I'm reading this tabulation correctly, your first pressure is here at 7:45 p. m. on 5-10 with a pressure of 3528 at the datum.

A. That's correct, yes.

Q. And three days later at 7:45 p. m. on 5-13, when the chart ran down, you had reached 5436, and the pressure apparently was still building, so at the end of 72 hours you had not reached stabilization in the well.

A. that's correct, yes, sir. At that point our clock ran out. We had a 72-hour clock in the hole. The curve showing what the buildup is, is also attached in there. We felt like at the time the on-site inspection of the charts indicated the appropriate data in time was there to where we could extrapolate that buildup curve to outer limits reservoir pressure, which we feel like we can.

Q. But this would still indicate a rather low permeability, the fact that the pressure is still building up after 72 hours.

A. It does look like it could be relatively small permeability, which .036 is relatively small permeability.

Q. And normally we would expect to have rather a good permeability if we're going to go to 160-acre spacing in an oil reservoir, wouldn't we?

A. Possibly, yes, sir. Again, I think there

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is an important relationship there relative to the fracture system you have there.

Q. Uh-huh.

A. There are several oil zones that have a rather well established fracture system, no porosity, no permeability in it, but have recovered many millions of barrels of oil in certain places.

Q. Now in Mr. Anderson's Exhibit Number One in this case, we have the area that's colored yellow. I believe he stated that that was the outline of the North Benson Deep Unit, is that right?

A. Yes, sir, that's correct.

Q. Does Napeco operate the North Benson Deep Unit, or the Benson DEep Unit?

A. the Benson Deep Unit, yes, sir.

Q. You operate that.

A. Yes, sir, not -- not the North Benson, that's the --

Q. Well, that was a mistake. I didn't mean North Benson. I meant Benson Deep Unit.

A. Yes, sir. Yes, sir.

Q. The area in yellow is the area that you operate.

A. Yes, sir, we are operator on record.

Q. So actually Napeco is operating all of the

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acreage within more than a mile to the south, almost a mile to the north, a mile to the east, and most of a mile to the west of the subject well.

A. That is correct, yes, sir.

Whether or not that is all reservoir, we don't plan on predicting that right now. We feel like future development and performance history on the Benson Deep No. 1 will give us the support and justification that we feel like we need. Right now probably everything we had is purely subjective, but we do feel like we have some data that can support our request.

Q. But you do control the acreage all around the well.

A. That is correct, yes, sir.

MR. NUTTER: Are there any further questions of the witness? He may be excused.

Do you have anything further, Mr. Carson?

MR. CARSON: We have no further witnesses.

MR. NUTTER: Does anyone have anything they wish to offer in Case Number 6609?

We'll take the case under advisement.

(Hearing concluded.)

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REPORTER'S CERTIFICATE

I, SALLY WALTON BOYD, a Court Reporter, DO HEREBY CERTIFY that the foregoing and attached Transcript of Hearing before the Oil Conservation Division was reported by me; that said transcript is a full, true, and correct record of the hearing, prepared by me to the best of my ability, knowledge, and skill, from my notes taken at the time of the hearing.

Sally W. Boyd, C.S.R.

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 6609 heard by me on 7/25 19 79.

Oil Conservation Division, Examiner

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Docket No. 27-79

Dockets Nos. 29-79 and 31-79 are tentatively set for hearing on August 8 and 22, 1979. Applications for hearing must be filed at least 22 days in advance of hearing date.

DOCKET: COMMISSION HEARING - TUESDAY - JULY 24, 1979

OIL CONSERVATION COMMISSION - 9 A.M. - ROOM 205
STATE LAND OFFICE BUILDING, SANTA FE, NEW MEXICO

CASE 6596: Application of Harvey E. Yates Company for pool creation and special pool rules, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks the creation of a new Upper Pennsylvanian gas pool to be designated as the Southeast Indian Basin-Upper Pennsylvanian Gas Pool for its Southeast Indian Basin Well No. 1 located in Unit A of Section 23, Township 22 South, Range 23 East, and special pool rules therefor including 320-acre gas well spacing.

CASE 6597: Application of Harvey E. Yates Company for an unorthodox gas well location, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks approval for the unorthodox location of its Southeast Indian Basin Well No. 2, an Upper Pennsylvanian well to be drilled 660 feet from the North and West lines of Section 24, Township 22 South, Range 23 East, with the N/2 or all of said Section 24 to be dedicated to the well, depending on the outcome of Case No. 6596.

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Docket No. 28-79

DOCKET: EXAMINER HEARING - WEDNESDAY - JULY 25, 1979

9 A.M. - OIL CONSERVATION DIVISION CONFERENCE ROOM,
STATE LAND OFFICE BUILDING, SANTA FE, NEW MEXICO

The following cases will be heard before Daniel S. Nutter, Examiner, or Richard L. Stamets, Alternate Examiner:

CASE 6545: (Continued from June 27, 1979, Examiner Hearing)

In the matter of the hearing called by the Oil Conservation Division on its own motion to permit Corinne Grace, Travelers Indemnity Company, and all other interested parties to appear and show cause why the Kuklah Baby Well No. 1 located in Unit G of Section 24, Township 22 South, Range 26 East, Eddy County, New Mexico, should not be plugged and abandoned in accordance with a Division-approved plugging program.

CASE 6598: Application of Gulf Oil Corporation for downhole commingling, Rio Arriba County, New Mexico. Applicant, in the above-styled cause, seeks approval for the downhole commingling of Otero-Gallup and Basin-Dakota production in the wellbores of its Apache Federal Wells No. 8 located in Unit C of Section 8 and No. 9 located in Unit D of Section 17, both in Township 24 North, Range 5 West.

CASE 6599: Application of Gulf Oil Corporation for downhole commingling, Lea County, New Mexico. Applicant, in the above-styled cause, seeks approval for the downhole commingling of Fusselman and Montoya production, North Justis Field, in the wellbore of its W. A. Ramsay Well No. 4 located in Unit M of Section 36, Township 24 South, Range 37 East.

CASE 6600: Application of Mesa Petroleum Company for compulsory pooling, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests in the Morrow formation underlying the E/2 of Section 10, Township 16 South, Range 27 East, to be dedicated to a well to be drilled at a standard location thereon. Also to be considered will be the cost of drilling and completing said well and the allocation of the cost thereof as well as actual operating costs and charges for supervision. Also to be considered will be the designation of applicant as operator of the well and a charge for risk involved in drilling said well.

CASE 6601: Application of Harvey E. Yates Company for compulsory pooling, Lea County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests in the Wolfcamp through Mississippian formations underlying the E/2 of Section 8, Township 14 South, Range 36 East, to be dedicated to a well to be drilled at a standard location thereon. Also to be considered will be the cost of drilling and completing said well and the allocation of the cost thereof as well as actual operating costs and charges for supervision. Also to be considered will be the designation of applicant as operator of the well and a charge for risk involved in drilling said well.

CASE 6602: Application of Tenneco Oil Company for an unorthodox well location, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks approval for the unorthodox location of its Federal 33 C No. 2 well 1010 feet from the North line and 1710 feet from the West line of Section 33, Township 17 South, Range 29 East, South Empire-Wolfcamp Pool, the E/2 NW/4 of said Section 33 to be dedicated to the well.

CASE 6603: (This case will be continued to the August 8 hearing.)

Application of Conoco Inc. for downhole commingling, Lea County, New Mexico. Applicant, in the above-styled cause, seeks approval for the downhole commingling of Penrose Skelly and Eumont production in the wellbore of its Hawk B-1 Well No. 12 located in Unit O of Section 8, Township 21 South, Range 37 East.

CASE 6604: Application of Cities Service Company for rescission of Division Order No. R-5921, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks the rescission of Order No. R-5921 which order provided for the compulsory pooling of all of the mineral interests in the Pennsylvanian formation underlying the S/2 of Section 8, Township 23 South, Range 28 East.

CASE 6605: Application of Estoril Producing Corporation for compulsory pooling and an unorthodox gas well location, Lea County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests in the Morrow formation underlying the W/2 of Section 15, Township 20 South, Range 34 East, to be dedicated to a well to be drilled at an unorthodox location 660 feet from the North and West lines of said Section 15. Also to be considered will be the cost of drilling and completing said well and the allocation of the cost thereof as well as actual operating costs and charges for supervision. Also to be considered will be the designation of applicant as operator of the well and a charge for risk involved in drilling said well.

CASE 6564: (Continued and Readvertised)

Application of Herndon Oil & Gas Co. for an unorthodox oil well location, Lea County, New Mexico. Applicant, in the above-styled cause, seeks approval for the unorthodox location of its O. A. Woody Well No. 1 to be drilled 2310 feet from the North line and 330 feet from the West line of Section 35, Township 16 South, Range 38 East, Knowles-Devonian Pool.

CASE 6606: Application of Getty Oil Company for salt water disposal, Lea County, New Mexico. Applicant, in the above-styled cause, seeks authority to dispose of produced salt water in the Yates formation in the open-hole interval from 3810 feet to 4169 feet in its State "AA" Well No. 1 located in Unit I of Section 35, Township 21 South, Range 34 East.

CASE 6607: Application of Getty Oil Company for a dual completion, Lea County, New Mexico. Applicant, in the above-styled cause, seeks approval for the dual completion of its Getty 36 State Well No. 1 located in Unit F of Section 36, Township 21 South, Range 34 East, to produce oil from the Wolfcamp formation and gas from the Morrow formation through parallel strings of tubing.

CASE 6608: Application of Getty Oil Company for pool creation and special pool rules, Lea County, New Mexico. Applicant, in the above-styled cause, seeks the creation of a new Wolfcamp oil pool for its Getty 36 State Well No. 1 located in Unit F of Section 36, Township 21 South, Range 34 East, and special rules therefor, including 160-acre oil well spacing.

CASE 6609: Application of Napeco Inc. for pool creation and special pool rules, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks the creation of a new Strawn oil pool for its Benson Deep Unit Well No. 1 located in Unit O of Section 33, Township 18 South, Range 30 East, and special rules therefor, including 160-acre spacing and standard well locations.

CASE 6610: Application of Koch Industries, Inc. for salt water disposal, Lea County, New Mexico. Applicant, in the above-styled cause, seeks authority to dispose of produced salt water in the Rustler formation through the perforated interval from 1190 feet to 1210 feet in its Wills "A" Well No. 7 located in Unit E of Section 35, Township 26 South, Range 37 East, Rhodes Field.

CASE 6611: Application of Cabot Corp. for salt water disposal, Lea County, New Mexico. Applicant, in the above-styled cause, seeks approval for the disposal of produced salt water in the Devonian formation through the perforated interval from 12,156 feet to 12,574 feet in its Reed Well No. 1 located in Unit H of Section 35, Township 13 South, Range 37 East, King Field.

CASE 6487: (Continued from May 23, 1979, Examiner Hearing)

Application of El Paso Natural Gas Company for approval of infill drilling, Lea County, New Mexico. Applicant, in the above-styled cause, seeks a waiver of existing well-spacing requirements and a finding that the drilling of its Shell E State Com Well No. 2 located in Unit N of Section 6, Township 21 South, Range 36 East, Eumont Gas Pool, Lea County, New Mexico, is necessary to effectively and efficiently drain that portion of the proration unit which cannot be so drained by the existing well.

CASE 6471: (Continued from May 23, 1979, Examiner Hearing)

Application of Consolidated Oil & Gas, Inc. for approval of infill drilling, San Juan County, New Mexico. Applicant, in the above-styled cause, seeks a waiver of existing well-spacing requirements and a finding that the drilling of its Freeman Well No. 1-A to be located in Unit C of Section 11, Township 31 North, Range 13 West, Basin-Dakota Pool, San Juan County, New Mexico, is necessary to effectively and efficiently drain that portion of the proration unit which cannot be so drained by the existing well.

CASE 6472: (Continued from May 23, 1979, Examiner Hearing)

Application of Consolidated Oil & Gas, Inc. for approval of infill drilling, Rio Arriba County, New Mexico. Applicant, in the above-styled cause, seeks a waiver of existing well-spacing requirements and a finding that the drilling of its Jenny Well No. 1-A to be located in Unit P of Section 13, Township 26 North, Range 4 West, Basin-Dakota Pool, Rio Arriba County, New Mexico, is necessary to effectively and efficiently drain that portion of the proration unit which cannot be so drained by the existing well.

CASE 6473: (Continued from May 23, 1979, Examiner Hearing)

Application of Consolidated Oil & Gas, Inc. for approval of infill drilling, Rio Arriba County, New Mexico. Applicant, in the above-styled cause, seeks a waiver of existing well-spacing requirements and a finding that the drilling of its McIntyre Well No. 1-A to be located in Unit K of Section 11, Township 26 North, Range 4 West, Basin-Dakota Pool, Rio Arriba County, New Mexico, is necessary to effectively and efficiently drain that portion of the proration unit which cannot be so drained by the existing well.

CASE 6474: (Continued from May 23, 1979, Examiner Hearing)

Application of Consolidated Oil & Gas, Inc. for approval of infill drilling, San Juan County, New Mexico. Applicant, in the above-styled cause, seeks a waiver of existing well-spacing requirements and a finding that the drilling of its Williams Well No. 1-A to be located in Unit C of Section 24, Township 31 North, Range 13 West, Basin-Dakota Pool, San Juan County, New Mexico, is necessary to effectively and efficiently drain that portion of the proration unit which cannot be so drained by the existing well.

CASE 6475: (Continued from May 23, 1979, Examiner Hearing)

Application of Consolidated Oil & Gas, Inc. for approval of infill drilling, San Juan County, New Mexico. Applicant, in the above-styled cause, seeks a waiver of existing well-spacing requirements and a finding that the drilling of its Montoya Well No. 1-A to be located in Unit I of Section 35, Township 32 North, Range 13 West, Basin-Dakota Pool, San Juan County, New Mexico, is necessary to effectively and efficiently drain that portion of the proration unit which cannot be so drained by the existing well.

CASE 6535: (Continued from June 13, 1979, Examiner Hearing)

Application of Jorreon Oil Company for a waterflood project, Sandoval County, New Mexico. Applicant, in the above-styled cause, seeks authority to institute a waterflood project in the San Luis-Mesaverde Pool by the injection of water into the Menefee formation through two wells located in Section 21, Township 18 North, Range 3 West, Sandoval County, New Mexico.

CASE 6579: (Continued from June 27, 1979, Examiner Hearing)

Application of R. N. Hillin for an unorthodox well location and approval of infill drilling, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks a waiver of existing well spacing requirements and a finding that the drilling of a Morrow gas well at an unorthodox location 800 feet from the South line and 2000 feet from the East line of Section 34, Township 19 South, Range 28 East, is necessary to effectively and efficiently drain that portion of the E/2 of said Section 34 which cannot be so drained by the existing well.

CASE 6580: (Continued from June 27, 1979, Examiner Hearing) (This case will be continued to the August 22 hearing.)

Application of Continental Oil Company for a carbon dioxide injection project, Lea County, New Mexico. Applicant, in the above-styled cause, seeks authority to initiate a pilot carbon dioxide injection project in the Grayburg-San Andres formation in Units H and I of Section 20, Township 17 South, Range 32 East, Maljamar Pool, for tertiary recovery purposes.

CASE 6270: (Continued from July 11, 1979, Examiner Hearing)

In the matter of Case 6270 being reopened pursuant to the provisions of Order No. R-5771 which order created the South Peterson-Fusselman Pool, Roosevelt County, New Mexico, and provided for 80-acre spacing. All interested parties may appear and show cause why said pool should not be developed on 40-acre spacing units.

CASE 6590: (Continued from July 11, 1979, Examiner Hearing)

Application of Grace Petroleum Corporation for compulsory pooling and an unorthodox gas well location, Lea County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests in the Morrow formation underlying Lots 9, 10, 15, and 16 and the SE/4 of Section 6, Township 21 South, Range 32 East, to be dedicated to a well to be drilled at an unorthodox location 4650 feet from the South line and 660 feet from the East line of said Section 6. Also to be considered will be the cost of drilling and completing said well and the allocation of the costs thereof as well as actual operating costs and charges for supervision. Also to be considered will be the designation of applicant as operator of the well and a charge for risk involved in drilling said well.

PERSONAL DATA

Name: P. T. Hughes, Jr.
Birth Date: August 9, 1947
Address: 8615 Quail Burg Lane
Missouri City, Texas 77459

EDUCATION

Bachelor of Science, Natural Gas Engineering
Texas A & I University, Kingsville, Texas
December, 1973

CONTINUING EDUCATION

IADC Approved Blowout School
Dresser Pressure Detection and Control School
Chenevert & Associates Wellbore Stability Seminar
Safety and Health, Inc. Hydrogen Sulfide Detection and Control
University of Texas Production Engineering Course
University of Texas Reservoir Engineering Seminar

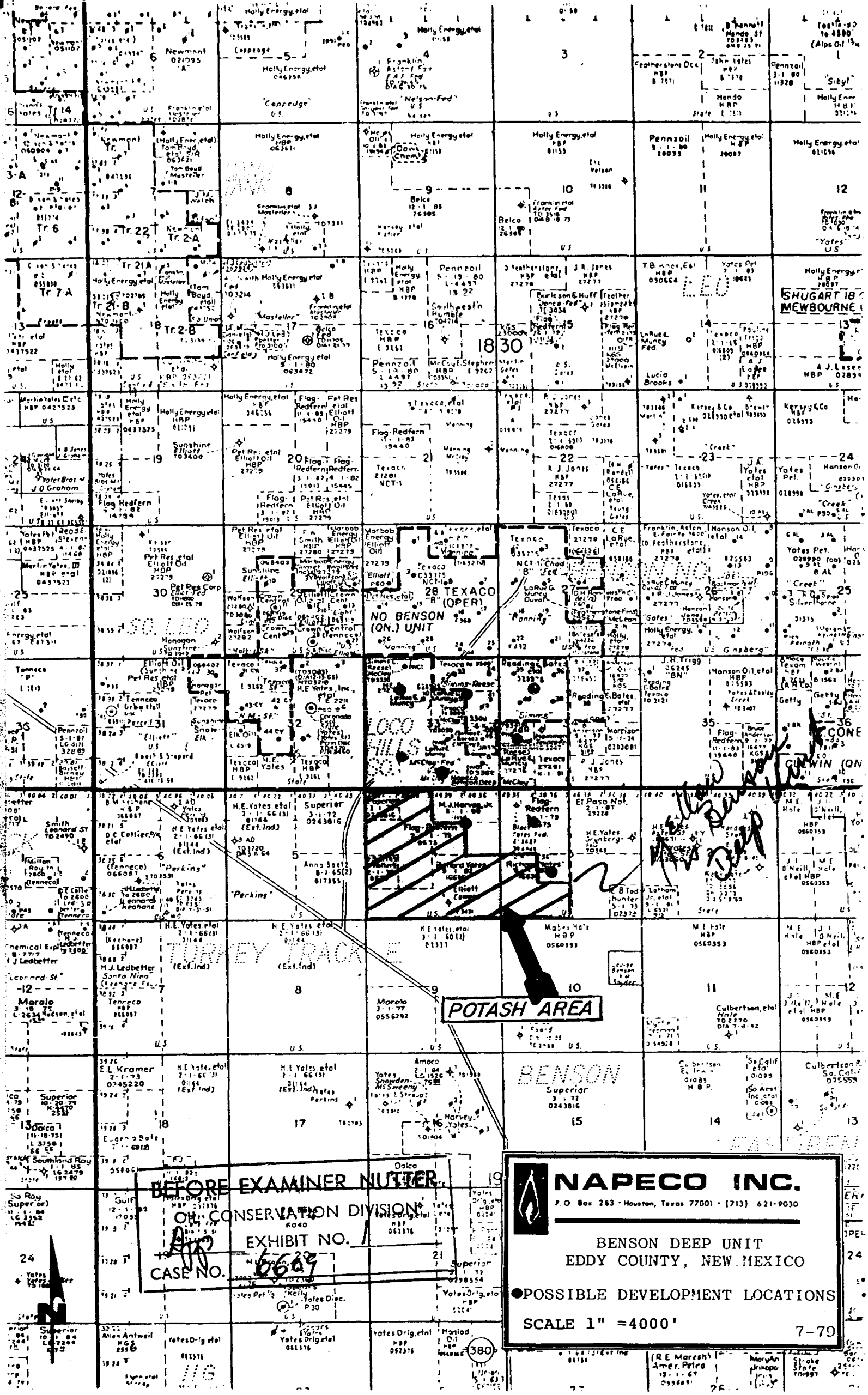
PROFESSIONAL SOCIETIES

Independent Association of Drilling Contractors
American Petroleum Institute
American Institute of Mining and Metallurgical Engineers
Society of Petroleum Engineers
Licensed Professional Engineer, State of Texas - January, 1978

PRESENT JOB RESPONSIBILITIES

As Manager of Drilling & Production for NAPECO, Inc. and NARMCO, Inc. (Del.), subsidiaries of Natural Gas Pipeline Company of America, my responsibilities include overseeing producing properties in a multi-state area, as well as the drilling and completion of properties inland and offshore. I am also in charge of all reservoir engineering and calculation of reserves for company-owned properties.

As Manager of Drilling & Production, I work closely with and report directly to Clyde T. Metz, Vice President of Exploration and Production.



BEFORE EXAMINER NUTTER
OIL CONSERVATION DIVISION
EXHIBIT NO. 6
CASE NO. 6609

NAPECO INC.

P.O Box 283 · Houston, Texas 77001 · (713) 621-9030

BENSON DEEP UNIT
EDDY COUNTY, NEW MEXICO

●POSSIBLE DEVELOPMENT LOCATIONS

SCALE 1" =4000'

7-79

COMPLETION/DRILLING DATA

OPERATOR NAPECO INC. DATE 7-23-79

LEASE/WELL NAME Benson Deep Unit #1

FIELD Wildcat COUNTY Eddy

RESERVOIR Strawn

General Data

ELEVATION: 3,404' G.L.

COMPLETION DATE: 5-9-79

TEST DATE: 5-9-79

CAOF: 104 BOPD, 550 MCFPD, -0- BSWPD w/ 968# FTP on 12/64" ck.

CAOF = 629 MCFPD, GOR = 5720/1

SIBHP: 5440 psig @ 10,720'

PERFORATIONS: 10,648' - 10,718' w/ 33 shots (10,648-56'; 10,671-77'; 10,702-18')

ZONE: Strawn

CASING SETTING SIZE/DEPTH: 13-3/8" @ 448'; 9-5/8" @ 3,494'; 5-1/2" @ 12,065'

TUBING SIZE/DEPTH: 2-7/8" @ 10,543'

TYPE PACKER/SETTING DEPTH: Baker "FB" Pkr. @ 10,543'

based on DST data (1) mud flare dies by 1 hr. 40 ft.

1. The Physical Properties of the reservoir rock
   a. Average Porosity 8%
   b. Average Permeability .036 md based on Sg = .7; vis = .0213 cp, F = .842
   c. Average oil and interstitial water saturations Oil ≈ 7%; SW ave = 20%

2. The characteristics of the reservoir fluids
   a. Average gravity of oil and gas 47.1° API @ 60° F
   b. Salinity of water Unknown
   c. Oil-gas saturation pressure or bubble point, formation volume factor, viscosity & gas solubility at various pressures ASTM Distillation Results: End Point = 637° F; % Residue = 2.50; % Recovery = 97.5%

BEFORE EXAMINER NUTTER
OIL CONSERVATION DIVISION
EXHIBIT NO. 5
CASE NO. 6609

SVD

WOLF PETRO LAB, INC.

DIAL EMERSON 6-9701
DIAL EMERSON 6-7171

2411 WEST 42ND STREET

P. O. BOX 643
ODESSA, TEXAS
79760

HYDROCARBON ANALYSIS

LABORATORY REPORT

Charge Narmco, Inc.
Test No. WPL-79-369
Date of Run 5-10-79
Date Received 5-09-79

A Sample of Liquid Hydrocarbons from Separator - Benson Deep Unit No. 1
Secured from Strawn Formation
At Eddy County New Mexico Secured by
Purpose Date Time
Sampling Conditions

DISTILLATION

I B P	100	°F
5%	135	°F
10%	160	°F
20%	193	°F
30%	222	°F
40%	250	°F
50%	281	°F
60%	335	°F
70%	380	°F
75%	424	°F
80%	450	°F
85%	507	°F
90%	552	°F
95%	606	°F
End Point	637	°F
% Residue	2.50	
% Recovery	97.50	
Color		

YIELD

Gasoline 300°F	54.25	%
Gasoline 350°F	10.75	%
Gasoline 400°F	7.50	%
Total Gasoline	72.50	%
Kerosene 525°F	14.50	%
Diesel Fuel 650°F	10.50	%

ASTM OR SPECIAL TESTING

Ash Content
Acid or Base Numbers
B. S. & W. (Centrifuge)
Carbon Residue
Carbon Residue on 10% Residue
Cloud and Pour Point to °F
Doctor Test
Flash Point (open or closed)
Fire Point
Gravity, A. P. I. Hydrometer 47.10 @ 60°F.
Hydrogen Sulfide (Crude Oil)
Salt Content (Crude Oil)
Sulfur (lamp method) .05191 % By Weight
Vapor Pressure (Reid)
Vapor Pressure (N.G.A.A.)
Vapor Pressure (Lean Oil)
Viscosity (Saybolt) 100°F
Viscosity (Saybolt) 210°F
Viscosity (Index No.)

Run by: J. Wolf Checked by: J. Wolf Approved:

Additional Data and Remarks

COPIES
4 - Mr. Jerry Crews
P.O. Box 283
Houston, Texas 77002
1 - Mr. Jim Reser
404 W. Illinois - Suite D
Midland, Texas 79701
1 - File

NEW MEXICO OIL CONSERVATION COMMSSION

MULTIPOINT AND ONE POINT BACK PRESSURE TEST FOR GAS WELL

Form C-122
Revised 9-1-65

Type Test: ☒ Initial ☐ Annual ☐ Special						Test Date: 5-10-79			
Company: NARMCO, INC.				Connection: TO AIR					
Pool: WILDCAT				Formation: STRAWN				Unit	
Completion Date: 5-5-79		Total Depth: 12,071		Plug Back TD: 11,993		Elevation		Farm or Lease Name: BENSON DEEP UNIT	
Csg. Size: 5 ½	Wt.: 17#	d: 4.892"	Set At: 12,071	Perforations: From 10,648 To 10,718				Well No.: 1	
Tbg. Size: 2 7/8	Wt.: 6.4#	d: 2.441"	Set At: 10,543	Perforations: From OPEN To END				Unit: O Sec.: 33 Twp.: 18 Rge.: 30	
Type Well – Single – Bradenhead – G.G. or G.O. Multiple: SINGLE				Packer Set At: 10,543				County: EDDY	
Producing Thru: TUBING		Reservoir Temp. °F: 181 @ 10,727		Mean Annual Temp. °F: 60		Baro. Press. – P_a: 13.2		State: N.M.	
L: 10,727	H: 10,727	Gg: .757	% CO_2: 75	% N_2: 2.03	% H_2S:	Prover	Meter Run: 4	Taps: FLG.	

	FLOW DATA					TUBING DATA		CASING DATA		
NO.	Prover Line Size	X Orifice Size	Press. p.s.i.g.	Diff. h_w	Temp. °F	Press. p.s.i.g.	Temp. °F	Press. p.s.i.g.	Temp. °F	Duration of Flow
SI						2920				72 HRS.
1.	4	x 1.250	515	4.2	79	1575	72			1 HR.
2.	4	x 1.250	515	4.2	86	1432	73			1 HR.
3.	4	x 1.250	515	6.0	90	1228	75			1 HR.
4.	4	x 1.250	515	5.5	90	985	76			1 HR.
5.										

RATE OF FLOW CALCULATIONS

NO.	Coefficient (24 Hour)	$\sqrt{h_w P_m}$	Pressure P_m	Flow Temp. Factor Ft.	Gravity Factor Fg	Super Compress. Factor, Fpv	Rate of Flow Q, Mcfd
1	7.469	47.10	528.2	.9822	1.149	1.067	424
2.	7.469	47.10	528.2	.9759	1.149	1.064	420
3.	7.469	56.30	528.2	.9723	1.149	1.062	499
4.	7.469	53.90	528.2	.9723	1.149	1.062	478
5.							

NO.	P_t	Temp. °R	T_t	Z
1.	.80	539	1.33	.878
2.	.80	546	1.35	.883
3.	.80	550	1.36	.886
4.	.80	550	1.36	.886
5.				

Gas Liquid Hydrocarbon Ratio 6,993 Mcf/bbl.
A.P.I. Gravity of Liquid Hydrocarbons 49.9 @ 60 Deg.
Specific Gravity Separator Gas .757 XXXXXXXXXX
Specific Gravity Flowing Fluid XXXXX
Critical Pressure 664 P.S.I.A. ____ P.S.I.A.
Critical Temperature 405 R ____ R

* P_c 4,129.5 P_c^2 17,052.8

NO	P_t^2	P_w	P_w^2	$P_c^2 - P_w^2$
1	*	3051.8	9,313.5	7,739.3
2	*	2837.2	8,049.7	9,003.1
3	*	2432.0	5,915.6	11,137.2
4	*	2002.5	4,010.0	13,042.8
5				

(1) $\frac{P_c^2}{P_c^2 - P_w^2} = 2.203$ (2) $\left[\frac{P_c^2}{P_c^2 - P_w^2}\right]^n = 1.484$

AOF = Q $\left[\frac{P_c^2}{P_c^2 - P_w^2}\right]^n = .629$

Absolute Open Flow 629 Mcfd @ 15.025 Angle of Slope θ 63.5 Slope, n .500

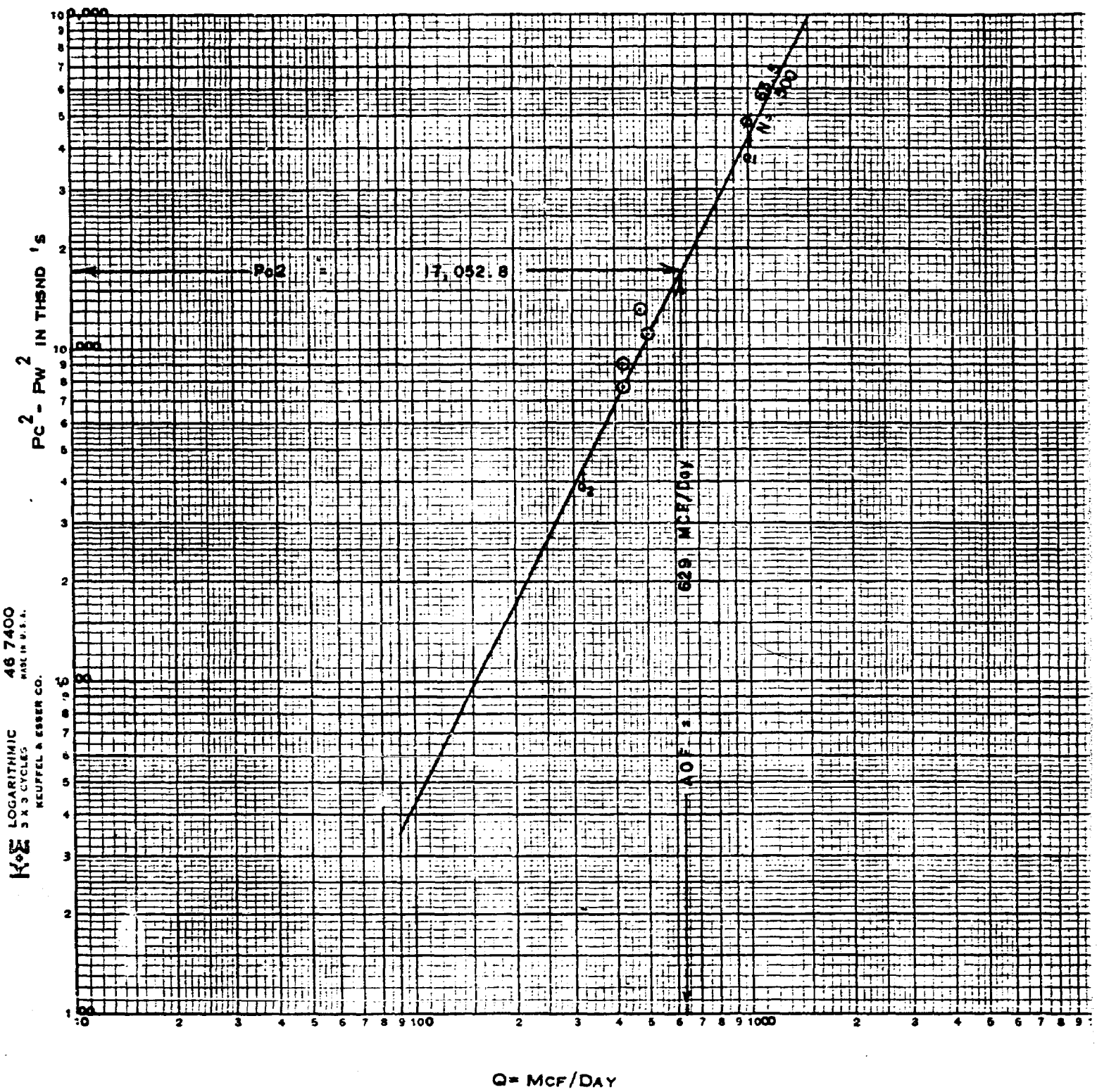
Remarks: * CALCULATED FROM KNOWN B.H.P.. POINT ALIGNMENT WAS TOO STEEP AND 63.5° SLOPE WAS THROUGH LOW RATE OF FLOW, BOTTOM HOLE PRESSURES MEASURED WITH KUSTER GAUGE.
21.7 BBLS COND. MADE DURING TEST.

Approved By Commission:	Conducted By:	Calculated By:	Checked By:
	M.B.	R.R.	J.W.W.

NARMCO, INC. BENSON DEEP UNIT # 1 MAY 10, 1979

ABS. SLOPE (N) Q_1 =1012 = 3.005149
Q_2 = 320 = 2.505149
N= .500000

$$CAOF = 424\left(\frac{17052.8}{7739.3}\right)^{.500} = 629 \text{ MCF/DA}$$



NEW-TEX LAB
P. O. BOX 1161
HOBBS, N.M. 88240

No. 1233
Run No.
Date of Run 5-11-79
Date Secured 5-10-79

CERTIFICATE OF ANALYSIS

A Sample of Benson Deep Unit #1 Normco Inc.
Secured from West Engineering
At 412 N. Dal Paso
Hobbs, N. M. 88240
Secured by
Time Date
Sampling conditions Press
Temp.

FRACTIONAL ANALYSIS

Percentage Composition

	MOL %	LIQ. %	G.P.M.
Carbon Dioxide	1.00		
Air			
Nitrogen	2.42		
Oxygen			
Hydrogen sulfide			
Hydrogen			
Methane	71.01		
Ethane	15.91		4.243
Propane	6.79		1.869
Butanes			
Iso-Butane	.46		.151
N-Butane	1.53		.481
Pentanes			
Iso-Pentane	.27		.098
N-Pentane	.25		.090
Hexanes	.15		.061
Heptanes	.21		.894
Octanes			
TOTAL	100.000		7.887

Calc. Sp. Gr.— 0.7645
Calc. A.P.I.—
Calc. Vapor Press.— PSI
Sp. Gr.
Mol. Wt.

LIQUID CONTENT (GAL./MCF)

Propane Calc. G.P.M.	1.869
Butanes Calc. G.P.M.	.632
Pentanes Plus. G.P.M.	1.143
Ethane Calc. G.P.M.	4.243
___ RVP Gasoline G.P.M.	

B.T.U./Cu. Ft. @ 14.696 P.S.I.A.

Dry Basis	1274
Wet Basis	1251

Sulfur Analysis by Titration Gr./100 Cu. Ft.

Hydrogen Sulfide	
Mercaptans	
Sulfides	
Residual Sulfur	
Total Sulfur	

Run by Deane Simpson Checked by Approved by Deane Simpson

Additional Data and Remarks

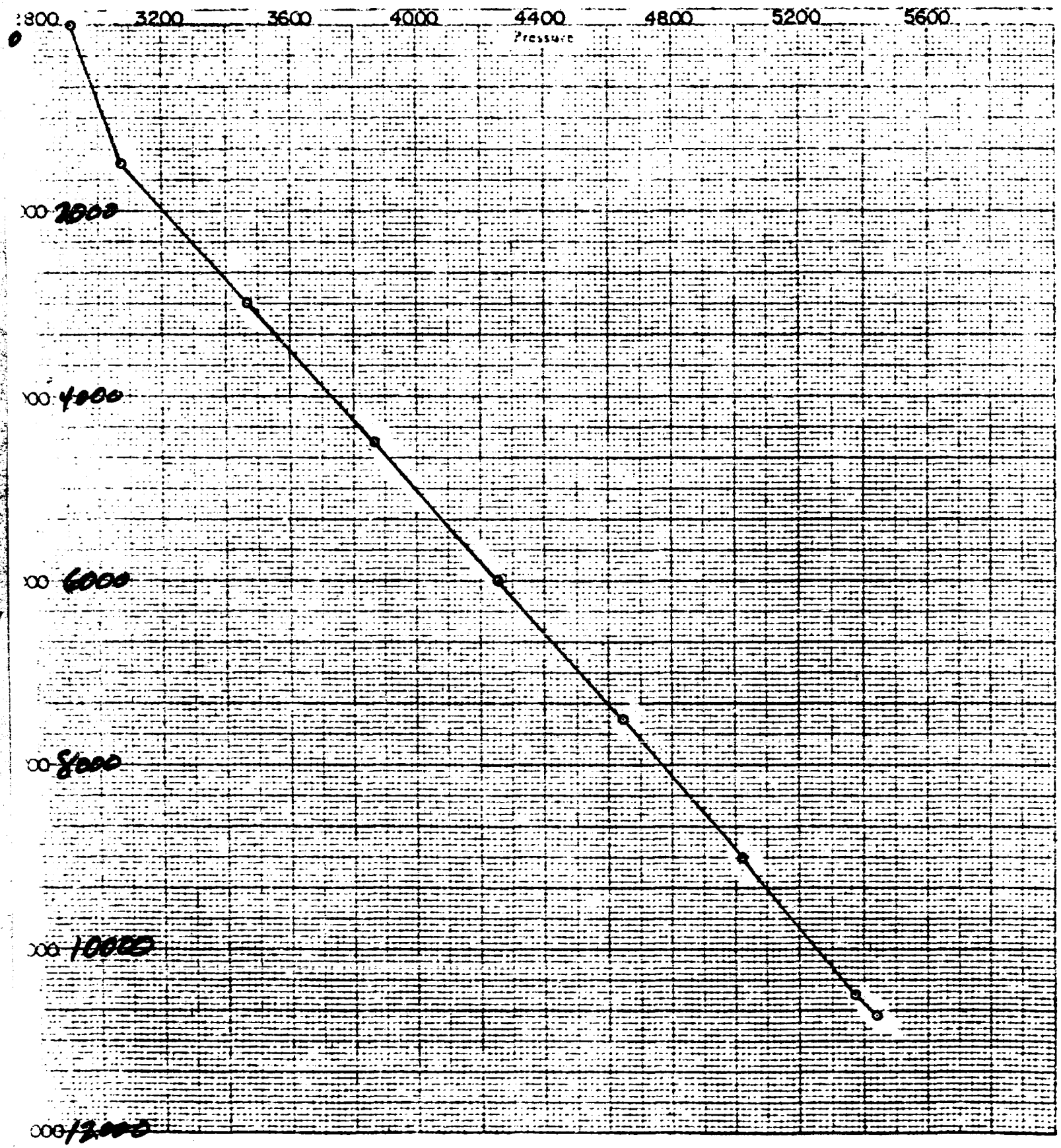
JOHN W WEST ENGINEERING COMPANY
[illegible] NORTH DAL PASO HOBBS, NEW MEXICO

TELEPHONES [illegible]

BOTTOM HOLE PRESSURE SURVEY REPORT

[illegible]ATOR	NARMCO, INC.		
[illegible]	BENSON DEEP UNIT		
[illegible] NO	1		
[illegible]			
[illegible]	5-10-72 TIME	12:1[illegible] PM	
[illegible]	SHUT-IN TEST DEPTH	10,720'	
[illegible]	34 HRS. LAST TEST DATE		
[illegible]	BHP LAST TEST		
[illegible]	2918 PSIG HP CHANGE		
[illegible]	3408 GR. [illegible] TOP	1,350'	
[illegible]	WATER TOP		
[illegible]	181 F. [illegible] BY	M.D.	
[illegible] NO	4052 GAUGE NO	19389	
[illegible]MENT NO. 34912 (0-3000 PSI)			

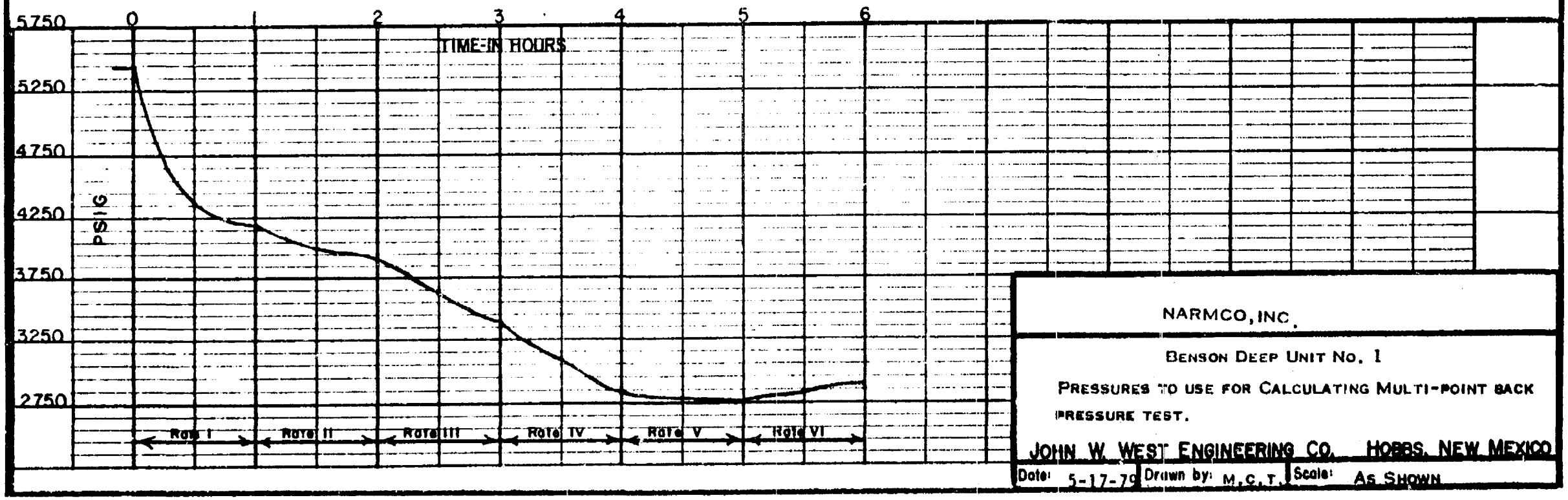
DEPTH	PRESSURE	GRADIENT
000	2918	
1500	3077	.106
3000	3467	.260
4500	3866	.266
6000	4258	.261
7500	4645	.258
9000	5020	.250
10500	5372	.235
10720	5440	.309



TIME	PSIG @ 10,720'	TIME	PSIG @ 10,720'
12:30 PM	5440 OPEN CHOKE, BEGIN TEST		
12:45	4714	3:45 PM	3240
1:00	4379	4:00	3098
1:15	4230	4:15	2951
1:30	4181 END RATE I	4:30	2829 END RATE IV
1:45	4093	4:45	2796
2:00	4016	5:00	2784
2:15	3967	5:15	2776
2:30	3919 END RATE II	5:30	2763 END RATE V
2:45	3780	5:45	2804
3:00	3618	6:00	2837
3:15	3504	6:15	2865
3:30	3407 END RATE III	6:30	2878 END RATE VI

TEST DATE: MAY 10, 1979
TEST DEPTH: 10,720 FEET

ELEMENT NO. 34912 (0-8000 PSI)
CLOCK NO. 4052 (0-12 HRS.)



NARMCO, INC.

BENSON DEEP UNIT NO. 1

PRESSURES TO USE FOR CALCULATING MULTI-POINT BACK PRESSURE TEST.

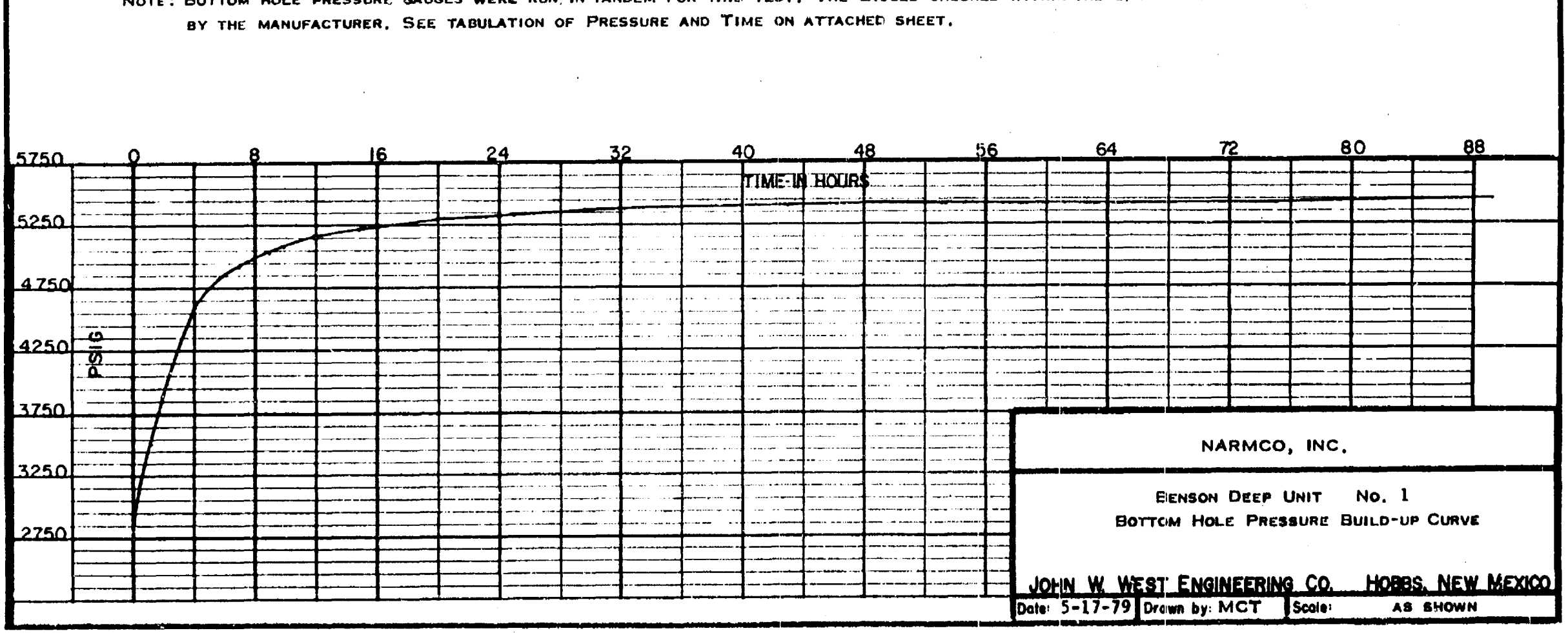
JOHN W. WEST ENGINEERING CO. HOBBS, NEW MEXICO

Date: 5-17-79 Drawn by: M.C.T. Scale: AS SHOWN

TEST DATE: MAY 10 TO 13, 1979
TEST DEPTH: 10,720 FEET

ELEMENT NO.: 34912
RANGE: 0-800 PSI
ELEMENT NO.: 8534
RANGE: 0-5600 PSI
CLOCK NO.: 20439
RANGE: 0-72 HOUR
CLOCK NO.: E-6532
RANGE: 0-72 HOUR

NOTE: BOTTOM HOLE PRESSURE GAUGES WERE RUN IN TANDEM FOR THIS TEST. THE GAUGES CHECKED WITHIN THE 1/10 OF 1% ACCURACY SPECIFIED BY THE MANUFACTURER. SEE TABULATION OF PRESSURE AND TIME ON ATTACHED SHEET.



NARMCO, INC.

BENSON DEEP UNIT No. 1
BOTTOM HOLE PRESSURE BUILD-UP CURVE

JOHN W. WEST ENGINEERING CO. HOBBS, NEW MEXICO

Date: 5-17-79 | Drawn by: MCT | Scale: AS SHOWN

NARMCO, INC.
BENSON DEEP UNIT NO. 1
BOTTOM HOLE PRESSURE BUILD-UP TEST
TABULATION OF PRESSURE AND TIME

TEST COUCTED BY:
JOHN WEST ENGINEERING

TEST DATE: MAY 10 TO 13, 1979
TEST DEPTH: 10,720 FEET
ELEMENT NO.: 34912 (0-8000 PSI)
OPER.: M.B. & M.R.

DATE	TIME	CUM. HRS./MIN.		PSIG @ 10,720 FEET
		00 HRS	00 MIN	
5-10-79	6:30 PM			2878 SHUT-IN
5-10-79	7:45	01	15	3528 BACK TO 10,720 FEET
	8:00	01	30	3642
	8:15	01	45	3780
	8:30	02	00	3898
	9:00	02	30	4165
	9:30	03	00	4327
	10:00	03	30	4472
	10:30	04	00	4601
5-10-79	11:30 PM	05	00	4750
5-11-79	12:30 AM	06	00	4859
	1:30	07	00	4931
	2:30	08	00	4996
	3:30	09	00	5040
	4:30	10	00	5080
	6:30	12	00	5152
	9:30 AM	15	00	5224
	2:30 PM	20	00	5300
5-11-79	7:30 PM	25	00	5340
5-12-79	12:30 AM	30	00	5368
	5:30	35	00	5388
	10:30 AM	40	00	5404
5-12-79	8:30 PM	50	00	5424
5-13-79	6:30 AM	60	00	5432
5-13-79	7:45 PM	75	15	5436 CHART RAN DOWN, END TEST
4-14-79	10:00 AM	89	30	5448 OFF BOTTOM

ESTIMATED RECOVERY

"STRAWN SECTION"
BENSON DEEP UNIT #1
EDDY COUNTY, NEW MEXICO

VOLUMETRIC CALCULATION

BEFORE EXAMINER NUTTER
OIL CONSERVATION DIVISION
EXHIBIT NO. 6
CASE NO. 6609

ϕ = 8%

S_W = 20%

$FVF_{(1)}$ = 1.11

Reservoir Oil = $7758 \times \phi \times (1-S_W)$

= $7758 \times .08 \times (1-20)$

= 496 Reservoir Bbls/Ac-Ft

Recovery Factor = 40%

Recoverable Reservoir Oil = 198 Reservoir Bbls/Ac-Ft

Stock Tank Oil = $\frac{198}{1.11}$ Bbls/Ac-Ft = 178 STB/Ac-Ft

Assume Average Pay Thickness = 25'

Drainage, Acres	Recoverable Oil, STB
20	3,560
40	178,000
80	356,000
160	712,000
320	1,424,000
640	2,848,000

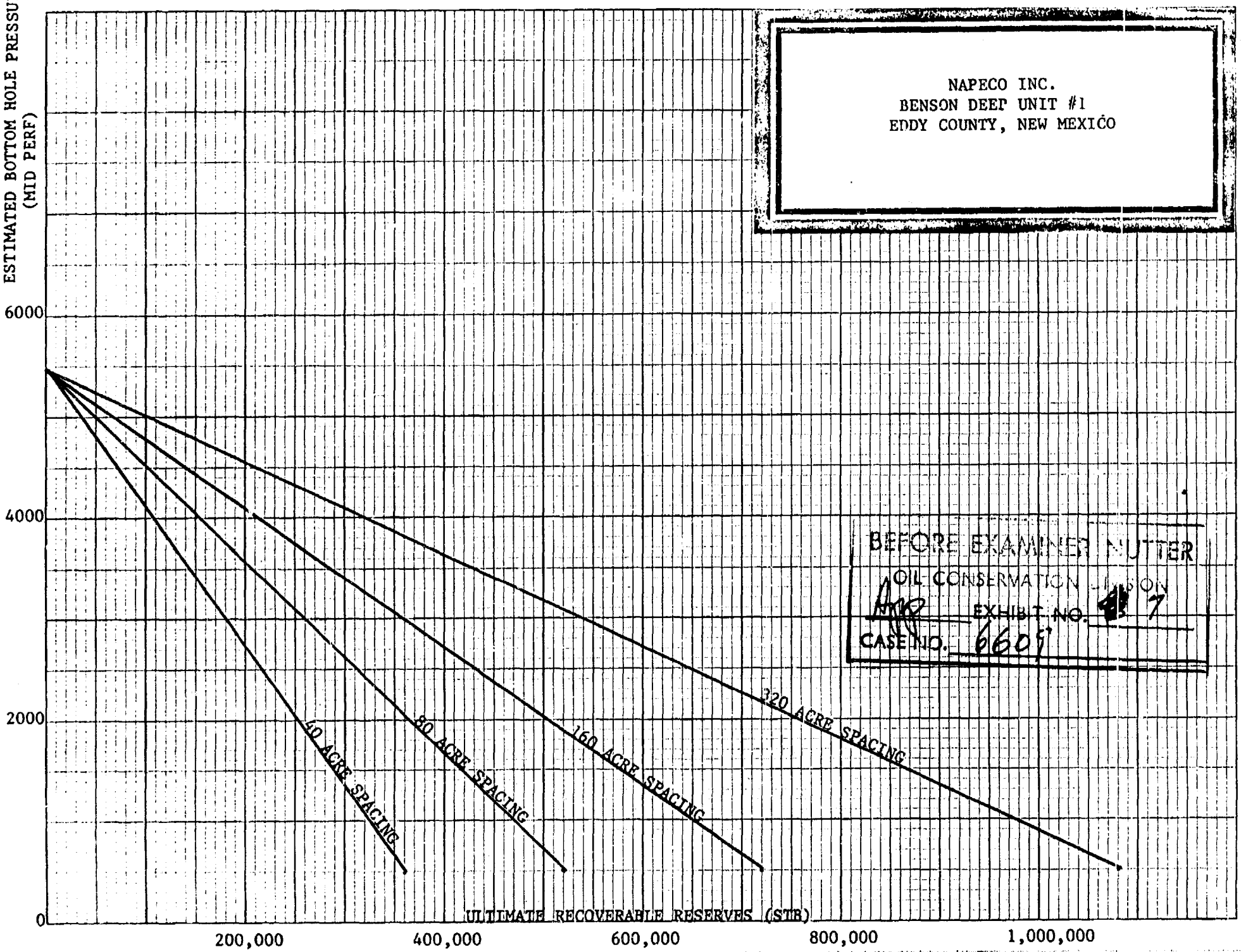
#1 650,000 dry hole AFE completed as 3rd tank battery. Recent #1 mile (was drilled to Morrow @ 12000+ PB to Strawn @ 10700

(1) From M. B. Standing, "Volumetric and Phase Behavior of Oil Field Hydrocarbon Systems", New York; Reinhold Publishing Corporation, 1952.

K·E 10 X 10 TO 5/6 INCH • 7 1/2 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 1020

NAPECO INC.
BENSON DEEP UNIT #1
EDDY COUNTY, NEW MEXICO



BEFORE EXAMINER NUTTER
OIL CONSERVATION DIVISION
EXHIBIT NO. 7
CASE NO. 6609

RESUME

CURTIS A. ANDERSON
NAPECO INC.

Education:

3/71 - 8/74	B. A. 8/74, University of Minnesota, Duluth Branch, Duluth Minnesota, Major in Geology
8/74 - 5/76	M. A. 5/76, University of North Dakota, Grand Forks, North Dakota, Major in Quarternary Geology, Minor in Economic Geology
11/76	AAPG Continuing Education Course, "Exploration for Sandstone Stratigraphic Traps," Dr. Robert R. Berg
5/78	AAPG Continuing Education Course, "Model Studies of Geologic Structures as Applied to Hydrocarbon Exploration," John K. Sales
5/78	Core Lab School, Fundamentals of Core Analysis
10/78	Schlumberger Cased Hole Seminar
2/26/79 - 3/9/79	AAPG Petroleum Exploration School, Topics:

1. Basin Assessment, Hunter Yarborough
2. Stratigraphic Principles in Petroleum Exploration, Dr. Robert J. Weimer
3. Exploration for Sandstone Reservoirs, Dr. Robert R. Berg
4. Exploration for Carbonate Reservoirs, Dr. Clyde H. Moore
5. Computer Applications by Petroleum Geologists. C. F. Iglehart

6. Gravity and Magnetic Interpretations, Dr. Thomas R. Lafehr

7. Seismic Exploration, Dr. R. E. Sheriff, Dr. F. J. Hilterman, and Dr. M. B. Dobrin

8. Remote Sensing, Dr. E. F. Sabins

9. Digital Well Logs in Exploration, Mr. P. L. Work

10. Pore Pressure, D. E. Powley and P. E. Gretener

11. Application of Organic Geochemistry, Dr. J. M. Hunt

12. Exploration Economics, E. C. Capen

13. Land Acquisition Techniques, R. G. Woodard

Professional Experience:

6/76 - 6/77	Geologist, NAPECO Inc., Houston, Texas Exploration, West Texas and Southeast New Mexico, primarily deep, gas-bearing formations.
7/77 - 4/78	Associate Hydrologist, Kansas Water Resources Board, Topeka, Kansas Study Kansas groundwater quantity and quality problems.
5/78 - Present	Geologist, NAPECO Inc., Midland, Texas Exploration, Southeast New Mexico, primarily Pennsylvanian system.

Memo

From

To Set for hearing and notify Napeco
Applicant seeks creation
of a new Strawn oil
Pool and the adoption
of special rules therefor, ...
including a provision for
320-acre spacing and
proration unit, standard well
locations, and infill drilling.

OIL CONSERVATION COMMISSION-SANTA FE

ENERGY AND MINERALS DEPARTMENT

OIL CONSERVATION DIVISION
ARTESIA DISTRICT OFFICE

BRUCE KING
GOVERNOR

LARRY KEHOE
SECRETARY

P.O. DRAWER DD
ARTESIA, NEW MEXICO 88210
(505) 746-4351

June 25, 1979

Case 6609

Napeco, Inc.
P. O. Box 283
Houston, Texas 77001

Re: Benson Deep Unit
#1-O-33-18-30
Eddy County, NM

Gentlemen:

According to our records, the subject well is classified as an oil well, and a hearing will be required to establish 320-acre spacing and temporary field rules. Therefore, your letter is being forwarded to our Santa Fe office.

Sincerely,

W. A. Gressett

W. A. Gressett
Supervisor, District II

WAG:ar
Xc: Mr. R. L. Stamets ✓
P. O. Box 2088
Santa Fe, NM 87501

NAPECO INC.

P.O. Box 283 • Houston, Texas • 77001 • (713) 621-9030

RECEIVED

JUN 22 1979

O. C. C.
ARTESIA, OFFICE

June 19, 1979

Re: Benson Deep Unit #1
Lea County, New Mexico

Case 6609

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

Gentlemen:

NAPECO hereby requests that the Conservation Commission grant 320 acre spacing, with an option to drill a second well, under temporary field rules. This is requested due to the uncertainty, at this stage, of the anticipated reserves from the well.

If a hearing will be required on this request, it will be appreciated if you will let us know the date of the hearing at your earliest convenience.

Should different spacing be justified in the future, we will file another request.

Very truly yours,

NAPECO Inc.

P. T. Hughes, Jr., P. E.
Drilling & Production Manager

yld

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION

BRUCE KING
GOVERNOR

LARRY KEHOE
SECRETARY

POST OFFICE BOX 2088
STATE LAND OFFICE BUILDING
SANTA FE, NEW MEXICO 87501
(505) 827-2434

July 2, 1979

Mr. P. T. Hughes, Jr.
Drilling & Production Manager
Napeco Inc.
P. O. Box 283
Houston, Texas 77001

Dear Mr. Hughes:

Your application dated June 19, 1979, for pool creation and special pool rules including a provision for 320-acre spacing for your Benson Deep Unit Well No. 1 has been received in this office.

A hearing will be required for this application and you have been placed on the docket for the July 25 hearing. A copy of the docket will be forwarded to you within the next week.

Yours very truly,

Florene Davidson
Administrative Secretary

ROUGH

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION

IN THE MATTER OF THE HEARING
CALLED BY THE OIL CONSERVATION
DIVISION FOR THE PURPOSE OF
CONSIDERING:

CASE NO. 6609

Order No. R-6129

APPLICATION OF NAPECO INC. FOR POOL CREATION AND SPECIAL RULES, EDDY COUNTY, NEW MEXICO

ORDER OF THE DIVISION

BY THE DIVISION:

This cause came on for hearing at 9 a.m. on July 25, 1979, at Santa Fe, New Mexico, before Examiner Daniel S. Nutter.

NOW, on this _____ day of September, 1979, the Division Director, having considered the testimony, the record, and the recommendations of the Examiner, and being fully advised in the premises,

FINDS:

(1) That due public notice having been given as required by law, the Division has jurisdiction of this cause and the subject matter thereof.

(2) That the applicant, Nepeco Inc, seeks the creation of a new pool for Strawn production, said pool having been discovered by applicant's Benson Deep Unit Well No. 1, located in Unit O of Section 33, Township 18 South, Range 30 East, NMPM, Eddy County, New Mexico, which well was completed in the Strawn formation on May 9, 1979, with an initial potential of 104 barrels of oil per day from perforations 10,648 feet to 10,718 feet.

(3) That the applicant further seeks the promulgation of special rules for said pool, including a provision for 160-~~acre~~ acre spacing and proration units and standard well ~~spacing~~ locations.

(4) That the applicant has failed to establish that one well can efficiently and effectively drain 160 acres, ~~even on a temporary basis~~

(5) That the evidence adduced at the hearing would indicate that the Strawn formation in the subject well is of poor permeability, and that approval of 160-acre spacing, even on a temporary basis, might cause waste.

(6) That the creation of a new oil pool for the subject well should be handled in a regular nomenclature case by the Division.

(7) That the application in the subject case should be denied.

(over)

IT IS THEREFORE ORDERED:

(1) That the application of Napeco Inc for creation of a new oil pool for Strawn production and the promulgation of special rules therefor, including a provision for 160-acre spacing and proration units and standard well locations, is hereby denied.

(2) Jurisdiction

DONE at

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION

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

CASE NO. 6609 DE NOVO
Order No. R-6129-A

APPLICATION OF NAPECO INC. FOR
POOL CREATION AND SPECIAL POOL
RULES, EDDY COUNTY, NEW MEXICO.

ORDER OF THE COMMISSION

BY THE COMMISSION:

This cause came on for hearing De Novo at 9 a.m. on April 16, 1980, at Santa Fe, New Mexico, before the Oil Conservation Commission of New Mexico, hereinafter referred to as the "Commission."

NOW, on this 14th day of May, 1980, the Commission, a quorum being present, having considered the testimony, the record, and the exhibits, and being fully advised in the premises,

FINDS:

(1) That due public notice having been given as required by law, the Division has jurisdiction of this cause and the subject matter thereof.

(2) That the applicant, Napeco Inc., seeks the creation of a new pool for Strawn production in Eddy County, New Mexico, and the promulgation of special rules therefor, including a provision for 160-acre spacing and proration units.

(3) That this cause came on for hearing before Examiner Daniel S. Nutter on July 25, 1979, and the Division entered its Order No. R-6129 on October 10, 1979, denying the application on the grounds that the applicant had failed to establish that one well could effectively and efficiently drain 160 acres.

(4) That on November 4, 1979, Napeco Inc. filed timely application for Hearing De Novo of Case No. 6609, whereupon this matter was set for hearing on November 27, 1979.

(5) That Case No. 6609 came on for Hearing De Novo on November 27, 1979, and was continued to several subsequent hearing dates, finally being heard on April 16, 1980.

(6) That subsequent to filing its application for Hearing De Novo, applicant modified its application, alleging that the subject reservoir is a volatile oil reservoir.

(7) That the evidence indicates that applicant's Benson Deep Unit Well No. 1, located in Unit O of Section 33, Township 18 South, Range 30 East, NMPM, Eddy County, New Mexico, has discovered a separate common source of supply in the Strawn formation which should be designated the Benson-Strawn Pool; that the vertical limits of the pool should be the Strawn formation, and that the horizontal limits of said pool should be as follows:

TOWNSHIP 18 SOUTH, RANGE 30 EAST, NMPM
Section 33: SE/4

(8) That in order to prevent the economic loss caused by the drilling of unnecessary wells, to avoid the augmentation of risk arising from the drilling of an excessive number of wells, to prevent reduced recovery which might result from the drilling of too few wells, and to otherwise prevent waste and protect correlative rights, special rules and regulations providing for 160-acre spacing units should be promulgated for the Benson-Strawn Pool.

(9) That the special rules and regulations should provide for limited well locations in order to assure orderly development of the pool and protect correlative rights.

(10) That the evidence presented demonstrated that said Benson-Strawn Pool should be assigned a special allowable of 70 barrels of oil per day pending further testing and establishment of a permanent optimum producing rate for wells in said pool.

(11) That during the first 90 days of actual production the applicant should conduct tests on its well in said Benson-Strawn Pool designed to establish the optimum producing rate for oil and gas from wells in said pool.

(12) That the results of such tests should be submitted to the Director of the Oil Conservation Division within 30 days following completion thereof.

(13) That the Director of the Division should be authorized to administratively establish a special depth bracket allowable and gas-oil ratio limitation for the Benson-Strawn Pool based upon the results of the tests set out above, or, at his option, set this matter for public hearing.

IT IS THEREFORE ORDERED:

(1) That effective June 1, 1980, a new pool in Eddy County, New Mexico, classified as an oil pool for Strawn production, is hereby created and designated the Benson-Strawn Pool, with vertical limits comprising the Strawn formation and horizontal limits comprising the following-described area:

TOWNSHIP 18 SOUTH, RANGE 30 EAST, NMPM
Section 33: SE/4

(2) That Special Rules and Regulations for the Benson-Strawn Pool, Eddy County, New Mexico, are hereby promulgated as follows:

SPECIAL RULES AND REGULATIONS
FOR THE BENSON-STRAWN POOL

RULE 1. Each well completed or recompleted in the Benson-Strawn Pool or in the Strawn formation within one mile of the Benson-Strawn Pool, and not nearer to nor within the limits of another designated Strawn pool, shall be spaced, drilled, operated, and prorated in accordance with the Special Rules and Regulations hereinafter set forth.

RULE 2. Each well completed or recompleted in the Benson-Strawn Pool shall be located on a unit containing 160 acres, more or less, substantially in the form of a square, which is a quarter section being a legal subdivision of the United States Public Lands Survey.

RULE 3. Each well completed or recompleted in said pool shall not be drilled closer than 660 feet to any quarter section line nor closer than 330 feet to any quarter-quarter section line.

RULE 4. For good cause shown, the Division Director may grant an exception to the requirements of Rule 2 without notice and hearing when the application is for a non-standard unit comprising less than 160 acres. All operators offsetting the proposed non-standard unit shall be notified of the application by registered or certified mail, and the application shall state that such notice has been furnished. The Division Director may

approve the application if, after a period of 30 days, no offset operator has entered an objection to the formation of such non-standard unit.

The allowable assigned to any such non-standard unit shall bear the same ratio to an established allowable in the Benson-Strawn Pool as the acreage in such non-standard unit bears to 160 acres.

RULE 5. A standard proration unit (158 through 162 acres) in the Benson-Strawn Pool shall be assigned a depth bracket allowable of 70 barrels, subject to the market demand percentage factor, and in the event there is more than one well on a 160-acre proration unit, the operator may produce the allowable assigned to the unit in any proportion.

IT IS FURTHER ORDERED:

(1) That the special depth bracket allowable set forth in Rule 5 above shall remain in effect pending establishment of a permanent depth bracket allowable and gas-oil ratio limit for said pool.

(2) That during the first 90 days of production the applicant shall conduct tests on said Benson Deep Unit Well No. 1 to establish the optimum producing rate for oil and gas from wells in said Benson-Strawn Pool, provided however, that there shall be no gas-oil ratio limitation in effect in said pool until a permanent depth bracket allowable and gas-oil ratio limitation for said pool has been established.

(3) That the applicant shall submit the results of such tests to the Director of the Division within 30 days following the close of the 90-day test period.

(4) That based upon the results of such tests the Director of the Division may administratively revise the special depth bracket allowable set forth in Rule 5 above and may establish a special gas-oil ratio limit for the Benson-Strawn Pool, or, at his option, he may set the matter for public hearing.

(5) That the locations of all wells presently drilling to or completed in the Benson-Strawn Pool or in the Strawn formation within one mile thereof are hereby approved; that the operator of any well having an unorthodox location shall notify the Artesia district office of the Division in writing of the name and location of the well on or before June 1, 1980.

(6) That, pursuant to Paragraph A. of Section 70-2-18, NMSA 1978, contained in Chapter 271, Laws of 1969, existing wells in the Benson-Strawn Pool shall have dedicated thereto 160 acres in accordance with the foregoing pool rules; or, pursuant to Paragraph C. of said Section 70-2-18, existing wells may have non-standard spacing or proration units established by the Division and dedicated thereto.

Failure to file new Forms C-102 with the Division dedicating 160 acres to a well or to obtain a non-standard unit approved by the Division within 60 days from the date of this order shall subject the well to cancellation of allowable. Until said Form C-102 has been filed or until a non-standard unit has been approved, and subject to said 60-day limitation, each well presently drilling to or completed in the Benson-Strawn Pool or in the Strawn formation within one mile thereof shall receive no more than one-quarter of a standard allowable for the pool.

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

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

STATE OF NEW MEXICO
OIL CONSERVATION COMMISSION

ALEX J. ARMIJO, Member

EMERY C. ARNOLD, Member

JOE D. RAMEY, Member & Secretary

S E A L

fd/

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION

BRUCE KING
GOVERNOR

LARRY KEHOE
SECRETARY

POST OFFICE BOX 2088
STATE LAND OFFICE BUILDING
SANTA FE, NEW MEXICO 87501
(505) 827-2434

Re: CASE NO. 6609
ORDER NO. R-6129-A

Mr. A. J. Losee
Losee, Carson & Dickerson
Attorneys at Law
Post Office Box 239
Artesia, New Mexico 88210

Applicant:

Dear Sir:

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

Yours very truly,

JOE D. RAMEY
Director

JDR/fd

Copy of order also sent to:

Hobbs OCC x
Artesia OCC x
Aztec OCC

Other

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION
STATE LAND OFFICE BLDG.
SANTA FE, NEW MEXICO
16 April 1980

COMMISSION HEARING

IN THE MATTER OF:

Application of Napeco, Inc., for pool creation and special pool rules, Eddy County, New Mexico. CASE 6609

BEFORE: Commissioner Ramey
Commissioner Armijo

TRANSCRIPT OF HEARING

A P P E A R A N C E S

For the Oil Conservation Commission: Ernest L. Padilla, Esq.
Legal Counsel to the Commission
State Land Office Bldg.
Santa Fe, New Mexico 87501

For the Applicant: A. J. Losee, Esq.
LOSEE, CARSON, & DICKERSON
Artesia, New Mexico

SALLY W. BOYD, C.S.R.
Rt. 1 Box 193-B
Santa Fe, New Mexico 87501
Phone (505) 455-7409

I N D E X

PEYTON YATES

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Santa Fe, New Mexico 87501
Phone (505) 455-7409

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Santa Fe, New Mexico 87501
Phone (505) 455-7409

COMMISSIONER RAMEY: The hearing will come to order.

We'll call Case 6609.

MR. PADILLA: Application of Napeco, Inc., for pool creation and special pool rules, Eddy County, New Mexico.

MR. LOSEE: A. J. Losee of Losee, Carson, and Dickerson, Artesia, New Mexico, appearing on behalf of the Applicant.

I have four witnesses.

COMMISSIONER RAMEY: Any other appearances?

I'd ask that the witnesses stand and be sworn at this time.

(Witnesses sworn.)

PEYTON YATES

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

DIRECT EXAMINATION

BY MR. LOSEE:

Q Will you state your name, residence, and occupation?

SALLY W. BOYD, C.S.R.
Rt. 1 Box 193-B
Santa Fe, New Mexico 87501
Phone (505) 455-7409

A. My name is Peyton Yates. I live in Artesia, New Mexico, and I'm a petroleum engineer.

Q. Yates Petroleum Corporation is one of the applicants in this de novo request, is that correct?

A. Yes, sir.

Q. And Napeco is the other applicant in this request for de novo hearing.

A. Yes, sir. Napeco is the operator of the well and Yates Petroleum Corporation is a participant, a working interest owner in the well.

Q. What are you seeking in this application, Mr. Yates?

A. We're seeking the creation of a new pool for Strawn production. The new pool was discovered by the Benson Deep Unit No. 1, which is located 660 feet from the south line, 2180 feet from the east line in Section 33 of Township 18 South, Range 30 East, Eddy County, New Mexico.

The well was completed in the Strawn formation on May 9th, 1979.

We are requesting that special pool rules be established, including provision for 160-acre well spacing and standard well locations of 660 feet from the outer boundaries and 330 feet from the quarter quarter boundary.

A. What, Mr. Yates, will your testimony show today?

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Rt. 1 Box 193-B
Santa Fe, New Mexico 87501
Phone (505) 455-7409

A. We will show three things: That the well can effectively drain 160 acres; that it would cause waste to drill on 40 acres rather than on 160 acres; and we will show that a volatile oil reservoir requires special consideration in light of the pressure response of the hydrocarbons present in the reservoir.

Q. Mr. Yates, is this No. 1 Well on production at this time?

A. No, sir, it is not. We do expect it to go on sometime this week. It may very well go on production today. There has been a considerable delay because of an impasse reached with respect to Federal regulations.

One of the parties in the well who is attempting to sell their gas had to affect a gas exchange agreement, and which went through two other parties, two other transporting and purchasing parties, and it was necessary to go to the FERC, the Federal Energy Regulatory Commission,in order to get permission to conduct the exchange, the transportation, and to work out a tariff agreement that would be handled among all those parties, and it was not until Friday of last week that that tariff agreement and the permission of FERC was approved by the companies involved and by the FERC.

So we have just apparently gotten permission, by coincidence, just last Friday to turn the well on,

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Rt. 1 Box 193-B
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Phone (505) 455-7409

and I think it's going to be turned on this week.

Q. Mr. Yates, would you refer to what's been marked as Exhibit One and explain what is shown on this exhibit?

A. Exhibit One is a simple land plat, which shows the location of the Benson Deep Unit and also the Benson Deep Unit No. 1. The unit is outlined in red and the Benson Deep Unit No. 1 is colored in red.

It should be noted that all other wells that are indicated inside of the unit area are shallow wells that were not part of the unit and were drilled prior to the creation of the unit.

There is also shown a proposed location in the west half of Section 34, which is just that at this time, a proposed location.

Q. Would you turn to what has been marked as Exhibit Two and explain what is shown on this exhibit?

A. Exhibit Two is a copy of the two logs that were run across the particular pay in question in this well, the dual laterolog and the compensated neutron density log, which is located on the right of the two logs.

The logs show the producing intervals, the perforations at 10,648 to 56, from 10,671 to 77, from 10,702 to 16 feet. Those perforation intervals are colored in red on the compensated neutron formation density log.

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The producing interval is limestone. The well was acidized with 4000 gallons of acid and was completed for 104 barrels of oil per day and 550 Mcf per day at 968 psi flowing tubing pressure on a 12/64ths choke. Initial bottom hole pressure was measured at 5440 psig at 10,720 feet.

Q. Do you have anything further?

A. Yes. I might comment upon our proposed production procedure once we do get the well turned on.

We anticipate flowing, and the operator will be primarily the party that will determine the actual length of flow, but we'll be -- we'll be in cooperation with the other parties in the well, but we anticipate flowing the well for approximately a week to a month to evaluate the well's flowing performance and then we'll shut the well in and obtain a pressure buildup.

From that performance and from the pressure buildup, we intend to design an acid or a fracture treatment that will best help us to improve productivity of the well, but at this point the treatment has been limited to what we have described to you.

MR. LOSEE: I have no further questions of this witness.

COMMISSIONER RAMEY: Any questions of the witness? Mr. Stamets?

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QUESTIONS BY MR. STAMETS

Q. Mr. Yates, have you made any estimates at this point as to the extent of this pool?

A. No, sir, we have not had enough production history to obtain any kind of a boundary effect from any kind of pressure buildup, and the only means that we have of determining the -- what distance it may be is a volumetric calculation. Of course the real test of that will be subsequent wells, the performance of this well, and subsequent drilling.

Q. Will this one week to one month test that you are looking at give you any sort of a boundary determination?

A. We're hoping that it will. It may not be long enough. It will just depend on the -- how the well performs in that period of time, but we are hoping that it will give us some kind of a boundary determination.

Q. On Exhibit Number One you've outlined the Benson Deep Unit. Under the terms of that unit agreement could have all of the area inside that on 160's without the approval of the Division, couldn't you?

A. Yes, sir, except that, as I understand the -- we do have some acreage problems, and we may -- if we we'll only be allowed -- we have to drill so many wells. We

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have to have a development program to meet the USGS standards, and those standards will be designed upon what the proration units are, and so we have to drill subsequent wells every so often to keep the unit alive. And if we're having to drill on 40's versus 160's, which would be determined at the State level, then it would certainly affect the life of the unit, and whether or not the unit would be kept alive.

MR. STAMETS: That's all.

CROSS EXAMINATION

BY COMMISSIONER RAMEY:

Q. I notice, Mr. Yates, I notice on the drill stem test that you have initial shutin pressure covering the Strawn interval, initial shutin pressure of 5376.

A. Yes, sir.

Q. And your final shutin pressure of 5041. Does that indicate a limited reservoir?

A. There -- we would show this later in the testimony where we can present the actual drill stem test itself, but the values were extrapolated, and I believe that we had extrapolated about a 50 pound pressure drop is all, and it was felt like this was in the margin of hopefulness that we would not have any kind of a depleted reservoir, and since that time we have experienced a shutin of 5440, which is even higher than the initial shutin. And so within the

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range of error of recordings and the fact that it took time to buildup on the final shutin and was still building, I don't think that we've seen enough evidence to say that we have a depleted reservoir.

Q. Okay.

COMMISSIONER RAMEY: Any other questions of this witness? He may be excused.

FRANK O. REUDELHUBER

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

DIRECT EXAMINATION

BY MR. LOSEE:

Q. Will you state your name, residence, and occupation?

A. My name is Frank O. Reudelhuber. My residence is Dallas, Texas. I am a petroleum engineering consultant, self-employed.

Q. Frank, let's help the Commission, as you did me, with the spelling of your name and its pronounciation. It's German?

A. Yes, it is of German origin. It's Reudelhuber. It's spelled R-E-U-D-E-L-H-U-B-E-R. It's pronounced Reudelhuber, like Roy Rogers, Reudelhuber.

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Q. Thank you, Frank. You've not previously testified before this Commission?

A. No, I have not.

Q. Where did you obtain your undergraduate degree and in what year?

A. I obtained my Bachelor of Science in chemical engineering from the University of Oklahoma in 1947.

Q. Go ahead.

A. I'm currently a candidate for a PhD in geosciences at the University of Texas in Dallas.

Q. Would you state briefly for the record your employment history in the oil and gas field?

A. I was employed by Atlantic Refining Company, now Atlantic Richfield, from the time I graduated in 1947 until 1951 as a Field and Research Laboratory engineer. I was concerned principally with well testing, pressure testing, well sampling, and laboratory study of reservoir fluids.

I moved to Core Laboratories in 1951, remained with them until 1972 in several positions, both domestic and foreign; the final position with Core Laboratories was Assistant to the President.

Since 1972 I have been self-employed or self-unemployed, as you may choose, as a petroleum engineering consultant, operating out of Dallas and working for various

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clients in the oil industry, including Core Laboratories.

Q. Are you a Registered Professional Engineer?

A. Yes, I am a Registered Professional Engineer in the State of Texas.

Q. And have you authored any technical papers?

A. Yes, I've authored several technical papers on well testing, sampling, core analysis, and the laboratory study and application of fluid data on volatile oil reservoirs.

Q. Did you write one of the early papers on volatile oil reservoirs?

A. Yes. The two earliest papers to appear in the Society of Petroleum Engineers literature were presented at the same meeting, one by myself and a co-author, Richard Heims (sic), the other by two gentlemen, Jacoby and Berry (sic) from PanAmerican Petroleum, or Amoco at the present time.

Q. What year was that?

A. 1957.

MR. LOSEE: Are Mr. Reudelhuber's qualifications acceptable?

COMMISSIONER RAMEY: Just barely.

A. Thank you very much.

Q. Would you give an explanation of the study of reservoir fluids in general so that the Commission

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will have an understanding with respect to the -- its effect in determining the nature of the reservoir and the subsequent testimony on simulation studies?

A. Yes, I would be happy to do so, and with the Commission's permission I would like to step to the blackboard, if I may.

I think, perhaps, I would appreciate it if you would accept this, please, as being an informal presentation on my part. The purpose of it is to bring us all to a common level of understanding, and I certainly do not intimate that anyone in this room is not knowledgeable in any of these areas. Some of these things may be very familiar to you, others may not, just by virtue of the fact that you have not been exposed to it.

I will have to begin with some rather basic data before I can move on to describing to you what, indeed, is a volatile oil that we are concerned with here today.

If at any point you feel that I have not adequately explained. or that I'm going too much into detail, simply tell me and I'll try to go through it faster.

We, who deal daily in our careers with oil and gas reservoirs are by necessity familiar with the reservoir fluid data application. Reservoir fluid is a term we use to describe the material which is present in the reservoir, whether it be gas in a gaseous phase, or whether it

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be in a liquid phase, we consider them all to be reservoir fluids. This is an all encompassing term.

The differences in what we see at the surface as we produce the reservoir fluids from the reservoir through the vertical flow column and through the separation equipment, determines in our mind whether this is a gas reservoir or an oil reservoir, based on experience that we have.

As far as the science itself is concerned, the chemistry of the situation, there is no real difference in these two things except in degree.

The reservoir fluids, oil and gas, as we know them, are principally, or with the exception of some contaminant, hydrocarbons. Hydrocarbons is a general term which covers in organic chemistry those materials which are made up of carbon and hydrogen.

The least, the most simple, the smallest of these chemical molecules is methane, which I'm sure you're all very familiar with. Methane has a formula of CH_4, and it is commonly designated in script as carbon with 4 hydrogen atoms attached to it, one carbon atom and hydrogen atoms. This is the simplest and lightest of all the hydrocarbons.

The next one, and you can perhaps foresee what it would be, is 2 carbons with 6 hydrogens. This is ethane.

The next is propane, which would be 3

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carbons. The number of "h" -- the formula for this is C_nH_{2n+2}. These are called the paraffinic hydrocarbons. There are a whole family of hydrocarbons, and methane, ethane, propane, which of course are 3; butane having 4; pentane having 5; hexane having 6; septane, 7; octane, 8; nonane (sic), 9; dectane, 10; these prefixes coming from the Greek and used in that manner.

A reservoir fluid can contain hydrocarbons ranging from methane, or we would say CH_4, or 4 carbons, up to 250, 300, 350, 400 hydrocarbons, hydrocarbon atoms. These you would anticipate would be very long, large, heavy molecules, and that is indeed what they are.

The fluids that we find in oil and gas reservoirs are then a mixture of these hydrocarbons, and listing -- listing them rather quickly and simply here, let's say that we would use the abbreviation of the number of carbon atoms. We have C_1, C_2, C_3, C_4 in two forms the C_4, a little complicated with that, C_5, C_6, and on and on and on.

Now, for convenience sake, in most reservoir fluid studies and in most analyses of reservoir fluids to yield this chemical composition we normally have a final complement that we will say all of this. This represents all of the rest. If we're dealing with a normal oil reservoir, if there is such a thing as a normal reservoir,

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let's just say for an example a reservoir that produces 30 degree API oil, has a gas/oil ratio of 500 cubic feet per barrel, there would be no question in anyone's mind in this room, I'm sure, that we're talking about an oil well.

If we have well that produces 10 million cubic feet of gas per day and 200 barrels of liquid per day, there would probably be little question in most minds that this was a gas well.

What then is the difference between these two? It really is the number and distribution of these hydrocarbons in the reservoir fluid itself before it has come to the surface and separated into two phases; while it is still in the reservoir in one phase.

A system which was heavy of -- this is going to be confusing -- let's say it this way, which contains a large concentration of the light hydrocarbons and a small concentration of the heavy hydrocarbons would be a gaseous form in the reservoir. Now, it wouldn't look like gas as you usually are aware of it. It's very much compressed; it's dense; it's fluid; it has vicosity; it has density. Whether you chose to call it a vapor or a fluid is academic, really. It's a fluid.

Now, if it is concentrated and the lighter material is produced to the surface, it will separate into predominantly gas. Since these materials are very

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volatile they boil off at surface temperature. It would separate into gas and a residual material remaining that contains some of the lighter material, but was heavier -- more concentrated in the heavier material. That would be a condensate. So we would be talking about a gas/condensate well. A smaller concentration of the light, a larger concentration of the heavy components.

If nature chooses in the generation and migration of the hydrocarbons system to subject it to different conditions, it will have in the reservoir a different reservoir fluid composition, and virtually every oil reservoir, every gas reservoir in the world probably has a different composition. Some are quite similar but due to the fact that they were generated during geologic time and migrated, they are all different, but very similar. So we sort of group them.

If, on the other hand, we find that we are dealing with a system where the concentration of the light materials, the methane, ethane, propane, is low and the concentration of these heavier materials, the C_5, C_6, and the C_7 plus, or whatever residue we choose to call remaining, the low concentration of this, high concentration of this, at the surface you will see what we would call an oil well. It would have an API gravity that would be probably lower than gas/condensate well, simply because it has

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more of the heavy heavies in it than the gas/condensate. So the differentiation between the two is simply a variation in chemical composition.

Okay, we've said a gas is light in these, it has a low concentration of lights, a large concentration of heavies. We said -- I'm sorry, correction for the record, please.

We said that gas had a high concentration of lights, a low concentration of heavies, and that oil had a low concentration of lights and a high concentration of heavies. What then might be in between? Something that we would call a volatile oil, which would come to be called a volatile oil. It simply happens to not be heavily pushed in the direction of the light material, nor in the direction of the heavy material, but has a large concentration of the intermediate hydrocarbons.

Now, all of these always add up to 100 percent total, and in volatile systems we're looking at intermediate composition, where these intermediate components are of the order of 20 to 30 percent. And that's a very general statement, please. The temperature of the reservoir has something to do with this, also.

But composition where we are heavy in the intermediate materials we call volatile oil, and for us there is no problem. We deal with these things in a routine fashion

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daily. We have gas; we have oil; we have things in between. The things in between are rich gas/condensate and volatile oil, and there is no line, clear line of demarcation between the two. It's a gradual transition from one to the other, depending on the composition.

So probably the best criteria, even though it is general, is that volatile oil system has a larger concentration of intermediate than a normal oil system or a normal gas system. You have a heavier concentration of these intermediate materials. Nature made it that way.

Now, since it's midway, or somewhere in between an oil and gas, then we would expect its physical properties also to be somewhere between that of an oil or a gas, and that indeed is the case. The viscosity of this liquid, the volatile oil, is low, in the order of a few tenths of a centipoise, a few tenths of a centipoise.

With oils we're looking at viscosities of 10, 50, 500, or 1000 centipoise. With gases we're looking at viscosities in the reservoir, and again, pressure has an effect here, so I can't be too specific, but in a general sense of .0 something approaching .1, which we find to be sort of the range of viscosities for these intermediate fluids, the viscosities between .1 and .3 , more or less.

The volatile oil also suffers a much larger shrinkage in coming from the reservoir to the surface.

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The words formation volume factor is used quite commonly for this. In general, the volatile oil reservoir, the formation volume factor will be two or greater. This means that for each barrel of stock tank liquid you recover you remove two barrels from the reservoir.

So formation volume factor of two.

Gas/oil ratio, again affected by pressure, the number of separators that you have, how we operate the separators, it can vary from 2000, or slightly less, perhaps, to 3000 standard cubic feet per barrel; 4000, possibly, and be the volatile oil.

The gravity, the API gravity, is normally above 45 degrees API. Quite often, it's 52, 53. It's very hard, again, to make a firm definition.

I think what I wanted to accomplish more than anything else in this explanation, is to make it as clear as possible that there is nothing magic about volatile oil, but they differ from the normal gas or the normal oil that we're used to dealing with in that they're sort of an intermediate thing between the two.

Some things about this are good; some things are not so good. The low viscosity is certainly a benefit because the fluid will flow more easily from the reservoir than if it were a heavier crude with higher viscosity. That's an advantage, certainly.

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The shrinkage is not so much of an advantage. In fact, you would have to sort of look at that as a disadvantage, shrinkage of formation volume factor, because for a reservoir at a given volume we have less barrels of stock tank liquid than we would were it filled with a more normal oil.

So from that standpoint our oil in place, so to speak, initial oil in place, is lower in terms of stock tank barrels that it would be if it were a normal oil -- a more normal oil.

Gas/oil ratio, with gas/oil ratios of 2000 cubic feet per barrel and higher, something in this range, there is some economic advantage today with the fact that we do produce along with our oil this extra amount of gas, of which we ordinarily don't have the benefit.

It has the disadvantage in that it causes some things to happen in the reservoir which make operation of the reservoir very, very touchy. It requires a lot of attention. They need to be produced in a prudent engineering fashion, and such being the case, everything -- doing everything you possibly can do, the ultimate recovery by pressure depletion and percent of initial oil in place is going to be lower, and significantly lower, than it might be in the case -- than it would be in the case of a normal oil.

Are there any questions? I can draw some

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more pictures, but I think I can illustrate these points a little better when --

COMMISSIONER ARMIJO: I have a question. Is this a unique thing?

A Unique, no. Common, no. The first fluid of this type that was recognized was the Elk City Field in southwestern Oklahoma operated by Shell Oil Company, and they realized that they had something that was different. They didn't know what it was. This was in the early '50's, and the Bureau of Mines worked with Shell Oil Company at that time to try to determine what this thing was.

Very shortly after that there were additional discoveries. My first association with it was in Oklahoma near Chickasha, and it was the first association that I had with volatile oil. The information that's included in the paper was the -- that Heims and I presented -- is information from that first reservoir that we dealt with in Oklahoma.

They are now fairly common. They're still much lower in number than the normal type of reservoir. There are a good many in south Texas and in south Louisiana; a good many in Oklahoma. I don't know how often they've been encountered here in New Mexico. Certainly the Lusk-Strawn Field, the little information I've seen from that and I'm certainly not entering that as best evidence or testimony, it

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very likely was a volatile oil reservoir, also, but whether there are others in New Mexico, I'm not that familiar with the state and with the cases that have come before the Commission. I couldn't say.

It is not a unique situation, no, sir, but it certainly is not common. It's unusual.

Now, the word volatile oil has been thrown around so much and tried to be classified by so many people that if you're writing a textbook of course you've got to put something in there, and you find statements like the temperature is usually above 250 degrees. Well, 250 degrees is not a criteria for determining whether or not it's a volatile oil. It just happened that that particular author was aware of several volatile oil reservoirs that existed in-- at temperatures above 250 degrees.

Now, temperature is a very important effect here. These hydrocarbons are very much affected by temperature. The lighter ones are more volatile. They want to get out of there. They're more active. They move faster. And if we raise the temperature they move faster and faster.

So high temperatures can lead to volatile oil systems with gas/oil ratios, perhaps, less than what we see and we'll discuss here in the testimony today. If these same fluids that we're discussing here today were in south Louisiana, at 10,000 feet, would be under a considerably

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higher reservoir temperature and would -- its behavior would be even more marked than it is here. New Mexico has one of the lowest thermal gradientsin the United States. It's a little over 1 degree per hundred feet of depth, and that also appears in the literature. So perhaps one of the reasons why we might not see more than -- more of them in your area may be the fact that reservoir temperatures are generally less.

We could also say as a generalization that these things are normally found deep; deep, hot. Here we're deep enough; we're relatively not as hot as we might be somewhere else.

Q. Frank, I'll give them all a chance to ask some more questions here in a minute. Let me ask you at this point if you'll explain the -- are you ready to go into laboratory procedure?

A. Yes, I am, unless there are other questions.

Q. Go ahead.

MR. HOLLAND: Okay.

QUESTIONS BY MR. HOLLAND:

Q. What is the efficiency of producing in a reservoir like this one, like the percentage as far as you know?

A. You're asking for a very -- this is for

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debate, no?

Q. Right.

A. It's certainly less than it would be in a normal reservoir. You're looking at recoveries probably in the range of 10 to 15 percent in most cases.

Q. You have a great deal of irreducable oil saturation?

A. No.

Q. No?

A. You'd leave behind a reservoir containing a large amount of gas.

Q. Oh, okay.

A. Also, your separation conditions at the surface are such that obviously if you're going to have a 2500 or 3000 gas/oil ratio, the amount of stock tank liquid that you're going to recover is going to be small, based on the total withdrawal figure.

The recoveries are, you know, are lower than you're used to looking at.

Q. It would be very pressure sensitive, too?

A. Yes, it is very pressure sensitive, extremely so.

Q. You would try to keep the -- keep it in an oil state rather than in a gas state in producing the reservoir?

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A. Yes. This would be one of your objectives, if possible, would be to keep the reservoir in a single phase, and I won't even attempt to call it oil or gas, just keep it in one phase so it doesn't undergo this change, which I'm going to discuss next when I discuss the laboratory procedure, in general.

Q. Frank, let's go to the laboratory procedure.

A. All right.

Q. And explain that.

A. I hope I haven't been too verbose, but I think it's very important that we have this basic understanding. It will go more rapidly from this point on.

In order to perform the laboratory study on any system, be it gas or oil or volatile oil or rich gas/condensate or lean gas/condensate or dry gas, we have to have samples from the reservoir. So the first step, of course, is sampling of the reservoir.

Volatile oil reservoirs are no different from any other except that you have to be very careful that, hopefully, we have not produced the reservoir at a rate sufficiently high enough to have resulted in separation in the reservoir into two phases, because this separation is extremely drastic in the case of a volatile oil. In the case of a normal oil it's more limited and can be overcome. So

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prepared conditioning before sampling is extremely important. Samples can either be taken at the surface and recombined or they can be taken by bottom hole sampling. Pressure maintenance is extremely important in association with the sampling of these reservoirs.

But, passing onward, assuming that we sampled the reservoir carefully, we arrive in the laboratory with a sample of the fluid as it exists in the reservoir, the fluid is then -- it is maintained under such a pressure as to keep it in one phase at all times.

It is then heated up to reservoir temperature and the laboratory procedures begin at some pressure above the reservoir pressure.

In the laboratory then we have the sample confined in a cell. This is mercury, and we have a pump, volumetric pump, attached to the cell so that we can measure an ounce of mercury in and out. We have a valve here and have a valve here, and then we have a long window in the cell so we can see inside and see what's going on.

At reservoir temperature, then, we begin to lower the pressure and we do this by removing, producing, some of the fluid from the system. In dealing with volatile oils the laboratory procedure is slightly different from normal systems. In laboratory procedure the volatile oil, or rich gas/condensate, we use what's called a constant

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volume depletion. We say that this is our original reservoir volume, cc, cubic centimeters or cubic inches. We lower the pressure by withdrawing some of the mercury and when we do that, we will see at the very top of the cell the formation of a small bubble of something. It's at the top and it's a bubble. We'll say it's gas, okay, this is called the bubble point or the saturation pressure, and in a volatile oil system we have a small bubble of gas. We know it's gas because it's at the top; it's lighter than the other fluid.

If we were dealing with a gas/condensate reservoir, the first thing we would see on reducing the pressure would be a small bubble of -- a small droplet of something at the bottom. We call that the dewpoint, like a dew; a small bubble.

Therein lies the classification of is this an oil reservoir or is it a gas reservoir. If the bubble point is at the top, it's considered an oil reservoir -- or a gas reservoir. If the bubble forms at the bottom, if the drop forms at the bottom, it is considered to be a condensate reservoir.

And that's the only strict definition that's possible.

In a volatile oil reservoir, then, we continue this process. We drop the pressure and then we displace gas out until we have returned back here again to our

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original reservoir volume. Draw mercury out to lower the pressure; then we push mercury back in at constant pressure pushing gas out, or producing it. This then corresponds to how much you will remove from the reservoir by going from pressure one to pressure two, or from the bubble point pressure to the first pressure below.

We keep -- we do this in steps by every 600 pound increments to obtain 10 or 12 points.

The gas which comes out is analyzed. The chemical composition of that gas is determined at every point in that depletion in the pressure pushing cycle. Knowing the amount we started with, knowing the amount and composition of the gas, we will calculate the composition of the liquid. We also measure the amount of the liquid by use of this window and some special devices.

What, then, would be the difference between volatile oil and reservoir oil -- and normal oil under these circumstances?

The difference would be that both of them would, if ycu cautiously approach this thing, would produce a small bubble of gas at the bubble point pressure, at saturation. The volatile oil will do it just like a normal oil.

But the next pressure step, say we lowered the pressure 300 pounds, for example, from the pressure of 3000 pounds, we lower it to 2700, 3000 pounds is where we had

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our bubble, for example, and we lower the pressure to 2700, in a normal system the amount of gas up here will grow X amount in lowering the pressure; in a volatile oil it will grow more than X amount, one and a half X, perhaps 2X. In other words, a very small pressure drop below that bubble point causes the forming of a large volume of gas and the subsequent shrinkage, a large shrinkage, of the reservoir oil.

So this is the procedure that we follow in the laboratory and in a separate measurement, using exactly the same technique, we determine the viscosity. From this we determine the composition of both the gas and the oil phases at all points. We need these in order to go into the calculation procedures we're going to use. We determine the volume of liquid remaining at any point, the volume of gas which has been produced. We can do a material balance, the mass balance, chemical balance, around the whole system so that we know that nothing's been lost.

This then is the basic data that the reservoir engineer begins with on a volatile oil system, and I think I'd like to introduce into --

Q. I'll hand you what's been marked as Exhibit Three, and ask if you'll briefly explain it, explain what that is.

A. Thank you, Jerry. Exhibit Three is a

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laboratory study performed by P-V-T, Incorporated, in Houston on samples taken from the Benson Deep Unit No. 1 on December 19th of 1979.

If you'll turn to the first page of data after the letter, you'll see the sampling date was December 19th, and down at the very bottom you'll see some information referring to the gas -- producing gas/oil ratio.

Now I'd like to avoid confusion here for you at this point when in pointing out, we talked before about gas/oil ratios in the range of 2000 or so. You'll see here that this well was producing with a gas/oil ratio of 1095, but please note that this is separator gas to separator liquid, not separator gas to stock tank liquid.

Now the separator liquid will be 20 to 30 percent more than the stock barrel -- stock tank. The separator here was operating at -- I'm sorry, I don't see that, it was a test separator, but it's somewhere in the neighborhood of 300 pounds, I'm not sure; I don't recall.

So we measured in the field the separator gas, the separator liquid gas/oil ratio. We measured the stock tank, actually, but we corrected in the laboratory by determining the separator liquid.

So this 1095 is the ratio in which we put -- they put, P-V-T, Incorporated, the gas and the oil that were produced at the surface. They put them back to-

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gether in the same ratio, 1095 standard cubic feet of gas for every barrel of separator liquid.

Now this would translate to a much different number through the stock tank, and we'll talk about that later.

The rest of it, I won't go into detail. It's standard, straightforward. If you'll turn to the next page, you'll see that one of the very first things that's presented to you is the composition, the composition of the separator liquid, the composition of the separator gas, and the well stream, or the reservoir fluid composition, which is the result of putting back together again this oil and this gas. And you'll note, if you look at the separator liquid and separator gas, the composition is the very thing that we were talking about. The separator liquid has a lot of the heavier materials and not much of the light; the separator gas has all light materials and not much of the heavy, and that's exactly the situation it contains in the reservoir if we're dealing with a gas or oil system.

I have no further testimony to present as far as the fluid system unless you have questions.

Q. Frank, why don't you explain how this sample was -- who took this sample?

A. All right. The sample was taken by Tefteller, Incorporated, a wireline service and testing com-

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pany from Midland; Midland and Farmington, I believe, they have an office in Farmington, also. They did take the samples. They did measure the gas/oil ratios, and they were observed by a representative of Yates Petroleum, who was present during testing and sampling.

The samples were sent to Houston at the request of Napeco and analyzed by P-V-T, Incorporated, for the operator.

Q. Let me hand you what's been marked as Exhibit Four and ask you to explain briefly what this -- the purpose of this exhibit is.

A. We very often -- the exhibit referred to is an evaluation performed by Core Laboratories, Incorporated, of the P-V-T, Incorporated, laboratory study. The analysis has two purposes; one, to insure that the properties were correct; and two, to put them in the proper form so that they might be utilized in the reservoir engineering calculations which were to follow and which will be testified to, to follow. This is standard operating procedure for Core Laboratory. We do it on all studies. We take the laboratory data, we put it into a different form.

The particular thing we do, and I'll tell you very briefly, is instead of just using this large term down here of C7+, we will -- we carry it out, the information out four more components, and work with C11+. This is because

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most of our models permit us to input 16 different chemical components. It would be great if we could input 30, but computers seem to cost a great deal of money. But before our programs will accept the data it has to be put into a separate form.

So this is an evaluation of the data itself. It's been translated and put into a different format suitable for entry into our reservoir models, our reservoir simulator models.

Q. Why don't you turn to Figure 1, which is a graph, on the last page, if you will, and briefly explain what this graph portrays?

A. Figure 1 are the -- presents the information which is most necessary and most -- for use in the reservoir model, and most indicative of the fact that we're dealing with a volatile oil system.

The top curve is viscosity. You'll note that the viscosity is less than .2 centipoise. It is about 1.2 -- .146 at the bubble point, .146, very low viscosity.

The next two curves down are the differential formation volume factor and the flash formation volume factor, differential and flash. The differential is what we have done here in the laboratory. Flash is what Core Lab has done in preparing the data for entry into the computer. We have calculated how this gas and oil which will be produced

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in the future from the reservoir, how they will behave when they go through the separator. So we make separator calculations. Those calculations are called flash calculations. So we call the formation volume factor the flash formation volume factor.

This, which is done in the laboratory, we call differential formation volume factor. It represents what's going to happen in the reservoir. The flash formation volume factor represents what we're going to see at the surface.

Immediately below the saturation pressure, or the bubble point, which in this case is 3098, or roughly 3100 psi on your obttom scale, we have the differential formation volume factor and the flash formation volume factor. The scale is on the right. You'll notice that the differential formation volume factor is 2.2. The flash formation volume factor, or slightly over at the bubble point, but the flash formation volume factor is 2.1 something, slightly less. It's always this way. I won't attempt to explain it. It has to do with the system. So the differential formation volume factor is what -- now, if you'll notice just below the bubble point, it would be very nice if we could presume that as we lowered the pressure below the bubble point, this being gas in solution, this pressure, and we starting out here at a bubble point, at a bubble point. We won't discuss what hap-

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pens above the bubble point because of the single phase, and all we have to deal with there is compressibility.

But at the bubble point itself, 3000, 3100 pounds let's call it for round numbers, we would like to think that this gas will come out of solution in proportion with a pressure drop and that we'd have a nice line to look something like this. This is what you have with a normal oil system, so that this portion of the line is virtually linear. You'll notice here it is not linear. We have a curvature here. This curvature simply means that there is less gas in solution at a given pressure than you would have with a normal fluid, which means there has been more gas come out of solution. But we're talking here about the formation volume factor, I have here gas in solution, which are the two lower curves. Formation volume factor, we have the same thing. It's even more pronounced, perhaps, with the formation volume factor than with the gas in solution. I'm sorry I switched gears on you there, jumped from formation volume factor to gas in solution, but the same applies to both. In the normal oil we would expect a rather straight line and with volatile oil, as we see, this large dip, curvature, concavity, below the bubble point.

In a general sense, then, that is -- there are a great many details in this Core Lab evaluation. This is the information that we used in the model. It did come

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from the sample that was taken by Tefteller and analyzed by P-V-T, Incorporated.

Q. Let me ask you a question. Do you have an opinion as to whether or not the reservoir encountered by this Benson Deep Unit No. 1 is a volatile oil reservoir, as you have described it?

A. Within the general terminology that we can use, yes, it's a volatile oil reservoir. Yet the volatility effect would be much more evident were we to transport it to south Louisiana and raise the temperature above 200 degrees to 230 or 240. It would be more evident,

This fluid exhibits all of the behavior characteristics of a volatile reservoir fluid. It's intermediate in behavior between a gas and an oil.

Q. Frank, one other question. Has -- have volatile oil reservoirs, with respect to spacing requirements, been recognized by any other regulatory conservation commission?

A. Yes. I certainly cannot quote chapter and verse, Jerry, and --

Q. We won't ask for that.

A. No. They have been recognized, they are recognized in Oklahoma, in Texas and Louisiana, and special consideration is given in most cases to the volatile oil reservoir.

Q. Were Exhibits Three and Four secured under

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the supervision of Napeco?

A. Yes. Both exhibits were secured under the supervision of Napeco.

MR. LOSEE: I move their introduction.

COMMISSIONER RAMEY: They will be admitted.

MR. LOSEE: I have no further questions at this time.

COMMISSIONER RAMEY: That's just Exhibits Three and Four?

MR. LOSEE: I forgot, Mr. Commissioner, I'm going to ask one further question of my first witness.

COMMISSIONER RAMEY: Are there any questions of Mr. Reudelhuber? Mr. Stamets?

QUESTIONS BY MR. STAMETS:

Q. Do you have or can you tell us where to find or can you sell us -- send us a range of hydrocarbon constituents of what you feel would be in a volatile oil reservoir? For example, on Exhibit Number Three, page two of the analysis lists methane, heptane, percentage; for example, methane had 43.68 percent; heptanes plus, 18.56 percent?

A. Right.

Q. Now I would assume that there is a range of these constituents percentagewise that you feel would fit into volatile oil reservoirs along with the other definitions

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that you've given us here.

A. Yes.

Q. And I wonder if you could supply us with that or just plug some numbers in on this thing.

A. I'm not prepared to do it at this moment. I'm not prepared to. I don't have the information with me. I can point out to you, though, that one of the things that I mentioned was the volatile oil system is generally rich in intermediate material. The intermediate materials here, if you consider you have 43 percent methane and 18 percent heptanes plus, those two together add up to 62 percent, so that we would have 38 percent the intermediates. Part of the ethane is not considered to be an intermediate, but we're in the range of 40 percent of the intermediate materials. 30 percent, if we remove ethane, and the others are definitely intermediate material. So I stated to you previously, I believe in the testimony that this ranges from 25 to 35, or from 20 to 30, it depends on the system, but this is definitely in the range of what we would call a high concentration of intermediate components.

Q. Everything between methane and heptanes plus is what you would describe as --

A. More properly everything between ethane and heptanes plus. Now, ethane is sort of a double actor. Sometimes it behaves more like methane and sometimes it be-

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haves more like propane, depending on the reservoir pressure and temperature. It's kind of a strange actor. Most people refer to the intermediates as being C3 through C6.

Q. Now, what was the centipoise viscosity you described as being appropriate for a volatile oil reservoir?

A. In the order of 1/10 to 3/10 or 4/10, again, not as a hard and fast means of classification, but just as a generalization of what we have seen in our experience.

Q. And then based on the last page of Exhibit Number Four, what we would see, then, in a volatile oil reservoir, or in this particular reservoir, is a decline in gas/oil ratio after reservoir pressures drop below 3000 pounds?

A. That would be a decline in the gas remaining in solution. Now what has happened to your surface gas/oil ratio is another matter.

Q. I see, this is a reservoir --

A. This is a reservoir fluid study and this is what is happening in the reservoir. And the flash is what is happening at the surface as a result of what's happening in the reservoir but not taking into account any separation in the reservoir or any rock properties or anytbing else. These are just the properties expressed on a different basis

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instead of residual oil, which is the oil left in the cell in the laboratory at the end of the test, these are based on stock tank oil. The differential data are reported in terms standard cubic feet of barrels -- or per barrel of residual oil.

In the -- in the case of this particular sample in the Core Lab evaluation, the residual oil gravity by differential, and this is on Table 2, the residual oil gravity was 47 degrees API corrected to 60 from the differential.

And the stock tank oil gravity from the flashes, which are over at the right where it says surface separation, is 51.4 degrees API.

So you can see we have two different processes here. We're referring the differential data to the residual barrel remaining in the cell at reservoir temperature. We're referring the flash information to the stock tank barrel remaining at the surface after that fluid comes from the reservoir to the surface, were it not affected in any way by rock properties or by separation within the reservoir.

Q. Have you made any study of or will you be recommending any special production methods or limitations which should be applied in this reservoir to maximize recovery?

A. No, sir, I will not. Napeco has a con-

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sulting engineering firm, who will advise them, certainly, in this direction. My role here today is simply to explain the fluid data and to reach some common understanding as to what is a volatile oil and does this indeed, the Benson Deep Unit, represent a volatile oil system.

Q. Are you capable of making such recommendation if you were employed to?

A. Yes, of course.

Q. In your opinion how long a period of time, test time, would it take in order to make that determination?

A. I'd rather not comment on that. I really have not studied the other information that's going to be presented to you later. I was not privy to that information, not by any design, but I simply was not involved in this at that particular point. I was working on another job for another client at that time.

Q. Just, if you were employed by any client, not this particular one, how long do you feel that it would take under normal conditions to get the information necessary to design a proper production method?

A. I really can't generalize on that. Let me -- let me state it in a way which I really don't want to be a hedge, but it may sound like one. The criteria that I would use as an engineer, is that I would produce the well until we reached a stable flow, relatively stable flow condi-

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tion. That is to say it would be, perhaps, a matter of days or weeks; certainly not more than a month. But until our surface indications became constant within our ability to measure them. In other words, until the wellhead pressure had stabilized; until the gas/oil ratio had stabilized; at this point I would feel that I had conducted a sufficiently long flow test to have stable flowing data, and at that time I would shut the well in for a bit, or I would suggest that it be, I would not personally myself do that, although I have in the past. Shutin for a pressure buildup, the duration of that pressure buildup would be indeterminate. I would want the pressure buildup to run for a sufficiently long period of time to give me information that I would need to interpret the buildup curve. That does not mean that it would have to reach a static, no longer changing pressure, but simply long enough to provide the information needed for the calculation procedures, which are more or less standard in the industry.

Q. Thank you.

COMMISSIONER RAMEY: Any other questions? Mr. Holland?

QUESTIONS BY MR. HOLLAND:

Q. If you could keep the volatile oil from reaching the bubble point in the reservoir, would you not

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have a more efficient production of fluids?

A. You would of any reservoir, a normal oil reservoir or a gas/condensate reservoir. Pressure maintenance obviously --

A. I wondered if pressure maintenance was a factor in this.

Q. Pressure maintenance is an obviously advantageous thing in normal oil, volatile oil, gas/condensate systems. All are, in all cases recovery would be increased, not merely volatile oil.

COMMISSIONER RAMEY: Thank you.

MR. LOSEE: May I ask my first witness two questions from his seat, or one question?

COMMISSIONER RAMEY: Yes.

MR. LOSEE: Were Exhibits One and Two prepared under your supervision, Mr. Yates?

MR. YATES: Yes, sir.

MR. LOSEE: Move their introduction.

COMMISSIONER RAMEY: Exhibits One and Two will be admitted.

We'll take a 10-minute break.

(Thereupon a recess was taken.)

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COMMISSIONER RAMEY: The hearing will come to order.

GUS A. MISTROT

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

DIRECT EXAMINATION

BY MR. LOSEE:

Q. Will you state your name, residence, and occupation?

A. My name is Gus Mistrot. I am a resident of Houston, Texas, employed by the consulting firm of Keplinger and Associates as Vice President and Senior Engineer.

Q. You have not testified before this Commission and had your qualifications accepted?

A. No, sir, I have not.

Q. Would you please explain where and when you obtained your undergraduate degree?

A. I obtained a Bachelor of Science degree from A & M College of Texas in petroleum engineering in 1951.

Q. Since that date what have been your employment -- what has been your employment?

A. I have served in various capacities as production and operations engineer, reservoir engineer, pro-

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duction geologist, gas storage engineer, for first the Oil and Gas Division of the Railroad Commission of Texas, later with Heath (sic) Oil Corporation, J. Ray McDermott and Company, and with Southern Natural Gas Company.

I joined Keplinger and Associates in 1974.

Q. Are you a Registered Professional Engineer?

A. Yes, sir, in Texas, Louisiana, and Georgia.

MR. LOSEE: Is the witness --

COMMISSIONER RAMEY: He is qualified.

Q. Okay. Would you turn to what I've now marked as Exhibit Five-A and which is entitled the Reservoir Properties, and briefly explain what is important with respect to this exhibit?

A. The studies that were performed for the purpose of determining the -- or estimating the performance of the Benson Deep Unit Well No. 1 under various configurations, well spacing, and producing rate. The spacing configurations that we studied were 40 acres per well, 160 acres per well, and 320 acres per well. We also worked with varying producing rates within these configurations.

The reservoir properties shown on Exhibit Five-A are those that were encoded into the reservoir simu-

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lation model for volumetric calculation of oil in place and for the initialization of the studies. They consisted of a reservoir rock porosity of 6 percent; water saturation of 30 percent; an original formation volume factor of 2.0257, which was testified to earlier by Mr. Reudelhuber; a net effective pay thickness of 26 feet; a permeability to oil of .446 millidarcies, if we work with differential liberation P-V-T data; .429 millidarcies if we work with flash data, or in essence, about .43 to .45 millidarcy permeability effective to oil. A reservoir temperature of 181 degrees; an initial reservoir pressure 5465 psia. Mr. Yates stated 5440, which is psig. A saturation pressure, or bubble point pressure, of 3098 psia, and an initial solution gas/oil ratio of 1870 Mcf per barrel, or cubic feet per barrel, excuse me.

The volumetric calculations show in a 40-acre pattern a total of 167,000 barrels of stock tank oil in place; under 160 acres, 669,000 stock tank barrels; and under 320 acres, 1,338,000 barrels.

Q. Now, I notice the permeability you are -- the reservoir properties you calculated at .446. I realize this is a de novo hearing, but I also realize, and I'm sure you do, that testimony in the original hearing treated a permeability of .036, I believe.

A. Yes, sir.

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Q. Would you turn to Exhibit Five and explain the rather marked difference in permeability determination?

A. In the original hearing, Docket 6990, as I recall, the reservoir system for the calculation of permeability was treated as a gas. The final page of this group of pages, which shows Johnston Schlumberger Computerized Data Analysis on the hearing, if you will look in Section 3, Permeability, the second sentence states the calculations were based on a slope of 953 psi per log cycle obtained from the final shutin buildup plot. It was assumed for these calculations gas gravity, .7; viscosity, .0213 centipoise; gas deviation factor, .842.

Using those data and calculating the Horner flow time based on gas producing rate, you come up with the .036 millidarcy permeability which was stated into that hearing.

The fluid analysis that we have conducted has shown that the reservoir fluid exists in a liquid phase in the reservoir; consequently, the data should be analyzed on that basis; that is, it should be based on a flow rate of some 300 barrels of oil per day, I don't remember the exact -- 309 barrels of oil per day rate at stock tank conditions; that those conditions should be converted to reservoir liquid flow based on the formation volume factors determined from

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the fluid analysis. But the viscosity used in the Horner equation is the viscosity of the reservoir liquid, which is .175 centipoise at original reservoir conditions.

Using those data we have recalculated the test. We present the Horner plot, a copy of our calculations. The result of those is that the effective permeability to the flow of reservoir oil is on the order of .43 to .45 millidarcies, and not a permeability of .036 millidarcies to the flow of gas.

Q. All right, did you perform some studies on a simulator of the reservoir fluids?

A. Yes, sir, we did.

Q. Would you describe the simulator?

A. The particular reservoir simulator used was Core Lab's 3-phase 2-dimensional radial reservoir simulation model. It is one of the many reservoir simulation models on the market today and it is one of the quite well accepted reservoir simulators.

The reservoir simulator differs from the simple material balance calculation in that the pressure and rate projections are made on a cell or grid basis rather than on a single total field entity. The calculations are made on a time step basis and the results are printed out in that fashion.

Q. All right, do Exhibits Six and Seven that

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have been marked, summarize the results of these studies?

A. Yes, sir, they do.

Q. You studied what size spacing?

A. We studied 40-acre spacing, 160-acre spacing, and 320-acre spacing.

Q. At what flow rates?

A. We began with flow rates as low -- we studied the spacing configurations at flow rates basically of 20, 40, 70, and 110 barrels per day of oil production. We determined very quickly that at a rate of 110 barrels of oil per day the well would be drawn down well below bubble point in a very short period of time, and the attendant ultimate recovery from the well would be quite small. Consequently, we did not do any further detail study of the 110 barrel a day case. We concentrated on the 20, 40, and 70 barrel a day cases.

We found that the ultimate recovery from the well with no other considerations other than just ultimate recovery, was highest with the lower rates.

Exhibit Six presents a study at a producing rate of 20 -- actually this is at -- okay, this is at 20 barrels a day only, and on the extreme lefthand column of the sheet you see, under the term rate (BOPD) 20, 40, 70, which was printed. These were all done at 20 barrels a day but one, Case No. 50 at 40-acre spacing, Case 51 at

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160-acre spacing, Case 52 at 320-acre spacing.

So ignore the 20, 40, 70 in the extreme lefthand column and concentrate on the 40, 160, 320.

The studies indicated that -- and in this particular instance the configuration used was essentially that of the well as it sits today with a matrix permeability of around .45 millidarcies, a small improvement around the wellbore to a distance of approximately 16 feet, which we have estimated as to be in the nature of the improvement of the acid job that was performed on the well on completion.

The results of this study show that from inception of production to bubble point we can expect a cumulative recovery of on or about 4 perdent of the oil in place, ranging from a minimum of 3.91 percent if we were producing the well on a 320-acre spacing, to a maximum of 4.63 percent, if we were producing the well on 40-acre spacing.

The section titled Results Bubble Point to Abandonment, show that we can recover on or about 1.3 to 1.6 percent more of the oil in place after we have declined below the bubble point.

On the second page is the Summary of Results to abandonment of the well. Basically, our abandonment conditions were taken at the point at which our bottom

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hole flowing pressure reached approximately 2000 pounds per square inch absolute and we began to notice considerably high increases in the -- increasing rates in the producing gas/oil ratios.

These data show that the total recovery from the well, if it is not stimulated, will be on the order of 5.3 to 6 percent of the oil in place, varying again with the spacing.

The 10,020 barrels of recovery shown under the 40-acre case, and they're 10,000 barrels of oil per 40 acres, 37700 per 160 acres, 70860 per 320 acres. So if you're interested in comparing 40 acres with -- four wells on 40 acres with one well on 160 acres, our four wells on 40 acres would recover 40,080 barrels of oil compared with 37700 that can be recovered by one well on 160 acres.

The next two columns after the percent oil in place recovery, average pressure and boundary pressure, represent the final operating conditions of the well. That is to say under the 20 barrel per day producing case the average pressure within the 40-acre pattern was calculated at 3486 psia and the pressure at the 40-acre boundary was 3553. So the pressure has been drawn down at the boundary some 1900 to 2000 pounds below the original pressure.

On the 160-acre case the average pressure in the system is 3585 and a boundary pressure of 3648, indi-

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cating to us that at the depletion of the well we have reduced the boundary pressure from 5455 psi to 3648 psi, a distance of 160 acres from the well, indicative that the well definitely is draining 160 acres.

The length of time necessary for the pressure transient to reach a 160-acre distance is slightly less than 90 days. The 90-day time step on this particular study showed a boundary pressure on a 160-acre pattern of 5367, or some 80 pounds below original pressure after 90 days of production, so the transient reaches that 160-acre distance in slightly less than 90 days.

The pressure after some 180 days, or some 6 months, is 5273 psia, a good 160 pound drawdown at the boundary.

Q. Now, you heard Mr. Yates testify that they were going to produce the well and shut it in and for the purpose of obtaining data to design a treatment for the well, either acid or frac. Did you conduct any studies assuming that these treatments were given to the well?

A. Yes, sir, we did.

Q. Are those protrayed and the results summarized on Exhibit Seven?

A. Yes, sir, they are.

Q. Would you turn to that exhibit?

A. The first page of Exhibit Seven, in the

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middle of the page, Simulation Model Permeability Values, show a distance from the wellbore and list two sets, Set I and Set II.

Set I and Set II are approximations of permeability improvements at varying distances from the wellbore that might be obtained through a large matrix acidizing job or a sizeable acid fracture treatment.

For example, in Set I we used to a distance of two feet from the wellbore a permeability of 89.2 millidarcies, scaling down to 2.2 millidarcies a distance of 64 feet from the wellbore. From 64 feet to the boundary the matrix permeability of .45 plus or minus millidarcies is used. Now these are boundary permeabilities so what we're saying is that the distance from 2 feet to 4 feet the permeability declines from 89.2 to 44.6; from 2 feet -- or from 4 feet to 8 feet it declines uniformly from 44.6 to 22.3, and so on.

Set II is more representative of a very deep penetrating fracture treatment in which the permeability improvements are carried out to a greater distance, this being to a distance of 387 feet. We feel that Set II permeabilities are probably the maximum that one can expect to attain with an efficient fracture treatment.

Consequently, the data in the comparisons of operating modes under Set II represent what we feel would be optimum conditions for this well.

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The next series of pages are presentations in the same format as the study, Exhibit Six. You will find 40-acre Set I followed by 160-acre Set I followed by 320-acre Set I. These data then represent performance of the well at 20, 40, and 70 barrels a day on 40-acre spacing, 160-acre spacing, and 320-acre spacing for the improvement configuration described on the first page of the exhibit as Set I.

Again, the data show that the performance of the well is far more rate sensitive than it is pattern sensitive. For example, we see a recovery at 20 barrels a day on 40-acre spacing of 4.97 percent of the oil in place to bubble point on a 40-acre pattern; 5.29 percent on a 160-acre pattern. We see recovery to depletion at 20 barrels a day of 7.10 percent of the oil in place on 40 acres and 6.74 percent of the oil in place on 160 acres.

Continuing through at the 40 barrel a day rate we see an ultimate recovery of 5.7 percent of the oil in place on 40 acres; 4.66 on 160 acres; and we drop to 2.96 on 320. 320-acre spacing falls below the 160's on the Set I permeability, if this is the improvement that we would anticipate from the well.

We see boundary conditions at bubble point on all three spacings, 3842 psia on 40-acre pattern; or excuse me, on a 40-acre pattern at the varying rates we are well below the initial pressure. On the 160-acre case

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we show again the 3744 psia at the boundary at bubble point; 4356 at the 40 barrel a day case; 5189 at the 70 barrel a day case, so we have moved the pressure transient again beyond the 160-acre point.

Even on the 320-acre spacing we see our rates and pressures show that we have moved the transient out equivalent to that distance. At a 20 barrel a day rate we have 3852 psia at the boundary; 4532 under the 40 barrel case; 5369 under the 70 barrel case.

Now these pressures tie to the length of time, so that pressure is at the point in time listed in the last column.

Again looking at the specific printout and the various time steps, at a rate of 20 barrels a day on a 160-acre spacing configuration we have a boundary pressure of 5366 psia at the end of 90 days; 5272 psia at a time period of 180 days; 5366 again, or 80 pounds below the original pressure within 90 days.

Obviously, if the pressure transient will reach the 160-acre point with no stimulation then with progressive stimulation it would get out there a little quicker. At Set I the times are virtually the same all the way through for transient propogation as they are in the unstimulated case.

The next set of data sheets, which begin

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with the case description 40-acre Set II permeability cases 6, 7, and 8, represent a repeat of the study using the Case 2 permeability improvements.

We see here that we do substantially improve the overall recovery from the well. For example, on 40-acre spacing and 20 barrels per day rate we recover 7.26 percent of the original oil in place to bubble point with the Set II improvement as opposed to 4.97 with the Set I improvement. We have similar performance improvements through all of the cases.

The recoveries under 40-acre spacing, if you will turn to the next page, range from 10.78 percent at a 20 barrel a day producing rate to 8.8 percent at a 70 barrel a day producing rate. We have less differentiation between recovery at the lowest rate and the highest rate under this permeability configuration, again which is to be anticipated. We run into a less pronounced pressure gradient drawdown into the wellbore with the more efficient stimulation treatment. Consequently, the -- a greater retardation of the evolvement of gas from solution with the 10 and higher recoveries.

Moving to the 160-acre case, we see that the recoveries range from 8.51 percent of the oil in place at a 20 barrel rate, 6.5 percent at a 70 barrel a day rate. The recovery improvement between 40-acre spacing and 160-acre

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spacing for any given configuration of producing rate and improvement through stimulation is in terms of barrels of oil negligible.

The boundary pressures again are shown to be substantially below the original.

At the end of ninety days at a 20 barrel a day producing rate we have a pressure at the 160-acre boundary of 5358 psia, some 85, 90 pounds below original pressure. This pressure is down to 5264 pounds, or approximately 180 pounds below original pressure after 180 days.

At a 40 barrel a day rate pressure at the boundary, 160-acre boundary, at the end of ninety days is 5270; at the end of 180 days, 5083.

For a 70 barrel case, the boundary pressure, 160-acre, ninety days, 5140; at 180 acres -- or 180 days, excuse me, 4814.

The results of the studies show that ultimate recovery from the well is going to be to a certain extent rate sensitive and it is going to be highly sensitive to the efficiency of stimulation treatment. The type of treatment, depth of penetration, and other characteristics.

The studies show that a well will indeed drain 160 acres for any configuration of rate or wellbore or reservoir conditions. The 160-acre drainage is virtually as efficient physically as 40 acres without getting into the

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economic value of it.

The studies do also indicate that a well will physically drain 320 acres.

Q. Do you have an opinion as to whether 160-acre spacing will result in waste?

A. In my opinion 160-acre spacing will not result in waste.

MR. LOSEE: That's all the direct I have for the witness.

COMMISSIONER RAMEY: Any questions of the witness?

QUESTIONS BY MR. STAMETS:

Q. Mr. Mistrot, in all of this that you have told us, is there a figure that you would recommend as a maximum production rate during this test period?

A. Obviously less than 110 barrels a day. I do not know exactly what would be the optimum rate. This is one of the purposes of the extended test rate, to place the well on production to measure accurately and daily its producing rate in oil, procuding rate in gas, flowing tubing pressure, and to be governed by those data.

Our indications on this study, and this is not an MER study, it is a feasibility study to help to design a testing program and to be the initiation of the full

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scale studies. I would indicate that a rate of 70 barrels a day would not be excessive, but again, obviously, if the operator sees a major change in producing characteristics, and this is part of the test, we have recommended a fairly extensive production test, and an extensive buildup test, and the data from these tests can be submitted to one of the service companies for a very definitive stimulation treatment design. Once this treatment is designed, then the exact configuration of varying treatments can be modeled and predictions can be made, and the well place on production and monitored after that.

What we were attempting to do with the studies was to basically cover the waterfront conditions that could and should exist in the completion of this well, ranging from its initial condition, which we feel is pessimistic, considering that no doubt the well will be stimulated up to a stimulation treatment, which we felt would be, if anything, slightly optimistic, vary producing rates within these configurations and determine whether or not the data indicated anything substantial with regard to optimum well spacing or optimum producing rates. Our conclusions are that it definitely points to efficient drainage of 160-acre pattern and a range of rates between 40 and 70 barrels a day, which should not be damaging to the well.

Q Will the most efficient rate following

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stimulation be different from the most efficient rates prior to stimulation?

A. I would certainly hope so because this is the purpose of the stimulation treatment, to extend the fracture into the reservoir, or to matrix acidize, which provides basically a larger pore space or in effect a larger wellbore radius for the flow of fluids as they move close to the wellbore. And as we're producing 70 barrels of oil a day from this well, we're producing 70 barrels of oil a day right into the wellbore, and also on a ring 160 acres away from that well we are within this radial area also producing 160 barrels a day, so we have a tremendous velocity increase with an attendant tremendous pressure reduction close to the wellbore. The purpose of the stimulation treatment being to extend a large fracture well into the wellbore, well away from it, and fracture designs have shown at times they can be extended 400 feet or more, is to provide a larger flow area for the fluids further away from the wellbore to arrest that high velocity into the wellbore, consequently maintaining a higher pressure to a further distance, or actually, yeah, to a further distance from the wellbore, keeping that flowing pressure above bubble point for a substantially longer period of time.

So rather than have a pressure drop that looks like that into the wellbore, and I'm aware that can't

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go into the record, but we get that type of thing.

Q. Let's see if I can ask this question properly. If the Division would, or Commission, I guess, would put a limitation on this well of 70 barrels a day that would apply during this initial testing phase and then subsequent to any fracturing or any acid treatment, this would allow the well to be tested both before and after and for the development of any subsequent recommended more efficient rate without causing waste? That's a question.

A. You're asking if the Commission were to set a temporary allowable of 70 barrels a day with the stipulation that this would be reviewed after testing, would that provision cause waste, is that basically what you're getting at?

Q. Through your testing, treatment and frac test.

A. Right. Right. In my opinion a 70 barrel a day rate would not cause waste.

Q. Thank you. That's all.

COMMISSIONER RAMEY: Any other questions? The witness may be excused.

RUSSELL D. SMITH

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

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DIRECT EXAMINATION

BY MR. LOSEE:

Q. Would you state your name, residence, and occupation?

A. Yes, my name is Russell D. Smith. I reside in Houston, Texas. I'm the Division Production Superintendent for Napeco, Incorporated, which is the operator of the subject well.

Q. You've not previously testified before this Commission?

A. No, sir, I have not.

Q. Do you have a degree in mechanical engineering, and if so, where did you obtain it?

A. Yes, sir, I obtained a Bachelor of Science in mechanical engineering from Southern Methodist University in Dallas in 1970.

Q. Since your graduation what positions have you held?

A. I've been a roughneck to production manager. I'm currently Division Production Superintendent. I have been at one point in my career the Production Manager for the Pioneer Division of Geosource (sic).

Q. Are you a Registered Professional Engineer?

A. Yes, sir, I'm a Registered Professional

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Engineer in the State of Texas.

MR. LOSEE: Are Mr. Smith's qualifications acceptable?

COMMISSIONER RAMEY: Yes they are.

Q. Would you please turn to what has been marked Exhibit Eight and explain the -- what is portrayed by this exhibit?

A. Exhibit Eight is an economic evaluation of the subject well based on the most optimistic estimated recoverable reserves at the 40-acre, 160-acre, 320-acre spacing at the 20 barrel a day, 40 barrel a day, and 70 barrel a day flow rates.

On the first page are the basic data that -- those give our economic considerations.

Q. That's the data that you plugged into your -- on the second page?

A. Yes, sir.

Q. Okay.

A. The second page indicates this, regardless of which flow rate we're talking about on a 40-acre spacing, that -- that we will have a negative rate of return, a negative payout, a negative net worth, or present worth, which we're terming net cash flow discounted, but I feel like at today's interest rate that 20 percent is more like what we'd see, but as you can see, we have a negative net

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worth, as well as negative rate of return, and negative payout.

We begin, as we go to 160-acre spacing, we begin getting into positive figures. I might mention this, that these economics are based on one well only being drilled on 40-acre spacing, 160-acre spacing, and 320-acre spacing. So if you were to compare, for instance, the net worth of four wells being drilled on a 40-acre space -- each being drilled on a 40-acre spacing versus one well on 160-acre spacing, in this case we'd have four times the negative $245,277 versus a positive $55,310 net worth.

Q. And so the end result of this exhibit is that economically the unit cannot afford to develop this field on 40-acre spacing?

A. Yes, sir, that's a true statement.

Q. And --

A. One thing that's interesting about the flow rates is this: A maximum, or with these three given flow rates, a maximum rate of return, payout, net worth, is at the 70 barrel a day -- 70 barrel a day rate, whether we're talking about 160-acre spacing or the 320.

Q. Do you have an opinion, Mr. Smith, as to whether or not the approval of this application will prevent waste?

A. Yes, sir, I believe that it will. I

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believe that producing within the range that we've given here will -- on 160-acre spacing, will result in the optimum estimated recoverable reserves, as well as the best payout.

Q. Was this exhibit prepared by you?

A. It was prepared under my direction.

MR. LOSEE: I move its introduction.

COMMISSIONER RAMEY: Exhibit Eight will be admitted.

MR. LOSEE: I have no further questions.

COMMISSIONER RAMEY: Did we admit the other exhibits of --

MR. LOSEE: No, no. I forgot to ask him -- I've got a note. I'll do it in due time.

COMMISSIONER RAMEY: Any questions of the witness, Mr. Smith? He may be excused.

MR. LOSEE: One question of Mr. Mistrot. Were Exhibits Five-A, Six, and Seven prepared under your supervision?

MR. MISTROT: Yes, sir, they were.

MR. LOSEE: I move their introduction.

COMMISSIONER RAMEY: Exhibit Five-A, Six, and Seven will be admitted.

MR. LOSEE: That's the applicant's case, Mr. Examiner.

COMMISSIONER RAMEY: Does anyone have

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anything further to add in this case?

If not, we'll take the case under advisement and the hearing is adjourned.

(Hearing concluded.)

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REPORTER'S CERTIFICATE

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

Sally W. Boyd C.S.R.

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NEW MEXICO OIL CONSERVATION COMMISSION

COMMISSION HEARING

SANTA FE, NEW MEXICO

Hearing Date APRIL 16, 1980 Time: 9:00 A.M.

NAME	REPRESENTING	LOCATION
R. Hulen	Capitol Observer	Santa Fe
Tates	Yates Pet.	Artesia NM
J. Losee	Losee, Carson & Dickerson	Artesia NM
Russell D. Smith	NAPECO, Inc.	Houston, TX
G. A. Mistrot	Kepliger & Assoc Inc	Houston TX
Frank Landelhaus	Self (Consultant)	Dallas, TX

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION
STATE LAND OFFICE BLDG.
SANTA FE, NEW MEXICO
16 April 1980

COMMISSION HEARING

IN THE MATTER OF:

Application of Napeco, Inc., for pool creation and special pool rules, Eddy County, New Mexico. CASE 6609

BEFORE: Commissioner Ramey
Commissioner Armijo

TRANSCRIPT OF HEARING

A P P E A R A N C E S

For the Oil Conservation Commission: Ernest L. Padilla, Esq.
Legal Counsel to the Commission
State Land Office Bldg.
Santa Fe, New Mexico 87501

For the Applicant: A. J. Losee, Esq.
LOSEE, CARSON, & DICKERSON
Artesia, New Mexico

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GUS A. MISTROT

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RUSSELL D. SMITH

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COMMISSIONER RAMEY: The hearing will come to order.

We'll call Case 6609.

MR. PADILLA: Application of Napoco, Inc., for pool creation and special pool rules, Eddy County, New Mexico.

MR. LOSEE: A. J. Losee of Losee, Carson, and Dickerson, Artesia, New Mexico, appearing on behalf of the Applicant.

I have four witnesses.

COMMISSIONER RAMEY: Any other appearances?

I'd ask that the witnesses stand and be sworn at this time.

(Witnesses sworn.)

PEYTON YATES

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

DIRECT EXAMINATION

BY MR. LOSEE:

Q Will you state your name, residence, and occupation?

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A. My name is Peyton Yates. I live in Artesia, New Mexico, and I'm a petroleum engineer.

Q. Yates Petroleum Corporation is one of the applicants in this de novo request, is that correct?

A. Yes, sir.

Q. And Napeco is the other applicant in this request for de novo hearing.

A. Yes, sir. Napeco is the operator of the well and Yates Petroleum Corporation is a participant, a working interest owner in the well.

Q. What are you seeking in this application, Mr. Yates?

A. We're seeking the creation of a new pool for Strawn production. The new pool was discovered by the Benson Deep Unit No. 1, which is located 660 feet from the south line, 2180 feet from the east line in Section 33 of Township 18 South, Range 30 East, Eddy County, New Mexico.

The well was completed in the Strawn formation on May 9th, 1979.

We are requesting that special pool rules be established, including provision for 160-acre well spacing and standard well locations of 660 feet from the outer boundaries and 330 feet from the quarter quarter boundary.

A. What, Mr. Yates, will your testimony show today?

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A. We will show three things: That the well can effectively drain 160 acres; that it would cause waste to drill on 40 acres rather than on 160 acres; and we will show that a volatile oil reservoir requires special consideration in light of the pressure response of the hydrocarbons present in the reservoir.

Q. Mr. Yates, is this No. 1 Well on production at this time?

A. No, sir, it is not. We do expect it to go on sometime this week. It may very well go on production today. There has been a considerable delay because of an impasse reached with respect to Federal regulations.

One of the parties in the well who is attempting to sell their gas had to affect a gas exchange agreement, and which went through two other parties, two other transporting and purchasing parties, and it was necessary to go to the FERC, the Federal Energy Regulatory Commission, in order to get permission to conduct the exchange, the transportation, and to work out a tariff agreement that would be handled among all those parties, and it was not until Friday of last week that that tariff agreement and the permission of FERC was approved by the companies involved and by the FERC.

So we have just apparently gotten permission, by coincidence, just last Friday to turn the well on,

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and I think it's going to be turned on this week.

Q. Mr. Yates, would you refer to what's been marked as Exhibit One and explain what is shown on this exhibit?

A. Exhibit One is a simple land plat, which shows the location of the Benson Deep Unit and also the Benson Deep Unit No. 1. The unit is outlined in red and the Benson Deep Unit No. 1 is colored in red.

It should be noted that all other wells that are indicated inside of the unit area are shallow wells that were not part of the unit and were drilled prior to the creation of the unit.

There is also shown a proposed location in the west half of Section 34, which is just that at this time, a proposed location.

Q. Would you turn to what has been marked as Exhibit Two and explain what is shown on this exhibit?

A. Exhibit Two is a copy of the two logs that were run across the particular pay in question in this well, the dual laterolog and the compensated neutron density log, which is located on the right of the two logs.

The logs show the producing intervals, the perforations at 10,648 to 56, from 10,671 to 77, from 10,702 to 18 feet. Those perforation intervals are colored in red on the compensated neutron formation density log.

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The producing interval is limestone. The well was acidized with 4000 gallons of acid and was completed for 104 barrels of oil per day and 550 Mcf per day at 968 psi flowing tubing pressure on a 12/64ths choke. Initial bottom hole pressure was measured at 5440 psig at 10,720 feet.

Q Do you have anything further?

A Yes. I might comment upon our proposed production procedure once we do get the well turned on.

We anticipate flowing, and the operator will be primarily the party that will determine the actual length of flow, but we'll be -- we'll be in cooperation with the other parties in the well, but we anticipate flowing the well for approximately a week to a month to evaluate the well's flowing performance and then we'll shut the well in and obtain a pressure buildup.

From that performance and from the pressure buildup, we intend to design an acid or a fracture treatment that will best help us to improve productivity of the well, but at this point the treatment has been limited to what we have described to you.

MR. LOSEE: I have no further questions of this witness.

COMMISSIONER RAMEY: Any questions of the witness? Mr. Stamets?

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QUESTIONS BY MR. STAMETS

Q. Mr. Yates, have you made any estimates at this point as to the extent of this pool?

A. No, sir, we have not had enough production history to obtain any kind of a boundary effect from any kind of pressure buildup, and the only means that we have of determining the -- what distance it may be is a volumetric calculation. Of course the real test of that will be subsequent wells, the performance of this well, and subsequent drilling.

Q. Will this one week to one month test that you are looking at give you any sort of a boundary determination?

A. We're hoping that it will. It may not be long enough. It will just depend on the -- how the well performs in that period of time, but we are hoping that it will give us some kind of a boundary determination.

Q. On Exhibit Number One you've outlined the Benson Deep Unit. Under the terms of that unit agreement could have all of the area inside that on 160's without the approval of the Division, couldn't you?

A. Yes, sir, except that, as I understand the -- we do have some acreage problems, and we may -- if we -- we'll only be allowed -- we have to drill so many wells. We

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have to have a development program to meet the USGS standards, and those standards will be designed upon what the proration units are, and so we have to drill subsequent wells every so often to keep the unit alive. And if we're having to drill on 40's versus 160's, which would be determined at the State level, then it would certainly affect the life of the unit, and whether or not the unit would be kept alive.

MR. STAMETS: That's all.

CROSS EXAMINATION

BY COMMISSIONER RAMEY:

Q. I notice, Mr. Yates, I notice on the drill stem test that you have initial shutin pressure covering the Strawn interval, initial shutin pressure of 5376.

A. Yes, sir.

Q. And your final shutin pressure of 5041. Does that indicate a limited reservoir?

A. There -- we would show this later in the testimony where we can present the actual drill stem test itself, but the values were extrapolated, and I believe that we had extrapolated about a 50 pound pressure drop is all, and it was felt like this was in the margin of hopefulness that we would not have any kind of a depleted reservoir, and since that time we have experienced a shutin of 5440, which is even higher than the initial shutin. And so within the

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range of error of recordings and the fact that it took time to buildup on the final shutin and was still building, I don't think that we've seen enough evidence to say that we have a depleted reservoir.

Q. Okay.

COMMISSIONER RAMEY: Any other questions of this witness? He may be excused.

FRANK O. REUDELHUBER

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

DIRECT EXAMINATION

BY MR. LOSEE:

Q. Will you state your name, residence, and occupation?

A. My name is Frank O. Reudelhuber. My residence is Dallas, Texas. I am a petroleum engineering consultant, self-employed.

Q. Frank, let's help the Commission, as you did me, with the spelling of your name and its pronounciation. It's German?

A. Yes, it is of German origin. It's Reudelhuber. It's spelled R-E-U-D-E-L-H-U-B-E-R. It's pronounced Reudelhuber, like Roy Rogers, Reudelhuber.

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Q. Thank you, Frank. You've not previously testified before this Commission?

A. No, I have not.

Q. Where did you obtain your undergraduate degree and in what year?

A. I obtained my Bachelor of Science in chemical engineering from the University of Oklahoma in 1947.

Q. Go ahead.

A. I'm currently a candidate for a PhD in geosciences at the University of Texas in Dallas.

Q. Would you state briefly for the record your employment history in the oil and gas field?

A. I was employed by Atlantic Refining Company, now Atlantic Richfield, from the time I graduated in 1947 until 1951 as a Field and Research Laboratory engineer. I was concerned principally with well testing, pressure testing, well sampling, and laboratory study of reservoir fluids.

I moved to Core Laboratories in 1951, remained with them until 1972 in several positions, both domestic and foreign; the final position with Core Laboratories was Assistant to the President.

Since 1972 I have been self-employed or self-unemployed, as you may choose, as a petroleum engineering consultant, operating out of Dallas and working for various

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clients in the oil industry, including Core Laboratories.

Q. Are you a Registered Professional Engineer?

A. Yes, I am a Registered Professional Engineer in the State of Texas.

Q. And have you authored any technical papers?

A. Yes, I've authored several technical papers on well testing, sampling, core analysis, and the laboratory study and application of fluid data on volatile oil reservoirs.

Q. Did you write one of the early papers on volatile oil reservoirs?

A. Yes. The two earliest papers to appear in the Society of Petroleum Engineers literature were presented at the same meeting, one by myself and a co-author, Richard Heims (sic), the other by two gentlemen, Jacoby and Berry (sic) from PanAmerican Petroleum, or Amoco at the present time.

Q. What year was that?

A. 1957.

MR. LOSEE: Are Mr. Reudelhuber's qualifications acceptable?

COMMISSIONER RAMEY: Just barely.

A. Thank you very much.

Q. Would you give an explanation of the study of reservoir fluids in general so that the Commission

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will have an understanding with respect to the -- its effect in determining the nature of the reservoir and the subsequent testimony on simulation studies?

A. Yes, I would be happy to do so, and with the Commission's permission I would like to step to the blackboard, if I may.

I think, perhaps, I would appreciate it if you would accept this, please, as being an informal presentation on my part. The purpose of it is to bring us all to a common level of understanding, and I certainly do not intimate that anyone in this room is not knowledgeable in any of these areas. Some of these things may be very familiar to you, others may not, just by virtue of the fact that you have not been exposed to it.

I will have to begin with some rather basic data before I can move on to describing to you what, indeed, is a volatile oil that we are concerned with here today.

If at any point you feel that I have not adequately explained. or that I'm going too much into detail, simply tell me and I'll try to go through it faster.

We, who deal daily in our careers with oil and gas reservoirs are by necessity familiar with the reservoir fluid data application. Reservoir fluid is a term we use to describe the material which is present in the reservoir, whether it be gas in a gaseous phase, or whether it

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be in a liquid phase, we consider them all to be reservoir fluids. This is an all encompassing term.

The differences in what we see at the surface as we produce the reservoir fluids from the reservoir through the vertical flow column and through the separation equipment, determines in our mind whether this is a gas reservoir or an oil reservoir, based on experience that we have.

As far as the science itself is concerned, the chemistry of the situation, there is no real difference in these two things except in degree.

The reservoir fluids, oil and gas, as we know them, are principally, or with the exception of some contaminant, hydrocarbons. Hydrocarbons is a general term which covers in organic chemistry those materials which are made up of carbon and hydrogen.

The least, the most simple, the smallest of these chemical molecules is methane, which I'm sure you're all very familiar with. Methane has a formula of CH_4, and it is commonly designated in script as carbon with 4 hydrogen atoms attached to it, one carbon atom and Hydrogen atoms. This is the simplest and lightest of all the hydrocarbons.

The next one, and you can perhaps foresee what it would be, is 2 carbons with 6 hydrogens. This is ethane.

The next is propane, which would be 3

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carbons. The number of "h" -- the formula for this is C_nH_{2n+2}. These are called the paraffinic hydrocarbons. There are a whole family of hydrocarbons, and methane, ethane, propane, which of course are 3; butane having 4; pentane having 5; hexane having 6; septane, 7; c tane, 8; nonane (sic), 9; dectane, 10; these prefixes coming from the Greek and used in that manner.

A reservoir fluid can contain hydrocarbons ranging from methane, or we would say CH_4, or 4 c rbons, up to 250, 300, 350, 400 hydrocarbons, hydrocarbon atoms. These you would anticipate would be very long, large, heavy molecules, and that is indeed what they are.

The fluids that we find in oil and gas reservoirs are then a mixture of these hydrocarbons, and listing -- listing them rather quickly and simply here, let's say that we would use the abbreviation of the number of carbon atoms. We have C_1, C_2, C_3, C_4 in two forms the C_4, a little complicated with that, C_5, C_6, and on and on and on.

Now, for convenience sake, in most reservoir fluid studies and in most analyses of reservoir fluids to yield this chemical composition we normally have a final complement that we will say all of this. This represents all of the rest. If we're dealing with a normal oil reservoir, if there is such a thing as a normal reservoir,

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let's just say for an example a reservoir that produces 30 degree API oil, has a gas/oil ratio of 500 cubic feet per barrel, there would be no question in anyone's mind in this room, I'm sure, that we're talking about an oil well.

If we have well that produces 10 million cubic feet of gas per day and 200 barrels of liquid per day, there would probably be little question in most minds that this was a gas well.

What then is the difference between these two? It really is the number and distribution of these hydrocarbons in the reservoir fluid itself before it has come to the surface and separated into two phases; while it is still in the reservoir in one phase.

A system which was heavy of -- this is going to be confusing -- let's say it this way, which contains a large concentration of the light hydrocarbons and a small concentration of the heavy hydrocarbons would be a gaseous form in the reservoir. Now, it wouldn't look like gas as you usually are aware of it. It's very much compressed; it's dense; it's fluid; it has vicosity; it has density. Whether you chose to call it a vapor or a fluid is academic, really. It's a fluid.

Now, if it is concentrated and the lighter material is produced to the surface, it will separate into predominantly gas. Since these materials are very

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volatile they boil off at surface temperature. It would separate into gas and a residual material remaining that contains some of the lighter material, but was heavier -- more concentrated in the heavier material. That would be a condensate. So we would be talking about a gas/condensate well. A smaller concentration of the light, a larger concentration of the heavy components.

If nature chooses in the generation and migration of the hydrocarbons system to subject it to different conditions, it will have in the reservoir a different reservoir fluid composition, and virtually every oil reservoir, every gas reservoir in the world probably has a different composition. Some are quite similar but due to the fact that they were generated during geologic time and migrated, they are all different, but very similar. So we sort of group them.

If, on the other hand, we find that we are dealing with a system where the concentration of the light materials, the methane, ethane, propane, is low and the concentration of these heavier materials, the C_5, C_6, and the C_7 plus, or whatever residue we choose to call remaining, the low concentration of this, high concentration of this, at the surface you will see what we would call an oil well. It would have an API gravity that would be probably lower than gas/condensate well, simply because it has

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more of the heavy heavies in it than the gas/condensate. So the differentiation between the two is simply a variation in chemical composition.

Okay, we've said a gas is light in these, it has a low concentration of lights, a large concentration of heavies. We said -- I'm sorry, correction for the record, please.

We said that gas had a high concentration of lights, a low concentration of heavies, and that oil had a low concentration of lights and a high concentration of heavies. What then might be in between? Something that we would call a volatile oil, which would come to be called a volatile oil. It simply happens to not be heavily pushed in the direction of the light material, nor in the direction of the heavy material, but has a large concentration of the intermediate hydrocarbons.

Now, all of these always add up to 100 percent total, and in volatile systems we're looking at intermediate composition, where these intermediate components are of the order of 20 to 30 percent. And that's a very general statement, please. The temperature of the reservoir has something to do with this, also.

But composition where we are heavy in the intermediate materials we call volatile oil, and for us there is no problem. We deal with these things in a routine fashion

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daily. We have gas; we have oil; we have things in between. The things in between are rich gas/condensate and volatile oil, and there is no line, clear line of demarcation between the two. It's a gradual transition from one to the other, depending on the composition.

So probably the best criteria, even though it is general, is that volatile oil system has a larger concentration of intermediate than a normal oil system or a normal gas system. You have a heavier concentration of these intermediate materials. Nature made it that way.

Now, since it's midway, or somewhere in between an oil and gas, then we would expect its physical properties also to be somewhere between that of an oil or a gas, and that indeed is the case. The viscosity of this liquid, the volatile oil, is low, in the order of a few tenths of a centipoise, a few tenths of a centipoise.

With oils we're looking at viscosities of 10, 50, 500, or 1000 centipoise. With gases we're looking at viscosities in the reservoir, and again, pressure has an effect here, so I can't be too specific, but in a general sense of .0 something approaching .1, which we find to be sort of the range of viscosities for these intermediate fluids, the viscosities between .1 and .3 , more or less.

The volatile oil also suffers a much larger shrinkage in coming from the reservoir to the surface.

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The words formation volume factor is used quite commonly for this. In general, the volatile oil reservoir, the formation volume factor will be two or greater. This means that for each barrel of stock tank liquid you recover you remove two barrels from the reservoir.

So formation volume factor of two.

Gas/oil ratio, again affected by pressure, the number of separators that you have, how we operate the separators, it can vary from 2000, or slightly less, perhaps, to 3000 standard cubic feet per barrel; 4000, possibly, and be the volatile oil.

The gravity, the API gravity, is normally above 45 degrees API. Quite often, it's 52, 53. It's very hard, again, to make a firm definition.

I think what I wanted to accomplish more than anything else in this explanation, is to make it as clear as possible that there is nothing magic about volatile oil, but they differ from the normal gas or the normal oil that we're used to dealing with in that they're sort of an intermediate thing between the two.

Some things about this are good; some things are not so good. The low viscosity is certainly a benefit because the fluid will flow more easily from the reservoir than if it were a heavier crude with higher viscosity. That's an advantage, certainly.

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The shrinkage is not so much of an advantage. In fact, you would have to sort of look at that as a disadvantage, shrinkage of formation volume factor, because for a reservoir at a given volume we have less barrels of stock tank liquid than we would were it filled with a more normal oil.

So from that standpoint our oil in place, so to speak, initial oil in place, is lower in terms of stock tank barrels that it would be if it were a normal oil -- a more normal oil.

Gas/oil ratio, with gas/oil ratios of 2000 cubic feet per barrel and higher, something in this range, there is some economic advantage today with the fact that we do produce along with our oil this extra amount of gas, of which we ordinarily don't have the benefit.

It has the disadvantage in that it causes some things to happen in the reservoir which make operation of the reservoir very, very touchy. It requires a lot of attention. They need to be produced in a prudent engineering fashion, and such being the case, everything -- doing everything you possibly can do, the ultimate recovery by pressure depletion and percent of initial oil in place is going to be lower, and significantly lower, than it might be in the case -- than it would be in the case of a normal oil.

Are there any questions? I can draw some

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more pictures, but I think I can illustrate these points a little better when --

COMMISSIONER ARMIJO: I have a question. Is this a unique thing?

A. Unique, no. Common, no. The first fluid of this type that was recognized was the Elk City Field in southwestern Oklahoma operated by Shell Oil Company, and they realized that they had something that was different. They didn't know what it was. This was in the early '50's, and the Bureau of Mines worked with Shell Oil Company at that time to try to determine what this thing was.

Very shortly after that there were additional discoveries. My first association with it was in Oklahoma near Chickasha, and it was the first association that I had with volatile oil. The information that's included in the paper was the -- that Heims and I presented -- is information from that first reservoir that we dealt with in Oklahoma.

They are now fairly common. They're still much lower in number than the normal type of reservoir. There are a good many in south Texas and in south Louisiana; a good many in Oklahoma. I don't know how often they've been encountered here in New Mexico. Certainly the Lusk-Strawn Field, the little information I've seen from that and I'm certainly not entering that as best evidence or testimony, it

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very likely was a volatile oil reservoir, also, but whether there are others in New Mexico, I'm not that familiar with the state and with the cases that have come before the Commission. I couldn't say.

It is not a unique situation, no, sir, but it certainly is not common. It's unusual.

Now, the word volatile oil has been thrown around so much and tried to be classified by so many people that if you're writing a textbook of course you've got to put something in there, and you find statements like the temperature is usually above 250 degrees. Well, 250 degrees is not a criteria for determining whether or not it's a volatile oil. It just happened that that particular author was aware of several volatile oil reservoirs that existed in-- at temperatures above 250 degrees.

Now, temperature is a very important effect here. These hydrocarbons are very much affected by temperature. The lighter ones are more volatile. They want to get out of there. They're more active. They move faster. And if we raise the temperature they move faster and faster.

So high temperatures can lead to volatile oil systems with gas/oil ratios, perhaps, less than what we see and we'll discuss here in the testimony today. If these same fluids that we're discussing here today were in south Louisiana, at 10,000 feet, would be under a considerably

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higher reservoir temperature and would -- its behavior would be even more marked than it is here. New Mexico has one of the lowest thermal gradientsin the United States. It's a little over 1 degree per hundred feet of depth, and that also appears in the literature. So perhaps one of the reasons why we might not see more than -- more of them in your area may be the fact that reservoir temperatures are generally less.

We could also say as a generalization that these things are normally found deep; deep, hot. Here we're deep enough; we're relatively not as hot as we might be somewhere else.

Q Frank, I'll give them all a chance to ask some more questions here in a minute. Let me ask you at this point if you'll explain the -- are you ready to go into laboratory procedure?

A Yes, I am, unless there are other questions.

Q Go ahead.

MR. HOLLAND: Okay.

QUESTIONS BY MR. HOLLAND:

Q What is the efficiency of producing in a reservoir like this one, like the percentage as far as you know?

A You're asking for a very -- this is for

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debate, no?

Q Right.

A It's certainly less than it would be in a normal reservoir. You're looking at recoveries probably in the range of 10 to 15 percent in most cases.

Q You have a great deal of irreducable oil saturation?

A No.

Q No?

A You'd leave behind a reservoir containing a large amount of gas.

Q Oh, okay.

A Also, your separation conditions at the surface are such that obviously if you're going to have a 2500 or 3000 gas/oil ratio, the amount of stock tank liquid that you're going to recover is going to be small, based on the total withdrawal figure.

The recoveries are, you know, are lower than you're used to looking at.

Q It would be very pressure sensitive, too?

A Yes, it is very pressure sensitive, extremely so.

Q You would try to keep the -- keep it in an oil state rather than in a gas state in producing the reservoir?

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A. Yes. This would be one of your objectives, if possible, would be to keep the reservoir in a single phase, and I won't even attempt to call it oil or gas, just keep it in one phase so it doesn't undergo this change, which I'm going to discuss next when I discuss the laboratory procedure, in general.

Q. Frank, let's go to the laboratory procedure.

A. All right.

Q. And explain that.

A. I hope I haven't been too verbose, but I think it's very important that we have this basic understanding. It will go more rapidly from this point on.

In order to perform the laboratory study on any system, be it gas or oil or volatile oil or rich gas/condensate or lean gas/condensate or dry gas, we have to have samples from the reservoir. So the first step, of course, is sampling of the reservoir.

Volatile oil reservoirs are no different from any other except that you have to be very careful that, hopefully, we have not produced the reservoir at a rate sufficiently high enough to have resulted in separation in the reservoir into two phases, because this separation is extremely drastic in the case of a volatile oil. In the case of a normal oil it's more limited and can be overcome. So

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prepared conditioning before sampling is extremely important. Samples can either be taken at the surface and recombined or they can be taken by bottom hole sampling. Pressure maintenance is extremely important in association with the sampling of these reservoirs.

But, passing onward, assuming that we sampled the reservoir carefully, we arrive in the laboratory with a sample of the fluid as it exists in the reservoir, the fluid is then -- it is maintained under such a pressure as to keep it in one phase at all times.

It is then heated up to reservoir temperature and the laboratory procedures begin at some pressure above the reservoir pressure.

In the laboratory then we have the sample confined in a cell. This is mercury, and we have a pump, volumetric pump, attached to the cell so that we can measure an ounce of mercury in and out. We have a valve here and have a valve here, and then we have a long window in the cell so we can see inside and see what's going on.

At reservoir temperature, then, we begin to lower the pressure and we do this by removing, producing, some of the fluid from the system. In dealing with volatile oils the laboratory procedure is slightly different from normal systems. In laboratory procedure the volatile oil, or rich gas/condensate, we use what's called a constant

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volume depletion. We say that this is our original reservoir volume, cc, cubic centimeters or cubic inches. We lower the pressure by withdrawing some of the mercury and when we do that, we will see at the very top of the cell the formation of a small bubble of something. It's at the top and it's a bubble. We'll say it's gas, okay, this is called the bubble point or the saturation pressure, and in a volatile oil system we have a small bubble of gas. We know it's gas because it's at the top; it's lighter than the other fluid.

If we were dealing with a gas/condensate reservoir, the first thing we would see on reducing the pressure would be a small bubble of -- a small droplet of something at the bottom. We call that the dewpoint, like a dew; a small bubble.

Therein lies the classification of is this an oil reservoir or is it a gas reservoir. If the bubble point is at the top, it's considered an oil reservoir -- or a gas reservoir. If the bubble forms at the bottom, if the drop forms at the bottom, it is considered to be a condensate reservoir.

And that's the only strict definition that's possible.

In a volatile oil reservoir, then, we continue this process. We drop the pressure and then we displace gas out until we have returned back here again to our

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original reservoir volume. Draw mercury out to lower the pressure; then we push mercury back in at constant pressure pushing gas out, or producing it. This then corresponds to how much you will remove from the reservoir by going from pressure one to pressure two, or from the bubble point pressure to the first pressure below.

We keep -- we do this in steps by every 600 pound increments to obtain 10 or 12 points.

The gas which comes out is analyzed. The chemical composition of that gas is determined at every point in that depletion in the pressure pushing cycle. Knowing the amount we started with, knowing the amount and composition of the gas, we will calculate the composition of the liquid. We also measure the amount of the liquid by use of this window and some special devices.

What, then, would be the difference between volatile oil and reservoir oil -- and normal oil under these circumstances?

The difference would be that both of them would, if you cautiously approach this thing, would produce a small bubble of gas at the bubble point pressure, at saturation. The volatile oil will do it just like a normal oil.

But the next pressure step, say we lowered the pressure 300 pounds, for example, from the pressure of 3000 pounds, we lower it to 2700, 3000 pounds is where we had

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our bubble, for example, and we lower the pressure to 2700, in a normal system the amount of gas up here will grow X amount in lowering the pressure; in a volatile oil it will grow more than X amount, one and a half X, perhaps 2X. In other words, a very small pressure drop below that bubble point causes the forming of a large volume of gas and the subsequent shrinkage, a large shrinkage, of the reservoir oil.

So this is the procedure that we follow in the laboratory and in a separate measurement, using exactly the same technique, we determine the viscosity. From this we determine the composition of both the gas and the oil phases at all points. We need these in order to go into the calculation procedures we're going to use. We determine the volume of liquid remaining at any point, the volume of gas which has been produced. We can do a material balance, the mass balance, chemical balance, around the whole system so that we know that nothing's been lost.

This then is the basic data that the reservoir engineer begins with on a volatile oil system, and I think I'd like to introduce into --

Q. I'll hand you what's been marked as Exhibit Three, and ask if you'll briefly explain it, explain what that is.

A. Thank you, Jerry. Exhibit Three is a

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laboratory study performed by P-V-T, Incorporated, in Houston on samples taken from the Benson Deep Unit No. 1 on December 19th of 1979.

If you'll turn to the first page of data after the letter, you'll see the sampling date was December 19th, and down at the very bottom you'll see some information referring to the gas -- producing gas/oil ratio.

Now I'd like to avoid confusion here for you at this point when in pointing out, we talked before about gas/oil ratios in the range of 2000 or so. You'll see here that this well was producing with a gas/oil ratio of 1095, but please note that this is separator gas to separator liquid, not separator gas to stock tank liquid.

Now the separator liquid will be 20 to 30 percent more than the stock barrel -- stock tank. The separator here was operating at -- I'm sorry, I don't see that, it was a test separator, but it's somewhere in the neighborhood of 300 pounds, I'm not sure; I don't recall.

So we measured in the field the separator gas, the separator liquid gas/oil ratio. We measured the stock tank, actually, but we corrected in the laboratory by determining the separator liquid.

So this 1095 is the ratio in which we put -- they put, P-V-T, Incorporated, the gas and the oil that were produced at the surface. They put them back to-

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gether in the same ratio, 1095 standard cubic feet of gas for every barrel of separator liquid.

Now this would translate to a much different number through the stock tank, and we'll talk about that later.

The rest of it, I won't go into detail. It's standard, straightforward. If you'll turn to the next page, you'll see that one of the very first things that's presented to you is the composition, the composition of the separator liquid, the composition of the separator gas, and the well stream, or the reservoir fluid composition, which is the result of putting back together again this oil and this gas. And you'll note, if you look at the separator liquid and separator gas, the composition is the very thing that we were talking about. The separator liquid has a lot of the heavier materials and not much of the light; the separator gas has all light materials and not much of the heavy, and that's exactly the situation it contains in the reservoir if we're dealing with a gas or oil system.

I have no further testimony to present as far as the fluid system unless you have questions.

Q Frank, why don't you explain how this sample was -- who took this sample?

A. All right. The sample was taken by Tefteller, Incorporated, a wireline service and testing com-

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pany from Midland; Midland and Farmington, I believe, they have an office in Farmington, also. They did take the samples. They did measure the gas/oil ratios, and they were observed by a representative of Yates Petroleum, who was present during testing and sampling.

The samples were sent to Houston at the request of Napeco and analyzed by P-V-T, Incorporated, for the operator.

Q Let me hand you what's been marked as Exhibit Four and ask you to explain briefly what this -- the purpose of this exhibit is.

A We very often -- the exhibit referred to is an evaluation performed by Core Laboratories, Incorporated, of the P-V-T, Incorporated, laboratory study. The analysis has two purposes; one, to insure that the properties were correct; and two, to put them in the proper form so that they might be utilized in the reservoir engineering calculations which were to follow and which will be testified to, to follow. This is standard operating procedure for Core Laboratory. We do it on all studies. We take the laboratory data, we put it into a different form.

The particular thing we do, and I'll tell you very briefly, is instead of just using this large term down here of C7+, we will -- we carry it out, the information out four more components, and work with C11+. This is because

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most of our models permit us to input 16 different chemical components. It would be great if we could input 30, but computers seem to cost a great deal of money. But before our programs will accept the data it has to be put into a separate form.

So this is an evaluation of the data itself. It's been translated and put into a different format suitable for entry into our reservoir models, our reservoir simulator models.

Q. Why don't you turn to Figure 1, which is a graph, on the last page, if you will, and briefly explain what this graph portrays?

A. Figure 1 are the -- presents the information which is most necessary and most -- for use in the reservoir model, and most indicative of the fact that we're dealing with a volatile oil system.

The top curve is viscosity. You'll note that the viscosity is less than .2 centipoise. It is about 1.2 -- .146 at the bubble point, .146, very low viscosity.

The next two curves down are the differential formation volume factor and the flash formation volume factor, differential and flash. The differential is what we have done here in the laboratory. Flash is what Core Lab has done in preparing the data for entry into the computer. We have calculated how this gas and oil which will be produced

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in the future from the reservoir, how they will behave when they go through the separator. So we make separator calculations. Those calculations are called flash calculations. So we call the formation volume factor the flash formation volume factor.

This, which is done in the laboratory, we call differential formation volume factor. It represents what's going to happen in the reservoir. The flash formation volume factor represents what we're going to see at the surface.

Immediately below the saturation pressure, or the bubble point, which in this case is 3098, or roughly 3100 psi on your obttom scale, we have the differential formation volume factor and the flash formation volume factor. The scale is on the right. You'll notice that the differential formation volume factor is 2.2. The flash formation volume factor, or slightly over at the bubble point, but the flash formation volume factor is 2.1 something, slightly less. It's always this way. I won't attempt to explain it. It has to do with the system. So the differential formation volume factor is what -- now, if you'll notice just below the bubble point, it would be very nice if we could presume that as we lowered the pressure below the bubble point, this being gas in sclution, this pressure, and we starting out here at a bubble point, at a bubble point. We won't discuss what hap-

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pens above the bubble point because of the single phase, and all we have to deal with there is compressibility.

But at the bubble point itself, 3000, 3100 pounds let's call it for round numbers, we would like to think that this gas will come out of solution in proportion with a pressure drop and that we'd have a nice line to look something like this. This is what you have with a normal oil system, so that this portion of the line is virtually linear. You'll notice here it is not linear. We have a curvature here. This curvature simply means that there is less gas in solution at a given pressure than you would have with a normal fluid, which means there has been more gas come out of solution. But we're talking here about the formation volume factor, I have here gas in solution, which are the two lower curves. Formation volume factor, we have the same thing. It's even more pronounced, perhaps, with the formation volume factor than with the gas in solution. I'm sorry I switched gears on you there, jumped from formation volume factor to gas in solution, but the same applies to both. In the normal oil we would expect a rather straight line and with volatile oil, as we see, this large dip, curvature, concavity, below the bubble point.

In a general sense, then, that is -- there are a great many details in this Core Lab evaluation. This is the information that we used in the model. It did come

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from the sample that was taken by Tefteller and analyzed by P-V-T, Incorporated.

Q. Let me ask you a question. Do you have an opinion as to whether or not the reservoir encountered by this Benson Deep Unit No. 1 is a volatile oil reservoir, as you have described it?

A. Within the general terminology that we can use, yes, it's a volatile oil reservoir. Yet the volatility effect would be much more evident were we to transport it to south Louisiana and raise the temperature above 200 degrees to 230 or 240. It would be more evident,

This fluid exhibits all of the behavior characteristics of a volatile reservoir fluid. It's intermediate in behavior between a gas and an oil.

Q. Frank, one other question. Has -- have volatile oil reservoirs, with respect to spacing requirements, been recognized by any other regulatory conservation commission?

A. Yes. I certainly cannot quote chapter and verse, Jerry, and --

Q. We won't ask for that.

A. No. They have been recognized, they are recognized in Oklahoma, in Texas and Louisiana, and special consideration is given in most cases to the volatile oil reservoir.

Q. Were Exhibits Three and Four secured under

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the supervision of Napeco?

A. Yes. Both exhibits were secured under the supervision of Napeco.

MR. LOSEE: I move their introduction.

COMMISSIONER RAMEY: They will be admitted.

MR. LOSEE: I have no further questions at this time.

COMMISSIONER RAMEY: That's just Exhibits Three and Four?

MR. LOSEE: I forgot, Mr. Commissioner, I'm going to ask one further question of my first witness.

COMMISSIONER RAMEY: Are there any questions of Mr. Reudelhuber? Mr. Stamets?

QUESTIONS BY MR. STAMETS:

Q. Do you have or can you tell us where to find or can you sell us -- send us a range of hydrocarbon constituents of what you feel would be in a volatile oil reservoir? For example, on Exhibit Number Three, page two of the analysis lists methane, heptane, percentage; for example, methane had 43.68 percent; heptanes plus, 18.56 percent?

A. Right.

Q. Now I would assume that there is a range of these constituents percentagewise that you feel would fit into volatile oil reservoirs along with the other definitions

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that you've given us here.

A. Yes.

Q. And I wonder if you could supply us with that or just plug some numbers in on this thing.

A. I'm not prepared to do it at this moment. I'm not prepared to. I don't have the information with me. I can point out to you, though, that one of the things that I mentioned was the volatile oil system is generally rich in intermediate material. The intermediate materials here, if you consider you have 43 percent methane and 18 percent heptanes plus, those two together add up to 62 percent, so that we would have 38 percent the intermediates. Part of the ethane is not considered to be an intermediate, but we're in the range of 40 percent of the intermediate materials. 30 percent, if we remove ethane, and the others are definitely intermediate material. So I stated to you previously, I believe in the testimony that this ranges from 25 to 35, or from 20 to 30, it depends on the system, but this is definitely in the range of what we would call a high concentration of intermediate components.

Q. Everything between methane and heptanes plus is what you would describe as --

A. More properly everything between ethane and heptanes plus. Now, ethane is sort of a double actor. Sometimes it behaves more like methane and sometimes it be-

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haves more like propane, depending on the reservoir pressure and temperature. It's kind of a strange actor. Most people refer to the intermediates as being C3 through C6.

Q. Now, what was the centipoise viscosity you described as being appropriate for a volatile oil reservoir?

A. In the order of 1/10 to 3/10 or 4/10, again, not as a hard and fast means of classification, but just as a generalization of what we have seen in our experience.

Q. And then based on the last page of Exhibit Number Four, what we would see, then, in a volatile oil reservoir, or in this particular reservoir, is a decline in gas/oil ratio after reservoir pressures drop below 3000 pounds?

A. That would be a decline in the gas remaining in solution. Now what has happened to your surface gas/oil ratio is another matter.

Q. I see, this is a reservoir --

A. This is a reservoir fluid study and this is what is happening in the reservoir. And the flash is what is happening at the surface as a result of what's happening in the reservoir but not taking into account any separation in the reservoir or any rock properties or anything else. These are just the properties expressed on a different basis

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Instead of residual oil, which is the oil left in the cell in the laboratory at the end of the test, these are based on stock tank oil. The differential data are reported in terms standard cubic feet of barrels -- or per barrel of residual oil.

In the -- in the case of this particular sample in the Core Lab evaluation, the residual oil gravity by differential, and this is on Table 2, the residual oil gravity was 47 degrees API corrected to 60 from the differential.

And the stock tank oil gravity from the flashes, which are over at the right where it says surface separation, is 51.4 degrees API.

So you can see we have two different processes here. We're referring the differential data to the residual barrel remaining in the cell at reservoir temperature. We're referring the flash information to the stock tank barrel remaining at the surface after that fluid comes from the reservoir to the surface, were it not affected in any way by rock properties or by separation within the reservoir.

Q Have you made any study of or will you be recommending any special production methods or limitations which should be applied in this reservoir to maximize recovery?

A No, sir, I will not. Napeco has a con-

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sulting engineering firm, who will advise them, certainly, in this direction. My role here today is simply to explain the fluid data and to reach some common understanding as to what is a volatile oil and does this indeed, the Denson Deep Unit, represent a volatile oil system.

Q Are you capable of making such recommendation if you were employed to?

A Yes, of course.

Q In your opinion how long a period of time, test time, would it take in order to make that determination?

A I'd rather not comment on that. I really have not studied the other information that's going to be presented to you later. I was not privy to that information, not by any design, but I simply was not involved in this at that particular point. I was working on another job for another client at that time.

Q Just, if you were employed by any client, not this particular one, how long do you feel that it would take under normal conditions to get the information necessary to design a proper production method?

A I really can't generalize on that. Let me -- let me state it in a way which I really don't want to be a hedge, but it may sound like one. The criteria that I would use as an engineer, is that I would produce the well until we reached a stable flow, relatively stable flow condi-

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tion. That is to say it would be, perhaps, a matter of days or weeks; certainly not more than a month. But until our surface indications became constant within our ability to measure them. In other words, until the wellhead pressure had stabilized; until the gas/oil ratio had stabilized; at this point I would feel that I had conducted a sufficiently long flow test to have stable flowing data, and at that time I would shut the well in for a bit, or I would suggest that it be, I would not personally myself do that, although I have in the past. Shutin for a pressure buildup, the duration of that pressure buildup would be indeterminate. I would want the pressure buildup to run for a sufficiently long period of time to give me information that I would need to interpret the buildup curve. That does not mean that it would have to reach a static, no longer changing pressure, but simply long enough to provide the information needed for the calculation procedures, which are more or less standard in the industry.

Q Thank you.

COMMISSIONER RAMEY: Any other questions? Mr. Holland?

QUESTIONS BY MR. HOLLAND:

Q If you could keep the volatile oil from reaching the bubble point in the reservoir, would you not

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have a more efficient production of fluids?

A. You would of any reservoir, a normal oil reservoir or a gas/condensate reservoir. Pressure maintenance obviously --

A. I wondered if pressure maintenance was a factor in this.

Q. Pressure maintenance is an obviously advantageous thing in normal oil, volatile oil, gas/condensate systems. All are, in all cases recovery would be increased, not merely volatile oil.

COMMISSIONER RAMEY: Thank you.

MR. LOSEE: May I ask my first witness two questions from his seat, or one question?

COMMISSIONER RAMEY: Yes.

MR. LOSEE: Were Exhibits One and Two prepared under your supervision, Mr. Yates?

MR. YATES: Yes, sir.

MR. LOSEE: Move their introduction.

COMMISSIONER RAMEY: Exhibits One and Two will be admitted.

We'll take a 10-minute break.

(Thereupon a recess was taken.)

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COMMISSIONER RAMEY: The hearing will come to order.

GUS A. MISTROT

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

DIRECT EXAMINATION

BY MR. LOSEE:

Q. Will you state your name, residence, and occupation?

A. My name is Gus Mistrot. I am a resident of Houston, Texas, employed by the consulting firm of Keplinger and Associates as Vice President and Senior Engineer.

Q. You have not testified before this Commission and had your qualifications accepted?

A. No, sir, I have not.

Q. Would you please explain where and when you obtained your undergraduate degree?

A. I obtained a Bachelor of Science degree from A & M College of Texas in petroleum engineering in 1951.

Q. Since that date what have been your employment -- what has been your employment?

A. I have served in various capacities as production and operations engineer, reservoir engineer, pro-

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duction geologist, gas storage engineer, for first the Oil and Gas Division of the Railroad Commission of Texas, later with Heath (sic) Oil Corporation, J. Ray McDermott and Company, and with Southern Natural Gas Company.

I joined Keplinger and Associates in 1974.

Q. Are you a Registered Professional Engineer?

A. Yes, sir, in Texas, Louisiana, and Georgia.

MR. LOSEE: Is the witness --

COMMISSIONER RAMEY: He is qualified.

Q. Okay. Would you turn to what I've now marked as Exhibit Five-A and which is entitled the Reservoir Properties, and briefly explain what is important with respect to this exhibit?

A. The studies that were performed for the purpose of determining the -- or estimating the performance of the Benson Deep Unit Well No. 1 under various configurations, well spacing, and producing rate. The spacing configurations that we studied were 40 acres per well, 160 acres per well, and 320 acres per well. We also worked with varying producing rates within these configurations.

The reservoir properties shown on Exhibit Five-A are those that were encoded into the reservoir simu-

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lation model for volumetric calculation of oil in place and for the initialization of the studies. They consisted of a reservoir rock porosity of 6 percent; water saturation of 30 percent; an original formation volume factor of 2.0257, which was testified to earlier by Mr. Reudelhuber; a net effective pay thickness of 26 feet; a permeability to oil of .446 millidarcies; if we work with differential liberation P-V-T data; .429 millidarcies if we work with flash data, or in essence, about .43 to .45 millidarcy permeability effective to oil. A reservoir temperature of 181 degrees; an initial reservoir pressure 5465 psia. Mr. Yates stated 5440, which is psig. A saturation pressure, or bubble point pressure, of 3098 psia, and an initial solution gas/oil ratio of 1870 Mcf per barrel, or cubic feet per barrel, excuse me.

The volumetric calculations show in a 40-acre pattern a total of 167,000 barrels of stock tank oil in place; under 160 acres, 669,000 stock tank barrels; and under 320 acres, 1,338,000 barrels.

Q. Now, I notice the permeability you are -- the reservoir properties you calculated at .446. I realize this is a de novo hearing, but I also realize, and I'm sure you do, that testimony in the original hearing treated a permeability of .036, I believe.

A. Yes, sir.

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Q Would you turn to Exhibit Five and explain the rather marked difference in permeability determination?

A In the original hearing, Docket 6990, as I recall, the reservoir system for the calculation of permeability was treated as a gas. The final page of this group of pages, which shows Johnston Schlumberger Computerized Data Analysis on the hearing, if you will look in Section 3, Permeability, the second sentence states the calculations were based on a slope of 953 psi per log cycle obtained from the final shutin buildup plot. It was assumed for these calculations gas gravity, .7; viscosity, .0213 centipoise; gas deviation factor, .842.

Using those data and calculating the Horner flow time based on gas producing rate, you come up with the .036 millidarcy permeability which was stated into that hearing.

The fluid analysis that we have conducted has shown that the reservoir fluid exists in a liquid phase in the reservoir; consequently, the data should be analyzed on that basis; that is, it should be based on a flow rate of some 300 barrels of oil per day, I don't remember the exact -- 309 barrels of oil per day rate at stock tank conditions; that those conditions should be converted to reservoir liquid flow based on the formation volume factors determined from

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the fluid analysis. But the viscosity used in the Horner equation is the viscosity of the reservoir liquid, which is .175 centipoise at original reservoir conditions.

Using those data we have recalculated the test. We present the Horner plot, a copy of our calculations. The result of those is that the effective permeability to the flow of reservoir oil is on the order of .43 to .45 millidarcies, and not a permeability of .036 millidarcies to the flow of gas.

Q All right, did you perform some studies on a simulator of the reservoir fluids?

A Yes, sir, we did.

Q Would you describe the simulator?

A The particular reservoir simulator used was Core Lab's 3-phase 2-dimensional radial reservoir simulation model. It is one of the many reservoir simulation models on the market today and it is one of the quite well accepted reservoir simulators.

The reservoir simulator differs from the simple material balance calculation in that the pressure and rate projections are made on a cell or grid basis rather than on a single total field entity. The calculations are made on a time step basis and the results are printed out in that fashion.

Q All right, do Exhibits Six and Seven that

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have been marked, summarize the results of these studies?

A. Yes, sir, they do.

Q. You studied what size spacing?

A. We studied 40-acre spacing, 160-acre spacing, and 320-acre spacing.

Q. At what flow rates?

A. We began with flow rates as low -- we studied the spacing configurations at flow rates basically of 20, 40, 70, and 110 barrels per day of oil production. We determined very quickly that at a rate of 110 barrels of oil per day the well would be drawn down well below bubble point in a very short period of time, and the attendant ultimate recovery from the well would be quite small. Consequently, we did not do any further detail study of the 110 barrel a day case. We concentrated on the 20, 40, and 70 barrel a day cases.

We found that the ultimate recovery from the well with no other considerations other than just ultimate recovery, was highest with the lower rates.

Exhibit Six presents a study at a producing rate of 20 -- actually this is at -- okay, this is at 20 barrels a day only, and on the extreme lefthand column of the sheet you see, under the term rate (BOPD) 20, 40, 70, which was printed. These were all done at 20 barrels a day but one, Case No. 50 at 40-acre spacing, Case 51 at

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160-acre spacing, Case 52 at 320-acre spacing.

So ignore the 20, 40, 70 in the extreme lefthand column and concentrate on the 40, 160, 320.

The studies indicated that -- and in this particular instance the configuration used was essentially that of the well as it sits today with a matrix permeability of around .45 millidarcies, a small improvement around the wellbore to a distance of approximately 16 feet, which we have estimated as to be in the nature of the improvement of the acid job that was performed on the well on completion.

The results of this study show that from inception of production to bubble point we can expect a cumulative recovery of on or about 4 perdent of the oil in place, ranging from a minimum of 3.91 percent if we were producing the well on a 320-acre spacing, to a maximum of 4.63 percent, if we were producing the well on 40-acre spacing.

The section titled Results Bubble Point to Abandonment, show that we can recover on or about 1.3 to 1.6 percent more of the oil in place after we have declined below the bubble point.

On the second page is the Summary of Results to abandonment of the well. Basically, our abandonment conditions were taken at the point at which our bottom

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hole flowing pressure reached approximately 2000 pounds per square inch absolute and we began to notice considerably high increases in the -- increasing rates in the producing gas/oil ratios.

These data show that the total recovery from the well, if it is not stimulated, will be on the order of 5.3 to 6 percent of the oil in place, varying again with the spacing.

The 10,020 barrels of recovery shown under the 40-acre case, and they're 10,000 barrels of oil per 40 acres, 37700 per 160 acres, 70860 per 320 acres. So if you're interested in comparing 40 acres with -- four wells on 40 acres with one well on 160 acres, our four wells on 40 acres would recover 40,080 barrels of oil compared with 37700 that can be recovered by one well on 160 acres.

The next two columns after the percent oil in place recovery, average pressure and boundary pressure, represent the final operating conditions of the well. That is to say under the 20 barrel per day producing case the average pressure within the 40-acre pattern was calculated at 3486 psia and the pressure at the 40-acre boundary was 3553. So the pressure has been drawn down at the boundary some 1900 to 2000 pounds below the original pressure.

On the 160-acre case the average pressure in the system is 3585 and a boundary pressure of 3648, indi-

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cating to us that at the depletion of the well we have reduced the boundary pressure from 5455 psi to 3648 psi, a distance of 160 acres from the well, indicative that the well definitely is draining 160 acres.

The length of time necessary for the pressure transient to reach a 160-acre distance is slightly less than 90 days. The 90-day time step on this particular study showed a boundary pressure on a 160-acre pattern of 5367, or some 80 pounds below original pressure after 90 days of production, so the transient reaches that 160-acre distance in slightly less than 90 days.

The pressure after some 180 days, or some 6 months, is 5273 psia, a good 160 pound drawdown at the boundary.

Q. Now, you heard Mr. Yates testify that they were going to produce the well and shut it in and for the purpose of obtaining data to design a treatment for the well, either acid or frac. Did you conduct any studies assuming that these treatments were given to the well?

A. Yes, sir, we did.

Q. Are those protrayed and the results summarized on Exhibit Seven?

A. Yes, sir, they are.

Q. Would you turn to that exhibit?

A. The first page of Exhibit Seven, in the

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middle of the page, Simulation Model Permeability Values, show a distance from the wellbore and list two sets, Set I and Set II.

Set I and Set II are approximations of permeability improvements at varying distances from the wellbore that might be obtained through a large matrix acidizing job or a sizeable acid fracture treatment.

For example, in Set I we used to a distance of two feet from the wellbore a permeability of 89.2 millidarcies, scaling down to 2.2 millidarcies a distance of 64 feet from the wellbore. From 64 feet to the boundary the matrix permeability of .45 plus or minus millidarcies is used. Now these are boundary permeabilities so what we're saying is that the distance from 2 feet to 4 feet the permeability declines from 89.2 to 44.6; from 2 feet -- or from 4 feet to 8 feet it declines uniformly from 44.6 to 22.3, and so on.

Set II is more representative of a very deep penetrating fracture treatment in which the permeability improvements are carried out to a greater distance, this being to a distance of 387 feet. We feel that Set II permeabilities are probably the maximum that one can expect to attain with an efficient fracture treatment.

Consequently, the data in the comparisons of operating modes under Set II represent what we feel would be optimum conditions for this well.

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The next series of pages are presentations in the same format as the study, Exhibit Six. You will find 40-acre Set I followed by 160-acre Set I followed by 320-acre Set I. These data then represent performance of the well at 20, 40, and 70 barrels a day on 40-acre spacing, 160-acre spacing, and 320-acre spacing for the improvement configuration described on the first page of the exhibit as Set I.

Again, the data show that the performance of the well is far more rate sensitive than it is pattern sensitive. For example, we see a recovery at 20 barrels a day on 40-acre spacing of 4.97 percent of the oil in place to bubble point on a 40-acre pattern; 5.29 percent on a 160-acre pattern. We see recovery to depletion at 20 barrels a day of 7.10 percent of the oil in place on 40 acres and 6.74 percent of the oil in place on 160 acres.

Continuing through at the 40 barrel a day rate we see an ultimate recovery of 5.7 percent of the oil in place on 40 acres; 4.66 on 160 acres; and we drop to 2.96 on 320. 320-acre spacing falls below the 160's on the Set I permeability, if this is the improvement that we would anticipate from the well.

We see boundary conditions at bubble point on all three spacings, 3842 psia on 40-acre pattern; or excuse me, on a 40-acre pattern at the varying rates we are well below the initial pressure. On the 160-acre case

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we show again the 3744 psia at the boundary at bubble point; 4356 at the 40 barrel a day case; 5189 at the 70 barrel a day case, so we have moved the pressure transient again beyond the 160-acre point.

Even on the 320-acre spacing we see our rates and pressures show that we have moved the transient out equivalent to that distance. At a 20 barrel a day rate we have 3852 psia at the boundary; 4532 under the 40 barrel case; 5369 under the 70 barrel case.

Now these pressures tie to the length of time, so that pressure is at the point in time listed in the last column.

Again looking at the specific printout and the various time steps, at a rate of 20 barrels a day on a 160-acre spacing configuration we have a boundary pressure of 5366 psia at the end of 90 days; 5272 psia at a time period of 180 days; 5366 again, or 80 pounds below the original pressure within 90 days.

Obviously, if the pressure transient will reach the 160-acre point with no stimulation then with progressive stimulation it would get out there a little quicker. At Set I the times are virtually the same all the way through for transient propogation as they are in the unstimulated case.

The next set of data sheets, which begin

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with the case description 40-acre Set II permeability cases 6, 7, and 8, represent a repeat of the study using the Case 2 permeability improvements.

We see here that we do substantially improve the overall recovery from the well. For example, on 40-acre spacing and 20 barrels per day rate we recover 7.26 percent of the original oil in place to bubble point with the Set II improvement as opposed to 4.97 with the Set I improvement. We have similar performance improvements through all of the cases.

The recoveries under 40-acre spacing, if you will turn to the next page, range from 10.78 percent at a 20 barrel a day producing rate to 8.8 percent at a 70 barrel a day producing rate. We have less differentiation between recovery at the lowest rate and the highest rate under this permeability configuration, again which is to be anticipated. We run into a less pronounced pressure gradient drawdown into the wellbore with the more efficient stimulation treatment. Consequently, the -- a greater retardation of the evolvement of gas from solution with the 10 and higher recoveries.

Moving to the 160-acre case, we see that the recoveries range from 8.51 percent of the oil in place at a 20 barrel rate, 6.5 percent at a 70 barrel a day rate. The recovery improvement between 40-acre spacing and 160-acre

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spacing for any given configuration of producing rate and improvement through stimulation is in terms of barrels of oil negligible.

The boundary pressures again are shown to be substantially below the original.

At the end of ninety days at a 20 barrel a day producing rate we have a pressure at the 160-acre boundary of 5358 psia, some 85, 90 pounds below original pressure. This pressure is down to 5264 pounds, or approximately 180 pounds below original pressure after 180 days.

At a 40 barrel a day rate pressure at the boundary, 160-acre boundary, at the end of ninety days is 5270; at the end of 180 days, 5083.

For a 70 barrel case, the boundary pressure, 160-acre, ninety days, 5140; at 180 acres -- or 180 days, excuse me, 4814.

The results of the studies show that ultimate recovery from the well is going to be to a certain extent rate sensitive and it is going to be highly sensitive to the efficiency of stimulation treatment. The type of treatment, depth of penetration, and other characteristics.

The studies show that a well will indeed drain 160 acres for any configuration of rate or wellbore or reservoir conditions. The 160-acre drainage is virtually as efficient physically as 40 acres without getting into the

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economic value of it.

The studies do also indicate that a well will physically drain 320 acres.

Q. Do you have an opinion as to whether 160-acre spacing will result in waste?

A. In my opinion 160-acre spacing will not result in waste.

MR. LOSEE: That's all the direct I have for the witness.

COMMISSIONER RAMEY: Any questions of the witness?

QUESTIONS BY MR. STAMETS:

Q. Mr. Mistrot, in all of this that you have told us, is there a figure that you would recommend as a maximum production rate during this test period?

A. Obviously less than 110 barrels a day. I do not know exactly what would be the optimum rate. This is one of the purposes of the extended test rate, to place the well on production to measure accurately and daily its producing rate in oil, procuding rate in gas, flowing tubing pressure, and to be governed by those data.

Our indications on this study, and this is not an MER study, it is a feasibility study to help to design a testing program and to be the initiation of the full

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scale studies. I would indicate that a rate of 70 barrels a day would not be excessive, but again, obviously, if the operator sees a major change in producing characteristics, and this is part of the test, we have recommended a fairly extensive production test, and an extensive buildup test, and the data from these tests can be submitted to one of the service companies for a very definitive stimulation treatment design. Once this treatment is designed, then the exact configuration of varying treatments can be modeled and predictions can be made, and the well place on production and monitored after that.

What we were attempting to do with the studies was to basically cover the waterfront conditions that could and should exist in the completion of this well, ranging from its initial condition, which we feel is pessimistic, considering that no doubt the well will be stimulated, up to a stimulation treatment, which we felt would be, if anything, slightly optimistic, vary producing rates within these configurations and determine whether or not the data indicated anything substantial with regard to optimum well spacing or optimum producing rates. Our conclusions are that it definitely points to efficient drainage of 160-acre pattern and a range of rates between 40 and 70 barrels a day, which should not be damaging to the well.

Q Will the most efficient rate following

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stimulation be different from the most efficient rates prior to stimulation?

A. I would certainly hope so because this is the purpose of the stimulation treatment, to extend the fracture into the reservoir, or to matrix acidize, which provides basically a larger pore space or in effect a larger wellbore radius for the flow of fluids as they move close to the wellbore. And as we're producing 70 barrels of oil a day from this well, we're producing 70 barrels of oil a day right into the wellbore, and also on a ring 160 acres away from that well we are within this radial area also producing 160 barrels a day, so we have a tremendous velocity increase with an attendant tremendous pressure reduction close to the wellbore. The purpose of the stimulation treatment being to extend a large fracture well into the wellbore, well away from it, and fracture designs have shown at times they can be extended 400 feet or more, is to provide a larger flow area for the fluids further away from the wellbore to arrest that high velocity into the wellbore, consequently maintaining a higher pressure to a further distance, or actually, yeah, to a further distance from the wellbore, keeping that flowing pressure above bubble point for a substantially longer period of time.

So rather than have a pressure drop that looks like that into the wellbore, and I'm aware that can't

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go into the record, but we get that type of thing.

Q Let's see if I can ask this question properly. If the Division would, or Commission, I guess, would put a limitation on this well of 70 barrels a day that would apply during this initial testing phase and then subsequent to any fracturing or any acid treatment, this would allow the well to be tested both before and after and for the development of any subsequent recommended more efficient rate without causing waste? That's a question.

A You're asking if the Commission were to set a temporary allowable of 70 barrels a day with the stipulation that this would be reviewed after testing, would that provision cause waste, is that basically what you're getting at?

Q Through your testing, treatment and frac test.

A Right. Right. In my opinion a 70 barrel a day rate would not cause waste.

Q Thank you. That's all.

COMMISSIONER RAMEY: Any other questions? The witness may be excused.

RUSSELL D. SMITH

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

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DIRECT EXAMINATION

BY MR. LOSEE:

Q. Would you state your name, residence, and occupation?

A. Yes, my name is Russell D. Smith. I reside in Houston, Texas. I'm the Division Production Superintendent for Napeco, Incorporated, which is the operator of the subject well.

Q. You've not previously testified before this Commission?

A. No, sir, I have not.

Q. Do you have a degree in mechanical engineering, and if so, where did you obtain it?

A. Yes, sir, I obtained a Bachelor of Science in mechanical engineering from Southern Methodist University in Dallas in 1970.

Q. Since your graduation what positions have you held?

A. I've been a roughneck to production manager. I'm currently Division Production Superintendent. I have been at one point in my career the Production Manager for the Pioneer Division of Geosource (sic).

Q. Are you a Registered Professional Engineer?

A. Yes, sir, I'm a Registered Professional

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Engineer in the State of Texas.

MR. LOSEE: Are Mr. Smith's qualifications acceptable?

COMMISSIONER RAMEY: Yes they are.

Q. Would you please turn to what has been marked Exhibit Eight and explain the -- what is portrayed by this exhibit?

A. Exhibit Eight is an economic evaluation of the subject well based on the most optimistic estimated recoverable reserves at the 40-acre, 160-acre, 320-acre spacing at the 20 barrel a day, 40 barrel a day, and 70 barrel a day flow rates.

On the first page are the basic data that -- those give our economic considerations.

Q. That's the data that you plugged into your -- on the second page?

A. Yes, sir.

Q. Okay.

A. The second page indicates this, regardless of which flow rate we're talking about on a 40-acre spacing, that -- that we will have a negative rate of return, a negative payout, a negative net worth, or present worth, which we're terming net cash flow discounted, but I feel like at today's interest rate that 20 percent is more like what we'd see, but as you can see, we have a negative net

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worth, as well as negative rate of return, and negative payout.

We begin, as we go to 160-acre spacing, we begin getting into positive figures. I might mention this, that these economics are based on one well only being drilled on 40-acre spacing, 160-acre spacing, and 320-acre spacing. So if you were to compare, for instance, the net worth of four wells being drilled on a 40-acre space -- each being drilled on a 40-acre spacing versus one well on 160-acre spacing, in this case we'd have four times the negative $245,277 versus a positive $55,310 net worth.

Q. And so the end result of this exhibit is that economically the unit cannot afford to develop this field on 40-acre spacing?

A. Yes, sir, that's a true statement.

Q. And --

A. One thing that's interesting about the flow rates is this: A maximum, or with these three given flow rates, a maximum rate of return, payout, net worth, is at the 70 barrel a day -- 70 barrel a day rate, whether we're talking about 160-acre spacing or the 320.

Q. Do you have an opinion, Mr. Smith, as to whether or not the approval of this application will prevent waste?

A. Yes, sir, I believe that it will. I

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believe that producing within the range that we've given here will -- on 160-acre spacing, will result in the optimum estimated recoverable reserves, as well as the best payout.

Q Was this exhibit prepared by you?

A It was prepared under my direction.

MR. LOSEE: I move its introduction.

COMMISSIONER RAMEY: Exhibit Eight will be admitted.

MR. LOSEE: I have no further questions.

COMMISSIONER RAMEY: Did we admit the other exhibits of --

MR. LOSEE: No, no. I forgot to ask him -- I've got a note. I'll do it in due time.

COMMISSIONER RAMEY: Any questions of the witness, Mr. Smith? He may be excused.

MR. LOSEE: One question of Mr. Mistrot. Were Exhibits Five-A, Six, and Seven prepared under your supervision?

MR. MISTROT: Yes, sir, they were.

MR. LOSEE: I move their introduction.

COMMISSIONER RAMEY: Exhibit Five-A, Six, and Seven will be admitted.

MR. LOSEE: That's the applicant's case, Mr. Examiner.

COMMISSIONER RAMEY: Does anyone have

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anything further to add in this case?

If not, we'll take the case under advisement and the hearing is adjourned.

(Hearing concluded.)

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REPORTER'S CERTIFICATE

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

_____

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BEFORE THE
NEW MEXICO OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
November 27, 1979

COMMISSION HEARING

IN THE MATTER OF: Application of Napeco Inc. for pool creation and special pool rules, Eddy County, New Mexico.	CASE 6609 (DE NOVO)

BEFORE: Joe D. Ramey, Director

TRANSCRIPT OF HEARING

A P P E A R A N C E S

For the New Mexico Oil Conservation Commission: Ernest L. Padilla
Legal Counsel for the Commission
State Land Office Building
Santa Fe, New Mexico

MR. RAMEY: Call Case 6609.

MR. PADILLA: Case 6609, application of Napeco Inc. for pool creation and special pool rules, Eddy County, New Mexico. Upon application of Yates Petroleum Corporation and Napeco Inc. this case will be heard De Novo. It is requested that this case be continued.

MR. RAMEY: The case is hereby continued indefinitely. When a date for a new hearing is determined, the case will be readvertised and heard at that time. The hearing is adjourned.

BEFORE THE
NEW MEXICO OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
November 27, 1979

COMMISSION HEARING

IN THE MATTER OF: Application of Napeco Inc. for pool creation and special pool rules, Eddy County, New Mexico.	CASE 5609 (DE NOVO)

BEFORE: Joe D. Ramey, Director

TRANSCRIPT OF HEARING

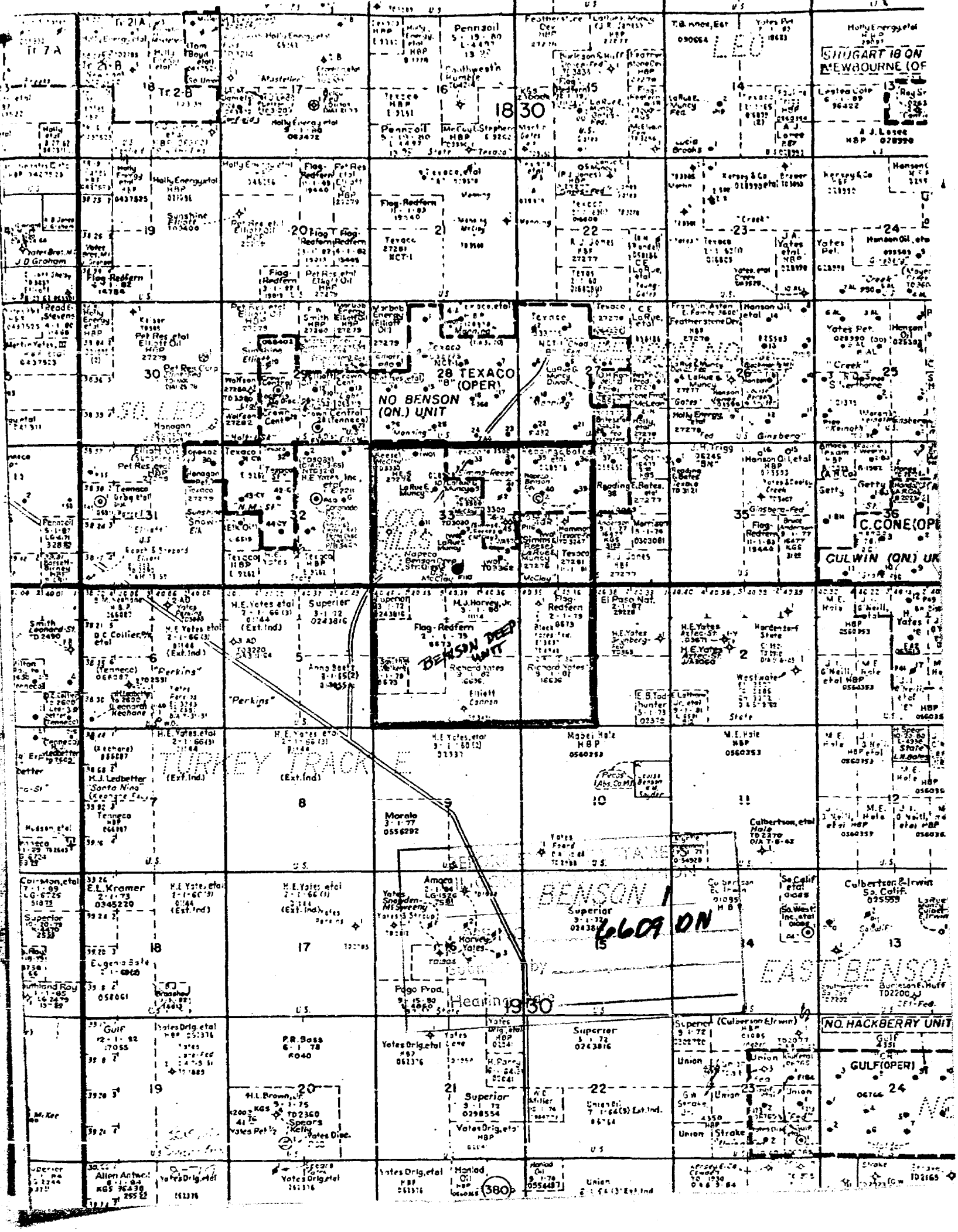
A P P E A R A N C E S

For the New Mexico Oil
Conservation Commission: Ernest L. Padilla
Legal Counsel for the Commission
State Land Office Building
Santa Fe, New Mexico

MR. RAMEY: Call Case 6609.

MR. PADILLA: Case 6609, application of Napeco Inc. for pool creation and special pool rules, Eddy County, New Mexico. Upon application of Yates Petroleum Corporation and Napeco Inc. this case will be heard De Novo. It is requested that this case be continued.

MR. RAMEY: The case is hereby continued indefinitely. When a date for a new hearing is determined, the case will be readvertised and heard at that time. The hearing is adjourned.


NO BENSON (ON.) UNIT
28 TEXACO "B" (OPER)
BENSON DEEP UNIT
"Perkins"
"Perkins"
TURKEY TRACK
BENSON
6609 DN
EAST BENSON
Hearing
1930
NO. HACKBERRY UNIT
GULF(OPER)
CULWIN (ON) UNIT
SHUGART 18 ON
NEWBOURNE (OP
Penn oil
Texaco
Holly Energy etal
Yates etal
Superior
Amoco
Gulf
Union
Strake
Pogo Prod.
Harvey Yates
Morale
Culberson & Irwin
So. Calif.
Hanson Oil etal
Getty
Sinclair
Gulf
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Reservoir Analysis and Computer Programs

P. O. Box 36272 / Houston, Texas 77036 / A C 713 782-3577

March 29, 1980

NAPECO
P. O. Box 283
Houston, Texas 77001

Attn: Mr. Rusty Smith

Subject: Reservoir Fluid Study
Benson Deep Unit No. 1
Eddy Co., New Mexico
Lab No. A-79535

Gentlemen:

Samples of separator liquid and vapor were collected from the subject well by a representative of TefTeller, Inc. on December 19, 1979. Presented in this report are the results of a reservoir fluid study performed using these samples.

The producing gas-liquid ratio was measured to be 1304 cubic feet of separator gas at 15.025 psia and 60°F. per barrel of stock tank liquid at 60°F. This ratio has been corrected for gas gravity and supercompressibility. In the laboratory it was found that the ratio is equivalent to 1268 standard cubic feet of separator gas per barrel of separator liquid. This ratio was used in conjunction with the measured compositions of the separator products to calculate the composition of the well stream material. These data are reported on page two.

The separator products were physically recombined to the producing ratio and examined in a visual cell at the reservoir temperature of 166°F. During a constant composition expansion a bubble point was observed at 3023 psig. Comparison of this value to the reservoir pressure indicates that the fluid exists in an undersaturated condition. Observation of the system at pressures immediately below the bubble point pressure shows that the liquid exhibits a rapid shrinkage which indicates this system to be a volatile oil.

Since a large amount of the production from this type of reservoir comes from the gaseous phase, a constant volume depletion study was performed on a sample of the recombined fluid to enable calculation of the production during depletion

...INER STATES
...ATION DIVISION
EXHIBIT NO. 3
CASE NO. 6609 DN
Submitted by
Hearing Date

below the bubble point pressure. The depletion consisted of a series of expansions and constant pressure displacements terminating at the original cell volume. This has the effect of maintaining a constant reservoir volume. The produced gas phase was charged to low temperature, fractional distillation equipment for analysis and volume measurement. The results of the depletion are tabulated on page five of the report.

The quantity of plant products available in the gas phase alone is shown on page six. A plant efficiency of 100 per cent has been assumed.

The well stream composition and equilibrium ratios from the literature were used to calculate the stock tank liquid and sales gas recoveries that will be obtained as the pressure declines from reservoir pressure to the bubble point pressure. These recoveries are based upon one MMSCF of fluid in place at the bubble point pressure. One MMSCF is the gaseous equivalent of 938.012 barrels of bubble point liquid.

The viscosity of the liquid phase was measured from pressures exceeding reservoir pressure to atmospheric pressure. These data are presented on page eight together with the calculated gas phase viscosity.

The data concerning the shrinkage of the liquid in the reservoir are shown on page nine of this report.

Thank you for this opportunity to be of service. If you have and questions or if we may assist you further, please do not hesitate to contact us.

Very truly yours,

Allen E. Barron

AEB/cam

P-V-T, Inc.

Physical and Design Data Research
K-Values • PVT • Enthalpy
Chemical Process & Petroleum Fluids
Reservoir Analysis and Computer Programs

P. O. Box 30272 / Houston, Texas 77030 / A C 713 782-3577

File A-79535

Company NAPECO — Date Sampled December 19, 1979

Well Benson Deep Unit No. 1 — County Eddy

Field Wildcat — State New Mexico

FORMATION CHARACTERISTICS

Formation Name	Strawn
Date First Well Completed	May 10, 1979
Original Reservoir Pressure	5450 PSIG @ 10720 Ft.
Original Produced Gas-Liquid Ratio	5682 SCF/Bbl
Production Rate	110 Bbls/Day
Separator Pressure and Temperature	PSIG ° F.
Liquid Gravity at 60° F.	48.9 ° API
Datum	Ft. Subsea

WELL CHARACTERISTICS

Elevation	3404 GL Ft.
Total Depth	12071 Ft.
Producing Interval	10648-10718 Ft.
Tubing Size and Depth	2-7/8 In. to 10543 Ft.
Open Flow Potential	0.625 MMSCF/Day
Last Reservoir Pressure	5448 PSIG @ 10720 Ft.
Date	May 11, 1979
Reservoir Temperature	181 ° F. @ 10720 Ft.
Status of Well	Shut in
Pressure Gauge	Amerada RPG-3

SAMPLING CONDITIONS

Flowing Tubing Pressure		1123 PSIG
Flowing Bottom Hole Pressure		? PSIG
Primary Separator Pressure		350 PSIG
Primary Separator Temperature		67 ° F.
Secondary Separator Pressure		PSIG
Secondary Separator Temperature		° F.
Field Stock Tank Liquid Gravity		48.9 ° API @ 60° F.
Primary Separator Gas Production Rate		78.167 MSCF/Day
Pressure Base	15.025 PSIA	
Temperature Base	60 ° F.	
Compressibility Factor (F_{pv})	1.028	
Gas Gravity (Laboratory)	0.745	
Gas Gravity Factor (F_g)	1.159	
Separator Liquid Production Rate @ 60° F.		* 71.39 Bbls/Day
Primary Separator Gas/Separator Liquid Ratio		* 1095 SCF/Bbl
	or	* 887.654 Bbls/MMSCF

ENGINEER: Tefteller, Inc.

REMARKS: *96 hours gross fluids 307.06833 bbls.oil;345.9835 MCF gas.

P-V-T, Inc.

File A-79535

Well Benson Deep Unit No. 1

Hydrocarbon Analyses of Separator Products and Calculated Well Stream

Component	Separator Liquid Mol Per Cent	Separator Gas Mol Per Cent	GPM	Well Stream Mol Per Cent	GPM
Hydrogen Sulfide	--	--		--	
Carbon Dioxide	0.10	0.45		0.29	
Nitrogen	0.06	2.11		1.19	
Methane	8.06	72.74		43.68	
Ethane	9.80	15.80	4.309	13.10	
Propane	14.61	6.44	1.807	10.11	
iso-Butane	2.91	0.61	0.204	1.64	
n-Butane	8.92	1.32	0.424	4.74	
iso-Pentane	3.33	0.20	0.075	1.61	
n-Pentane	3.58	0.19	0.070	1.71	
Hexane	7.41	0.08	0.033	3.37	
Heptanes plus	41.22	0.06	0.028	18.56	
	100.00	100.00	6.950	100.00	
Properties of Heptanes Plus					
API Gravity @ 60° F.	42.3				
Specific gravity @ 60/60° F.	0.8134			0.813	
Molecular weight	181	103		181	

Calculated separator gas gravity (air=1.000) = 0.745

Calculated gross heating value for separator gas = 1290 BTU per cubic foot of dry gas @15.025 psia and 60° F.

Primary separator gas collected @ 350 psig and 67 °F.

Primary separator liquid collected @ 350 psig and 67 °F.

Primary separator gas/separator liquid ratio 1093 SCF/Bbl @ 60° F.

Primary separator liquid/stock tank liquid ratio 1.0292 Bbls @ 60° F./Bbl.

VOLUMETRIC DATA OF RECOMBINED SAMPLE

1. Saturation pressure (bubble-point pressure) 3023 PSIG @ 166 °F.

2. Specific volume at saturation pressure: ft³/lb 0.02814 @ 166 °F.

3. Thermal expansion of saturated oil @ 6000 PSI = $\frac{V \text{ @ } 166 \text{ °F}}{V \text{ @ } \text{ °F}}$ = 1.0178

4. Compressibility of saturated oil @ reservoir temperature: Vol/Vol/PSI:

   From 6000 PSI to 5396 PSI = 15.29×10^{-6}

   From 5396 PSI to 4500 PSI = 17.32×10^{-6}

   From 4500 PSI to 3500 PSI = 21.41×10^{-6}

   From 3500 PSI to 3023 PSI = 26.94×10^{-6}

5. One MMSCF is the gaseous equivalent of 938.012 barrels of reservoir fluid at the bubble point.

File A-79535

Well Benson Deep Unit No. 1

Pressure-Volume Relations at 166 °F.

	Pressure PSIG	Relative Volume (1)	Density cm/cc
	6000	0.9422	0.6041
	5500	0.9494	0.5995
Res.Press.	5396	0.9510	0.5985
	5000	0.9573	0.5946
	4500	0.9660	0.5892
	4000	0.9758	0.5833
	3500	0.9871	0.5767
Sat.Press.	3023	1.0000	0.5692
	2900	1.0049	
	2800	1.0102	
	2700	1.0192	
	2500	1.0840	
	2000	1.2357	
	1500	1.5397	
	1229	1.8444	
	1048	2.1428	
	918	2.4488	
	821	2.7263	
	763	2.9410	

(1) Relative Volume: V/Vsat is barrels at indicated pressure per barrel at saturation pressure.

Depletion Study at 166 °F.

Hydrocarbon Analyses of Produced Gas Phase Produced -Mol Percent

Component	Reservoir Pressure - PSIG							
	3023	2600	2200	1800	1400	1000	600	600Liq.
Carbon dioxide	0.29	0.39	0.40	0.41	0.42	0.42	0.43	0.09
Nitrogen	1.19	3.21	2.90	2.51	2.12	1.61	1.36	0.06
Methane	43.68	70.11	71.71	72.73	72.78	71.24	66.89	8.96
Ethane	13.10	12.69	12.70	12.89	13.43	14.78	17.57	11.18
Propane	10.11	7.02	6.63	6.37	6.45	7.16	8.60	13.54
iso-Butane	1.64	1.02	0.95	0.88	0.85	0.87	0.97	2.63
n-Butane	4.74	2.42	2.15	1.99	1.92	1.95	2.13	8.25
iso-Pentane	1.61	0.74	0.63	0.57	0.54	0.52	0.58	2.86
n-Pentane	1.71	0.74	0.63	0.57	0.53	0.53	0.56	3.45
Hexanes	3.37	0.44	0.37	0.30	0.28	0.27	0.28	7.31
Heptanes plus	18.56	1.22	0.93	0.78	0.68	0.63	0.63	41.67
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Molecular weight of heptanes plus	180	137	129	122	117	113	114	187
Specific gravity of heptanes plus	0.811	0.776	0.768	0.761	0.756	0.752	0.753	0.821
Deviation Factor - Z								
Equilibrium gas	--	0.803	0.796	0.810	0.838	0.874	0.917	--
Gas phase produced-								
Cumulative percent of initial	0	5.722	13.073	20.840	30.840	41.307	51.412	--
GPM from Smooth Compositions								
Propane plus	--	4.516	3.995	3.673	3.564	3.740	4.629	
Butanes plus	--	2.547	2.134	1.885	1.754	1.725	1.856	
Pentanes plus	--	1.429	1.127	0.952	0.854	0.808	0.840	

Calculated Cumulative Recovery During Depletion
(Per MMSCF of Original Fluid)

Reservoir Pressure, PSIG	Gas Phase, MMSCF	"Plant Products" in Gas Phase, Gallons*		
		Propane	Butanes	Pentanes plus
3023	0	--	--	--
2600	57.22	97	--	18
2200	130.73	218	--	42
1800	208.40	344	159	68
1400	308.40	510	234	101
1000	413.07	703	312	134
600	514.12	921	392	164

*Assumes 100% plant efficiency

Primary separator at 350 psig and 67°F.
Stock tank at 0 psig and 60°F.

Results of Separator Calculation
Using Well Stream Composition

Primary gas/well stream ratio	525.06 MSCF/MMSCF
Tank gas/well stream ratio	200.88 MSCF/MMSCF
Tank liquid/well stream ratio	369.52 Bbls/MMSCF
Primary gas/tank liquid ratio	1354 SCF/Bbl
Tank gas/tank liquid ratio	518 SCF/Bbl
Tank liquid gravity at 60°F.	52.0
Formation volume factor at 3023 psig	2.001 Bbls/bbl

Separator Condition = 350 psig @ 67°F.
0 psig @ 60°F.

Viscosity Data at 166°F.

	Pressure PSIG	Oil Viscosity Centipoise
	6000	0.189
Res.Press.	5396	0.181
	5000	0.176
	4500	0.171
	4000	0.164
	3500	0.156
Pg	3023	0.151
	2800	0.157
	2600	0.167
	2200	0.192
	1800	0.224
	1400	0.267
	1000	0.318
	600	0.328
	250	0.475
	0	1.071

Gravity of residual oil = 47.3 °API @60°F.

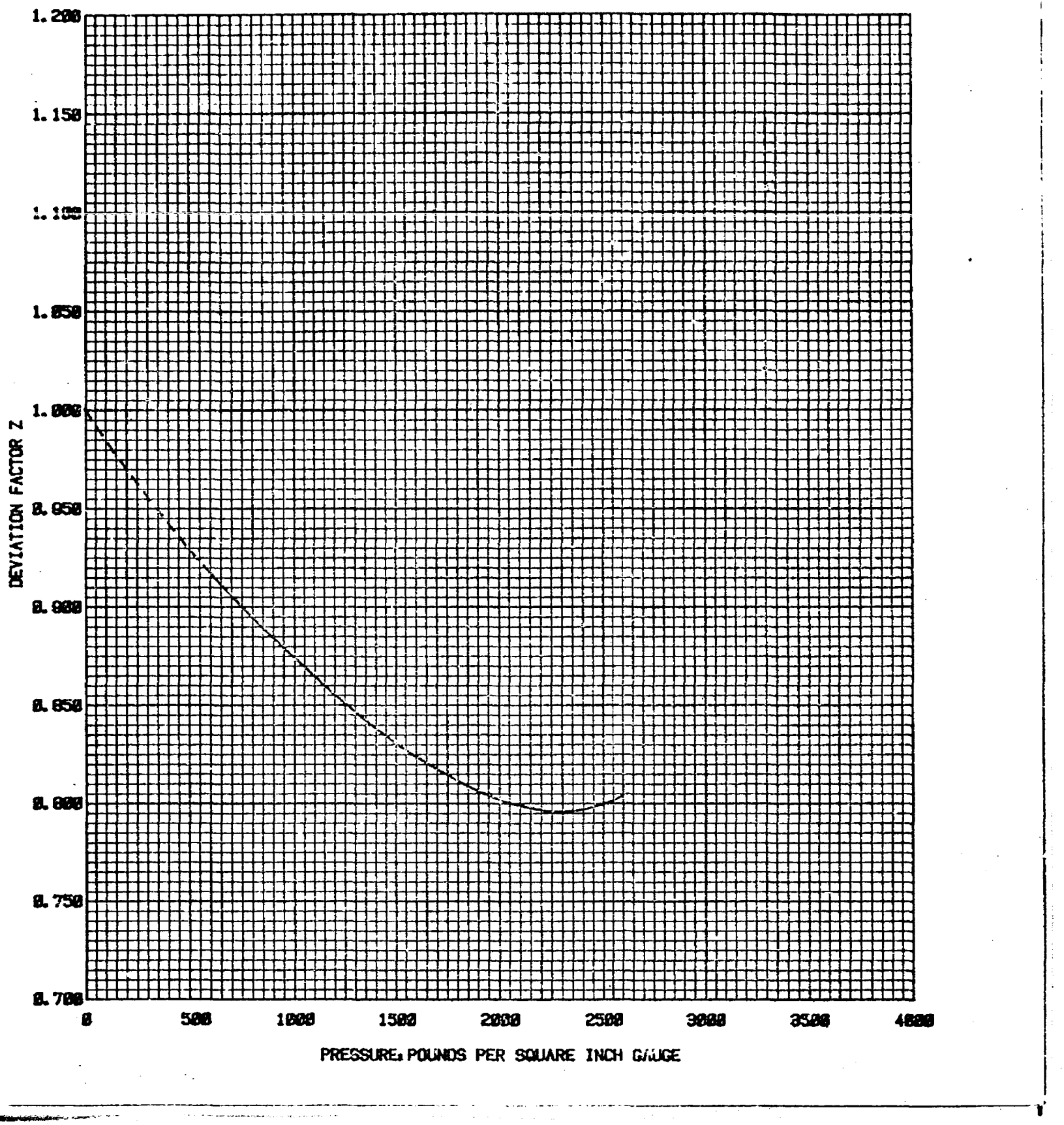
Volume of Liquid Phase at 166°F.

Pressure, PSIG	Liquid Phase Volume, Percent of Saturated Volume
3023	100.00
2900	95.65
2800	93.02
2600	88.94
2200	83.08
1800	78.14
1400	72.82
1000	68.39
600	65.47
0	48.26

Properties of residual oil = molecular weight = 169
density at 60°F. = 0.7919

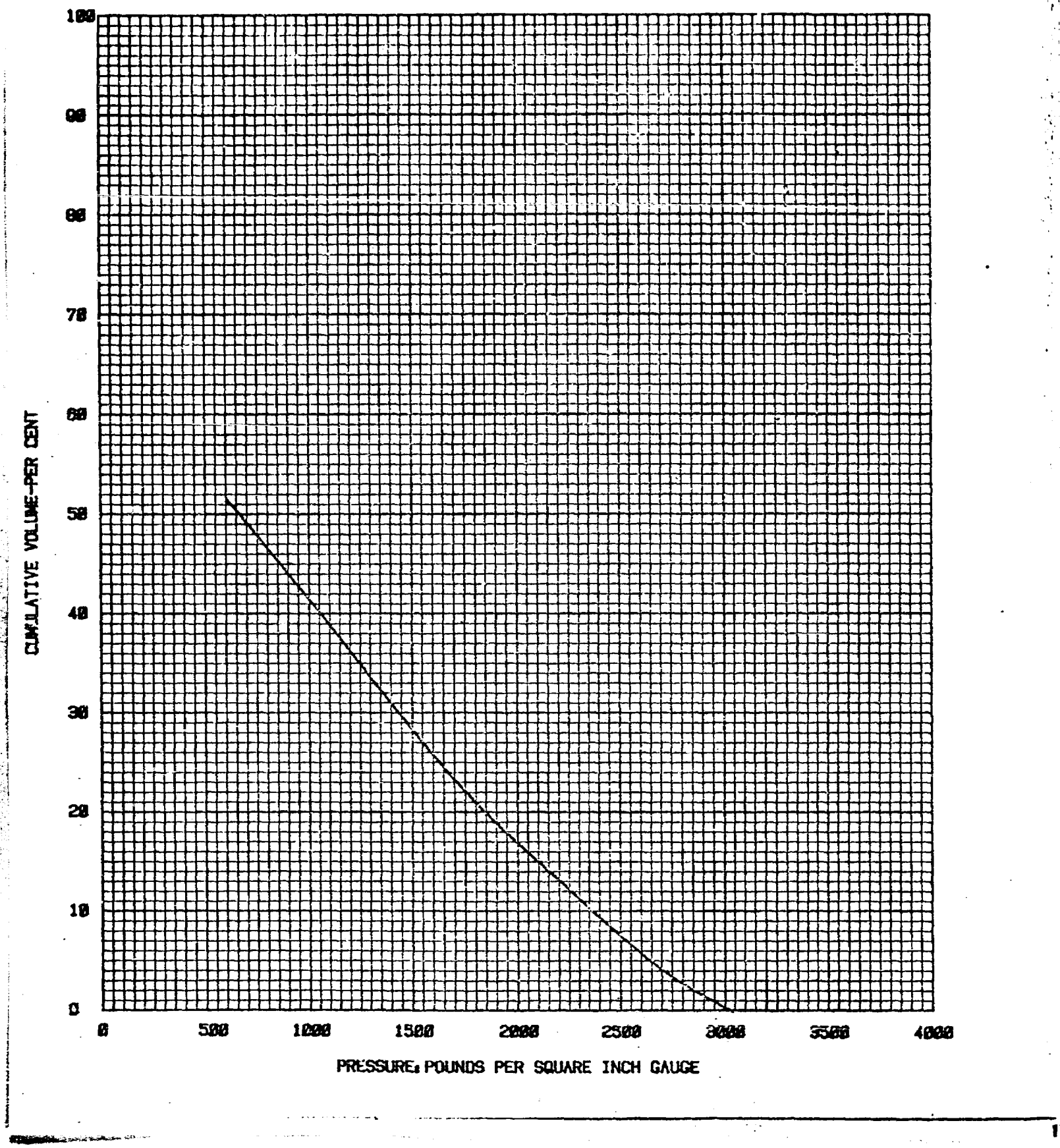
DEVIATION FACTOR Z OF WELL STREAM DURING DEPLETION AT 100°F.

Company NAPECO Formation STRAWN
Well BENSON DEEP UNIT NO. 1 County EDDY
Field WILDCAT State NEW MEXICO



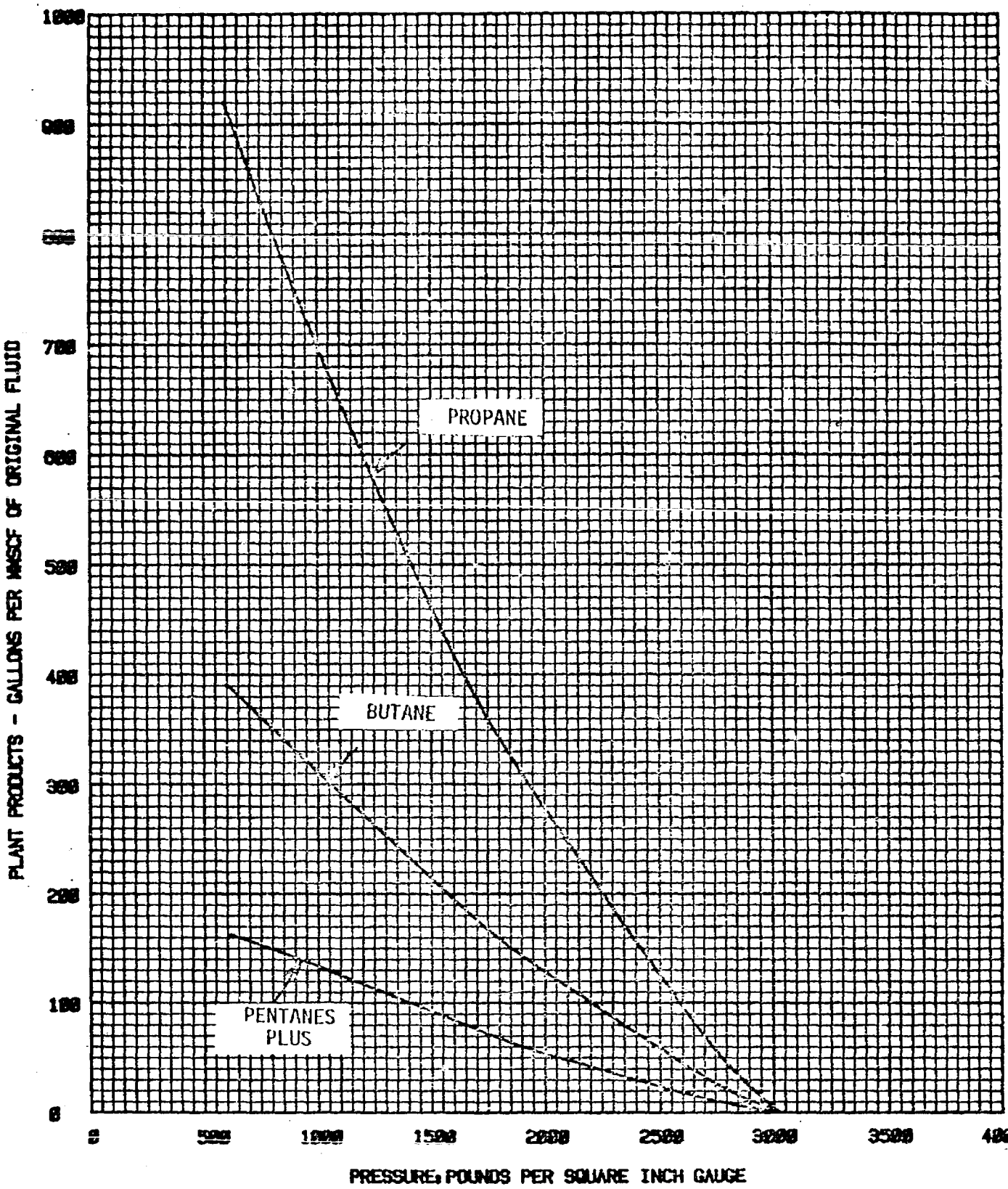
VOLUME OF GAS PHASE PRODUCED DURING DEPLETION

Company NAPECO Formation STRAWN
Well BENSON DEEP UNIT NO. 1 County EDDY
Field WILDCAT State NEW MEXICO



CUMULATIVE RECOVERY-PLANT PRODUCTS IN PRIMARY SEPARATOR GAS

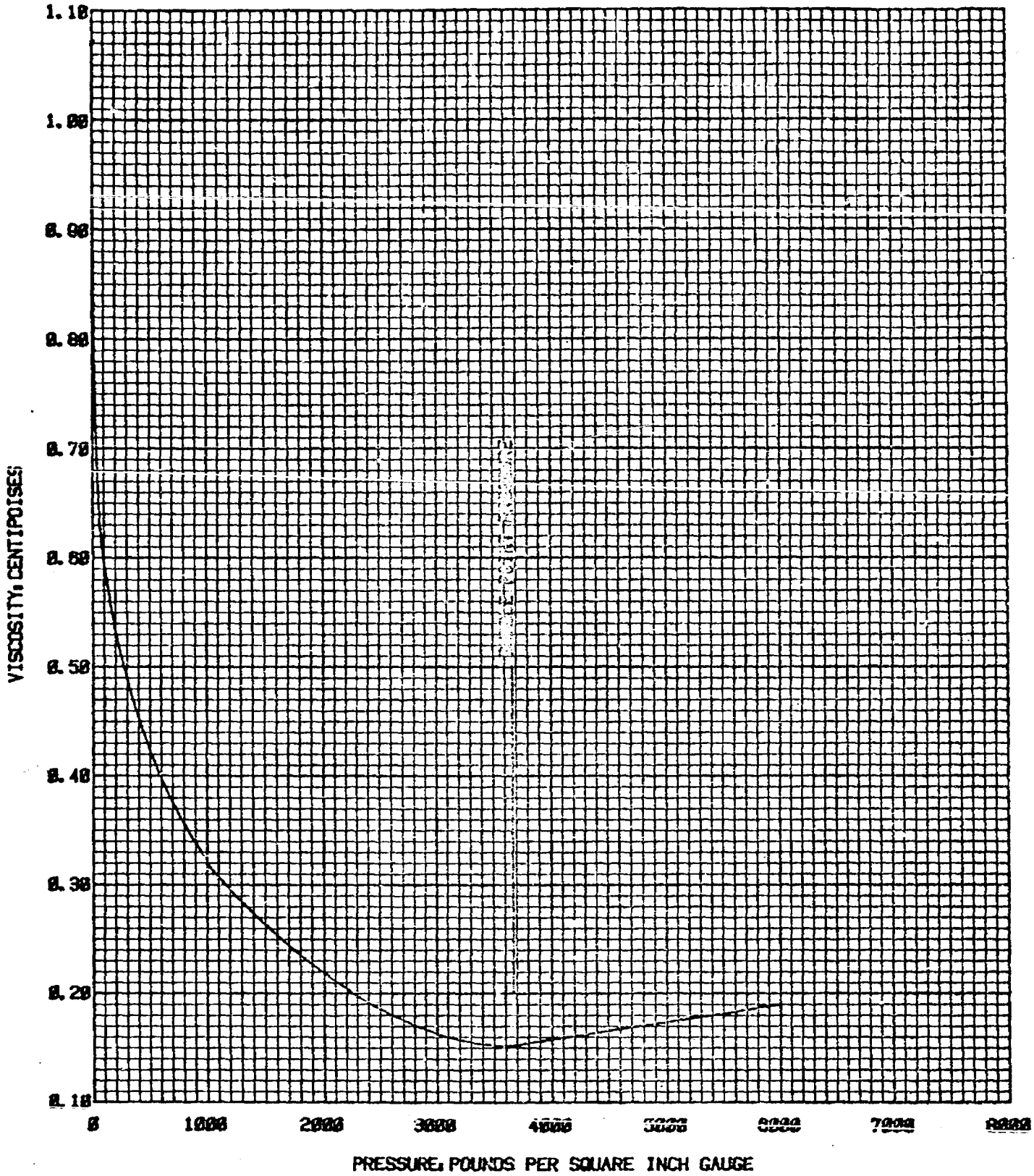
Company NAPECO Formation STRAWN
Well BENSON DEEP UNIT NO. 1 County EDDY
Field WILDCAT State NEW MEXICO



P-V-T, Inc.

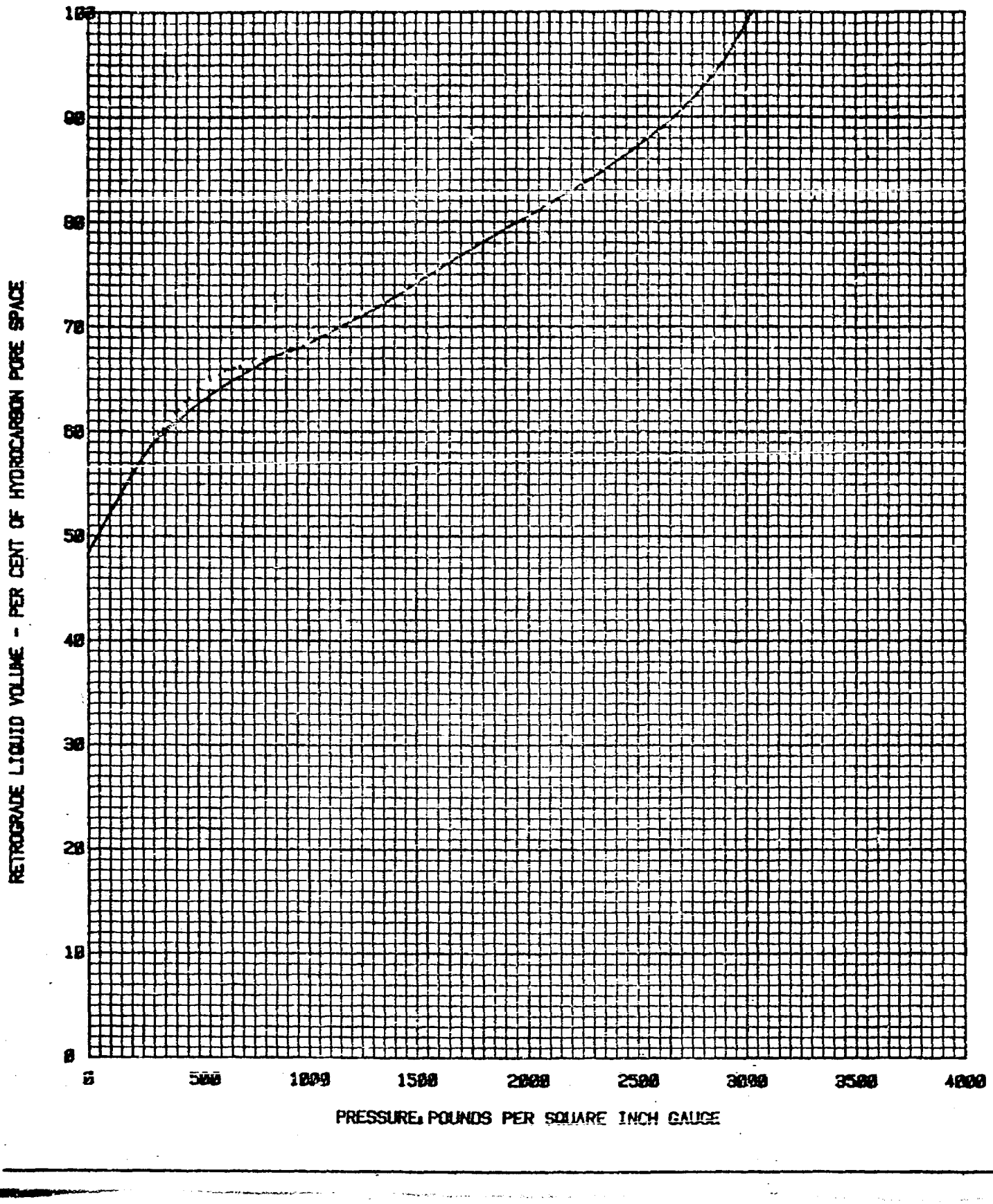
VISCOSITY OF RESERVOIR FLUID AT 166 °F.

Company NAPECO Formation STRAWN
Well BENSON DEEP UNIT NO. 1 County EDDY
Field WILDCAT State NEW MEXICO



VOLUME OF LIQUID PHASE DURING DEPLETION

Company NAPECO Formation STRAWN
Well BENSON DEEP UNIT NO. 1 County EDDY
Field WILDCAT State NEW MEXICO



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CORE LABORATORIES, INC.
ENGINEERING AND CONSULTING DEPARTMENT

Leon L. Crain
Manager
International Engineering Services

April 14, 1980

80-1122.01

4
4609 DN

NAPECO
P. O. Box 283
Houston, Texas 77001

Attention: Mr. Rusty Smith

Subject: Reservoir Fluid Properties
Benson Deep
Eddy County, New Mexico

Gentlemen:

A reservoir fluid study was performed by P-V-T, Inc. in Houston using separator gas and liquid samples from the Benson Deep. The study was identified as A-79535, dated February 14, 1980. At present, this is the only fluid analysis available.

In the laboratory, separator gas and liquid were recombined to yield a representative reservoir fluid sample, which was used in further testing. The recombined fluid was found to be a highly undersaturated liquid with a bubble-point pressure of 3038 psia at 166°F. The fluid exhibited some of the characteristics of a volatile oil, and a constant-volume depletion study and viscosity measurements were performed at 166°F. The compositions of the separator gas and liquid were determined, and the recombined reservoir fluid composition was calculated.

The reservoir temperature was subsequently determined to be 181°F, and it is estimated that the bubble point of the fluid would be 3098 psia at this temperature. The reservoir fluid properties were adjusted to 181°F, and these values were used in a reservoir simulator computer model. It was found that the reservoir fluid composition in the laboratory study had been miscalculated, and this was corrected. The composition and the major fluid properties at initial and bubble-point conditions are shown in Table 1. The effects of pressure upon the physical properties of the fluid at 181°F are shown in Table 2 and on Figure 1.

Based upon its behavior during expansion at reservoir temperature, any reservoir fluid can be classified as either dry gas, gas condensate (retrograde), volatile oil, or black oil. Dry gases are single-phase systems at all pressures. Condensates are single-phase gas systems above the dewpoint pressure, and expansion below the dew point will cause some liquid to drop out of solution and accumulate. Oils exhibit bubble points when expanded, and further expansion causes the release of gas from solution.

Some of the criteria used to distinguish whether an oil is volatile or not are that volatile oils usually have flash formation volume factors above 2 bbl/STB, contain large amounts of intermediate components, release more than 2000 scf/STB at the surface, and will be found in reservoirs where the temperature is over 250°F. These are all arbitrary rules of thumb. The Benson Deep reservoir fluid satisfies the first two items above, and is considered to be a borderline volatile oil system.

Depletion drive performance calculations will tend to give conservative results for very volatile (near critical) systems. Since the Benson Deep fluid is on the low side of the volatile category, recovery calculations should be within accepted limits of engineering accuracy.

Very truly yours,

CORE LABORATORIES, INC.

James A. Brown

James A. Brown
Petroleum Consultant

JAB:mr
Encl.

TABLE 1

SUMMARY OF INITIAL RESERVOIR FLUID PROPERTIES

BENSON DEEP

Datum depth	7316 ft subsea
Initial pressure at datum	5455 psia
Temperature at datum	181°F
Bubble-point pressure at datum	3098 psia

Differential Data

Formation volume factor at Pi	2.1072 bbl/bbl @ 60°F
Formation volume factor at Pb	2.2242 bbl/bbl @ 60°F
Solution gas-oil ratio at Pb	1981 scf/bbl @ 60°F
Oil density at Pb	0.5318 gm/cc
Oil viscosity at Pi	0.174 centipoise
Oil viscosity at Pb	0.146 centipoise
Residual oil gravity	47.0°API @ 60°F
Total liberated gas gravity	0.9033

Separator Data*

Formation volume factor at Pi	2.0257 bbl/bbl @ 60°F
Formation volume factor at Pb	2.1382 bbl/bbl @ 60°F
Total gas-oil ratio at Pb	1870 scf/bbl @ 60°F
Stock-tank oil gravity	51.4°API @ 60°F
Total liberated gas gravity	0.8946

*Separator at 115 psia and 80°F, stock tank at 70°F.
Standard conditions are 14.7 psia and 60°F.

Reservoir Fluid Composition

Component	Mol %
N2	1.19
CO2	0.29
C1	43.68
C2	13.10
C3	10.11
iC4	1.64
nC4	4.74
iC5	1.61
NC5	1.71
C6	3.37
C7+	18.56
	100.00

C7+ Density = 0.8125 gm/cc @ 60°F
C7+ Molecular Weight = 181

Formation Water Properties at Reservoir Temperature

Salinity	100,000 ppm NaCl
Density	1.051 gm/cc
Compressibility	3.24 x 10^{-6} psi^{-1}
Viscosity	0.44 centipoise

TABLE 2

RESERVOIR FLUID PROPERTIES AT 181°F

BENSON DEEP

Pressure, psia	Liquid Expansion: Relative Volume V/VB	Liquid Expansion: Liquid Compressibility, 10^{-6} psi^{-1}	Differential Liberation: Formation Volume Factor, bbl/STB	Differential Liberation: Solution Gas-Oil Ratio, scf/STB	Differential Liberation: Liberated Gas Gravity, (Air=1.0)	Differential Liberation: Gas Deviation Factor Z	Differential Liberation: Liquid Density, gm/cc	Differential Liberation: Liquid Viscosity, cps	Surface Separation*: Formation Volume Factor, bbl/STB	Surface Separation*: Solution Gas-Oil Ratio, scf/STB
6098	0.9251	21.3	2.0821	1981			0.5681	0.182	2.0016	1870
5598	0.9450	22.0	2.1019	1981			0.5628	0.176	2.0206	1870
5455(Pi)	0.9474	22.3	2.1072	1981			0.5613	0.174	2.0257	1870
5098	0.9540	23.0	2.1219	1981			0.5574	0.170	2.0398	1870
4598	0.9635	24.3	2.1430	1981			0.5519	0.164	2.0602	1870
4098	0.9738	26.2	2.1659	1981			0.5461	0.158	2.0822	1870
3598	0.9855	29.0	2.1919	1981			0.5396	0.152	2.1072	1870
3098(Pb)	1.0000	33.0	2.2242	1981	0.901	0.792	0.5318	0.146	2.1382	1870
2815			1.9857	1616	0.872	0.782	0.5608	0.157	1.9301	1545
2615			1.8658	1424	0.856	0.779	0.5777	0.167	1.8223	1369
2415			1.7721	1267	0.842	0.779	0.5920	0.179	1.7364	1223
2215			1.6959	1135	0.832	0.781	0.6044	0.192	1.6657	1097
2015			1.6314	1019	0.823	0.787	0.6157	0.206	1.6051	986
1815			1.5753	914	0.818	0.795	0.6257	0.224	1.5520	886
1615			1.5255	819	0.815	0.805	0.6351	0.243	1.5048	795
1415			1.4807	732	0.815	0.818	0.6438	0.265	1.4622	710
1215			1.4396	650	0.820	0.833	0.6520	0.289	1.4232	631
1015			1.4009	571	0.831	0.849	0.6599	0.317	1.3867	555
815			1.3632	495	0.852	0.866	0.6677	0.347	1.3513	482
615			1.3244	416	0.891	0.884	0.6758	0.388	1.3151	407
415			1.2800	330	0.967	0.904	0.6850	0.430	1.2740	325
15			1.0670	0	1.164	0.990	0.7429	0.990		
		@ 60°F =	1.0000							

Residual oil gravity = 47.0°API @ 60°F (differential)
Stock-tank oil gravity = 51.4°API @ 60°F (separator)

*Separator at 115 psia and 80°F, stock tank at 70°F.

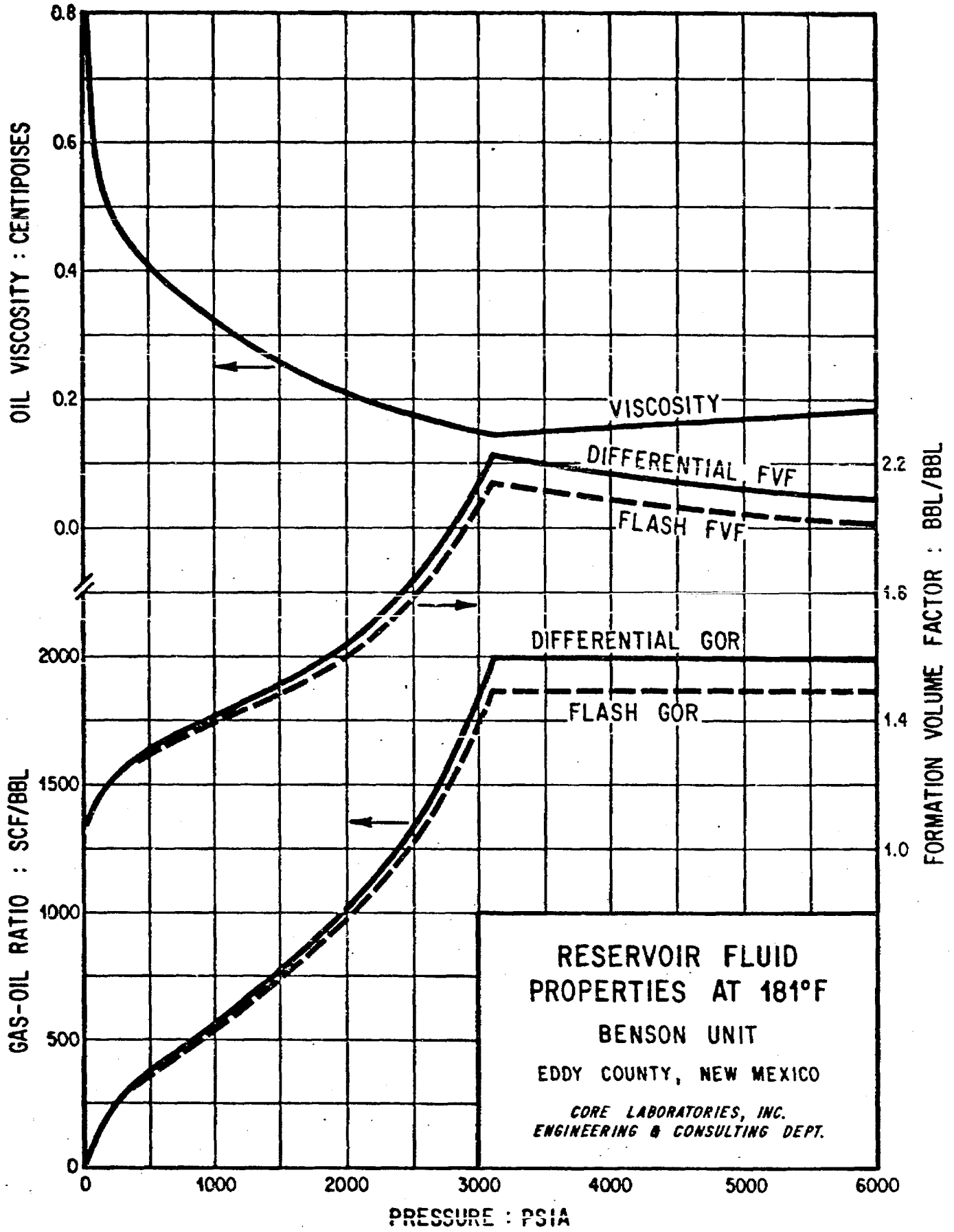
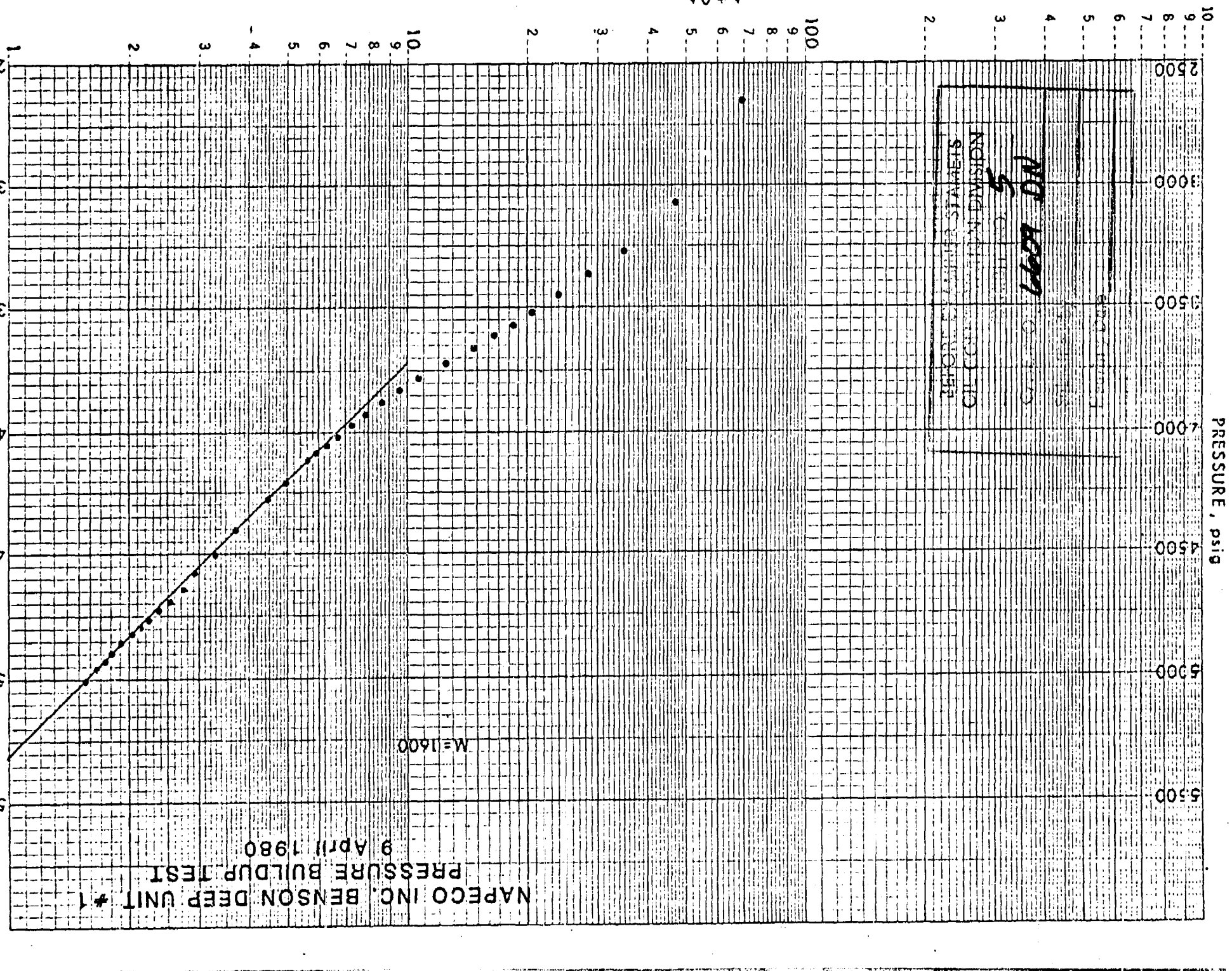

OIL VISCOSITY : CENTIPOISES
0.8
0.6
0.4
0.2
0.0
VISCOSITY
DIFFERENTIAL FVF
FLASH FVF
2.2
1.8
1.4
1.0
FORMATION VOLUME FACTOR : BBL/BBL
GAS-OIL RATIO : SCF/BBL
2000
1500
1000
500
0
DIFFERENTIAL GOR
FLASH GOR
RESERVOIR FLUID
PROPERTIES AT 181°F
BENSON UNIT
EDDY COUNTY, NEW MEXICO
CORE LABORATORIES, INC.
ENGINEERING & CONSULTING DEPT.
0
1000
2000
3000
4000
5000
6000
PRESSURE : PSIA

FIGURE 1

K•E SEMI-LOGARITHMIC • 3 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

$\frac{\Delta}{\Delta + 1}$

46 5493



KEPLINGER and Associates, inc.—
3430 ENTEX BUILDING
1200 MILAM STREET
HOUSTON, TEXAS 77002
AREA 713/651-3127
CABLE: KEPPET TELEX: 762-324

Pressure Build Up Calculations

309 B/D rate

31 Bbl accum ±

pseudo $t = \frac{31(24)}{309} \cong 2.405$ hrs

real time = 137.7 min. = 2.295 hrs OK

Δt	$\frac{t+\Delta t}{\Delta t}$	P
.0334	69.8	2651
.05	46.9	3087
.0667	35.4	3269
.0833	28.5	3372
.1	23.95	3450
.1167	20.6	3510
.1333	18.2	3566
.15	16.3	3611
.1667	14.8	3652
.2	12.5	3723
.2333	10.8	3783
.2667	9.6	3837
.3	8.6	3886
.3333	7.9	3932
.3667	7.3	3976
.4	6.7	4016
.433	6.3	4055
.4667	5.9	4092
.5	5.6	4127
.583	4.94	4208
.6667	4.44	4281
.8333	3.75	4405
1.0	3.3	4504
1.1667	2.97	4581
1.333	2.72	4645
1.5	2.53	4690

Reorder from KWIK-KOPY (Over Foley's Garage) 652-3906

KEPLINGER and Associates, inc.—
3430 ENTEX BUILDING
1200 MILAM STREET
HOUSTON, TEXAS 77002
AREA 713/651-3127
CABLE: KEPPET TELEX: 762-324

	Δt	$\frac{t+\Delta t}{\Delta t}$	P
	1.667	2.38	<1735
	1.833	2.25	1768
	2.0	2.15	1798
	2.167	2.06	1823
	2.33	1.98	1846
	2.5	1.92	1863
	2.67	1.86	1882
	2.83	1.81	1898
	3.0	1.77	1910
	3.1667	1.73	1930
	3.33	1.69	1946
	3.5	1.66	1961
	3.67	1.63	1975
	3.83	1.60	1989
	4.0	1.57	5002
	4.1	1.55	5010

Differential Liberation $kh = \frac{(162.6)(309)(2.11)(.175)}{1600}$

$= 11.60$ md ft

$k = .446$ md

Flash Liberation $kh = \frac{(162.6)(309)(2.03)(.175)}{1600}$

$= 11.16$ md ft

$k = .429$ md.

Reorder from KWIK-KOPY (Over Foley's Garage) 652-3906

JOHNSTON
Schlumberger

COMPUTERIZED DATA ANALYSIS

APRIL 24, 1979

GENTLEMEN:

THE ENCLOSED TEST APPEARS TO BE A GOOD MECHANICAL DRILL STEM TEST DURING WHICH THE TOOLS DID FUNCTION PROPERLY. THE FORMATION PRODUCED ENOUGH RESERVOIR FLUID FOR PROPER IDENTIFICATION. RESERVOIR PRESSURE DRAWDOWN WAS SUFFICIENT AND ADEQUATE SHUT-IN BUILD-UPS DID OCCUR FOR RELIABLE QUANTITATIVE ANALYSIS. RESERVOIR PARAMETERS WERE CALCULATED BY THE HORNER METHOD.

1. FLOW RATE: A FLOW RATE OF 509 MCF/DAY OF GAS AND A TOTAL LIQUID RATE OF 309 BBLS/DAY WAS NOTED DURING THIS TEST.

2. RESERVOIR PRESSURE: EXTRAPOLATION OF THE INITIAL SHUT-IN PRESSURE BUILD-UP INDICATES A MAXIMUM RESERVOIR PRESSURE OF 5469 P.S.I.G. AT RECORDER DEPTH. EXTRAPOLATION OF THE FINAL SHUT-IN PRESSURE BUILD-UP INDICATES A MAXIMUM RESERVOIR PRESSURE OF 5418 P.S.I.G. AT RECORDER DEPTH. THE DIFFERENCE BETWEEN THE INITIAL AND FINAL SHUT-IN PRESSURE OF 51 P.S.I.G. IS SIGNIFICANT BUT PROBABLY DUE TO INSUFFICIENT SHUT-IN TIME.

3. PERMEABILITY: THE CALCULATED TRANSMISSIBILITY FACTOR OF 68 MD.-FT./CP. INDICATES AN AVERAGE EFFECTIVE PERMEABILITY TO GAS OF .036 MD. FOR THE REPORTED 40 FOOT NET INTERVAL. THE CALCULATIONS WERE BASED ON A SLOPE OF 953 P.S.I./LOG CYCLE OBTAINED FROM THE FINAL SHUT-IN BUILD-UP PLOT. IT WAS ASSUMED FOR THESE CALCULATIONS: (A) GAS GRAVITY 0.70 (B) VISCOSITY .0213 CP. (C) AND GAS DEVIATION FACTOR .842. THESE FIGURES WERE OBTAINED FROM THE AVAILABLE TECHNICAL LITERATURE.

4. WELL BORE DAMAGE: THE CALCULATED DAMAGE RATIO OF 1.50 INDICATES THAT WELL BORE DAMAGE IS PRESENT AT THE TIME AND CONDITIONS OF THIS TEST.

5. RADIUS OF INVESTIGATION: THE CALCULATED RADIUS OF INVESTIGATION OF THIS TEST IS 14 FEET BASED ON AN ASSUMED POROSITY OF 10%, COMPRESSIBILITY OF 2.34 X 10^{-4}, AND OTHER ASSUMPTIONS MADE IN NUMBER 3 ABOVE.

6. GEL COMMENTS: THE FORMATION EXHIBITS THE CHARACTERISTICS OF RELATIVELY LOW PERMEABILITY EFFECTIVE TO THE RESERVOIR FLUID AND INDICATES THE PRESENCE OF WELL BORE DAMAGE. AN ANOMALY WAS NOTED AT THE END OF THE FINAL SHUT-IN. THIS UPWARD BREAK IN SLOPE IS REPRESENTATIVE OF A DECREASE IN EFFECTIVE TRANSMISSIBILITY AWAY FROM THE WELL BORE. THE ANOMALY GIVES THE INDICATION THAT THE WELL WILL NOT SUSTAIN THIS RATE AND GAS PRODUCTION IS EXPECTED TO DECREASE.

DENNIS MYREN
RESERVOIR EVALUATION
DEPARTMENT

NAPECO, INC.
BENSON DEEP UNIT #1; EDDY COUNTY, NEW MEXICO
TEST #3; 10635' TO 10695'
LOCATION: 660' FSL, 2180' FEL, SEC. 33 - T18S - R30E
FIELD REPORT # 19556 D

In making any interpretation, our employees will give Customer the benefit of their best judgment as to the correct interpretation. Nevertheless, since all interpretations are opinions based on inferences from electrical, mechanical or other measurements, we cannot, and do not guarantee the accuracy or correctness of any interpretations, and we shall not be liable or responsible, except in the case of gross or wilful negligence on our part, for any loss, costs, damages or expenses incurred or sustained by Customer resulting from any interpretation made by any of our agents or employees.

LINGER and Associates, inc.—
3430 ENTEX BUILDING
1200 MILAM STREET
HOUSTON, TEXAS 77002
AREA 713/651-3127
CABLE: KEPPET TELEX: 762-324

Reservoir Properties

ϕ	6%
S_w	.30
B_o	2.0257
h	26'
k_o	.446 md (Diff) .429 md (Flash)
T	181°F
P_o	5465 psia
P_s	3098 psia
R_s	1870

Oil in Place

40 Acres	1670008bl
160 Acres	6690008bl
320 Acres	13380008bl

DEPARTMENT EXHIBITS
OIL CONSERVATION DIVISION
CASE NO. 6609 DN
Submitted by
Hearing Date

All done at 20 BOPD

BENSON DEEP WELL SPACING EVALUATION

APRIL, 1980

CASE DESCRIPTION: Set 3 permeability

Case 50 - 40 acre spacing
Case 51 - 160 acre spacing
Case 52 - 320 acre spacing

RESULTS INITIAL PRODUCTION TO BUBBLE-POINT[1]

RATE (BOPD)		CASE NO.	RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME[1] (DAYS)
20	(40)	50	7740.	4.63	3897.	3958.	387.
40	(160)	51	27000.	4.04	4083.	4142.	1350.
70	(320)	52	52380	3.91	4122.	4181.	2619.

RESULTS BUBBLE-POINT TO ABANDONMENT[4]

RATE[5] (BOPD)	CASE NO.	RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME[6] (DAYS)
20	50	2280.	1.37	3486.	3553.	114.
40	51	10700	1.60	3585.	3648.	535.
70	52	18480	1.38	3687.	3749.	924.

ENGINEERING and CONSULTING DEPARTMENT

BEFORE EXAMINER STAMETS
OIL CONSERVATION DIVISION
EXHIBIT NO. 6
CASE NO. 6609 DN
Submitted by
Hearing Date

SUMMARY OF RESULTS

RATE OIL (BOPD)	CASE NO.	TOTAL RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY[3] PRESSURE (PSIA)	TIME (DAYS)
20	50	10020	6.00	3486.	3553.	501.
40	51	37700	5.64	3585.	3648.	1885.
70	52	70860	5.30	3687.	3749.	3543.

CONDITIONS AT ABANDONMENT

RATE OIL (BOPD)	CASE NO.	GOR[8] (SCF/BBL)	BHFP (PSIA)	GAS SATURATION[9] (PCT)
20	50	4224	<2000	11.60
40	51	2032	<2000	9.65
70	52	1993	<2000	9.54

NOTES:

1. Time at which gas saturation is formed in cell adjoining wellbore.
2. Average reservoir pressure within well-spacing at time bubble-point reached or abandonment.
3. Pressure at the center of the outermost cell within well-spacing at time bubble-point reached or abandonment.
4. See notes on abandonment conditions.
5. Below bubble-point, well producing rate was equal to rate above bubble-point, subject to abandonment conditions.
6. From bubble-point to abandonment.
7. Total time from initial production to abandonment.
8. GOR increased very rapidly with gas saturation and well did not produce for any substantial period at high GOR.
9. Gas saturation in cell adjoining wellbore.

ENGINEERING AND CONSULTING DEPARTMENT

BENSON DEEP

PERMEABILITY EFFECTS ON RECOVERY[1]

40-ACRE SPACING

CASE	PERM SET	ULT REC (BBL)	PER CENT OIP REC (PCT)
50	3	10,020	6.00
2	1	11,840	7.10
6	2	18,000	10.78

160-ACRE SPACING

51	3	37,700	5.64
18	1	45,120	6.74
22	2	56,720	7.58

320-ACRE SPACING

52	3	70,860	5.30
34	1	83,847	6.27
38	2	104,300	7.80

1. All cases used a producing rate of 20 BOPD.

No attempt was made in the model to optimize vertical flow. The wells had a tubing diameter of 1.441 inches, which is not considered an optimum value. Preliminary external calculations indicate the well will flow under assumed model conditions. The initial well productivity index was assumed to be about six barrels per psi, which represents a significant improvement upon that noticed in the limited test of an unstimulated section.

In each case, the assigned rate was held constant until the cell adjoining the wellbore passed through the bubble point. In most cases, the well retained the same rate from bubble point to abandonment, although in some cases some slight tapering was noticed. Increased drawdown pressures would have created additional tapering.

Cases to be run were specified by Keplinger and Associates. Run results are tabulated in a separate summary.

BENSON DEEP

SIMULATION MODEL PERMEABILITY VALUES[1]

DISTANCE[2] (ft.)	SET 1[3] (Md.)	SET 2[3] (Md.)
2	89.2 (200)	89.2 (200)
4	44.6 (100)	66.9 (150)
8	22.3 (50)	44.6
16	11.2 (25)	33.5 (75)
32	4.5 (10)	22.3 (50)
64	2.2 (5)	15.6 (35)
128		11.2 (25)
256		4.5 (10)
387		2.2 (5)

BEFORE EXAMINER STAMETS
OIL CONSERVATION DIVISION
EXHIBIT NO. 7
CASE NO. 6609DN
Submitted by
Hearing Date
ENGINEERING and CONSULTING DEPARTMENT

Notes:

1. Values given to Core Lab.

2. Distance from center of wellbore to cell face at which corresponding permeability was applied.

3. Values in parentheses represent factors by which the matrix permeability was scaled upward.

BENSON DEEP WELL SPACING EVALUATION

APRIL, 1980

CASE DESCRIPTION: 40 acre, set 1 permeability

RESULTS INITIAL PRODUCTION TO BUBBLE-POINT[1]

RATE (BOPD)	CASE NO.	RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME[1] (DAYS)
20	2	8,300	4.97	3782	3842	415.
40	3	7,480	4.48	3938	4055	187.
70	4	4,725	2.83	4478	4670	67.5

RESULTS BUBBLE-POINT TO ABANDONMENT[4]

RATE[5] (BOPD)	CASE NO.	RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME[6] (DAYS)
20	2	3,540	2.12	3194	3263	177.
40	3	2,040	1.22	3571	3699	51.
70	4	1.365	.82	[illegible]16	4412	19.5

ENGINEERING and CONSULTING DEPARTMENT

SUMMARY OF RESULTS

RATE OIL (BOPD)	CASE NO.	TOTAL RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME (DAYS)
20	2	11,840	7.10	3194	3263	592.
40	3	9,520	5.70	3571	3699	238
70	4	6,090	3.65	4216	4412	87

CONDITIONS AT ABANDONMENT

RATE OIL (BOPD)	CASE NO.	GOR[8] (SCF/BBL)	BHFP (PSIA)	GAS SATURATION[9] (PCT)
20	2	22,359	<2000	16.03
40	3	6,615	<2000	13.05
70	4	7,641	=2000	13.28

NOTES:

1. Time at which gas saturation is formed in cell adjoining wellbore.
2. Average reservoir pressure within well-spacing at time bubble-point reached or abandonment.
3. Pressure at the center of the outermost cell within well-spacing at time bubble-point reached or abandonment.
4. See notes on abandonment conditions.
5. Below bubble-point, well producing rate was equal to rate above bubble-point, subject to abandonment conditions.
6. From bubble-point to abandonment.
7. Total time from initial production to abandonment.
8. GOR increased very rapidly with gas saturation and well did not produce for any substantial period at high GOR.
9. Gas saturation in cell adjoining wellbore.

ENGINEERING and CONSULTING DEPARTMENT

BENSON DEEP WELL SPACING EVALUATION

APRIL, 1980

CASE DESCRIPTION: 160 acre, set 1 permeability

RESULTS INITIAL PRODUCTION TO BUBBLE-POINT[1]

RATE (BOPD)	CASE NO.	RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME[1] (DAYS)
20	18	35,360	5.29	3683.	3744.	1768.
40	19	23,600	3.53	4242.	4356.	590.
70	20	8,365	1.25	5013.	5189.	119.5

RESULTS BUBBLE-POINT TO ABANDONMENT[4]

RATE[5] (BOPD)	CASE NO.	RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME[6] (DAYS)
20	18	9,760	1.46	3273.	3332.	488.
40	19	7,600	1.14	3997.	3872.	190.
70	20	5,705	.85	4725.	4913.	81.5

ENGINEERING AND CONSULTING DEPARTMENT

SUMMARY OF RESULTS

RATE OIL (BOPD)	CASE NO.	TOTAL RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME (DAYS)
20	18	45,120	6.74	3273.	3332.	2256.
40	19	31,200	4.66	3997.	3872.	780.
70	20	14,070	2.10	4725.	4913.	201.

CONDITIONS AT ABANDONMENT

RATE OIL (BOPD)	CASE NO.	GOR[8] (SCF/BBL)	BHFP (PSIA)	GAS SATURATION[9] (PCT)
20	18	7572.	<2000	13.45
40	19	6074	<2000	12.90
70	20	3012	<2000	10.83

NOTES:

1. Time at which gas saturation is formed in cell adjoining wellbore.
2. Average reservoir pressure within well-spacing at time bubble-point reached or abandonment.
3. Pressure at the center of the outermost cell within well-spacing at time bubble-point reached or abandonment.
4. See notes on abandonment conditions.
5. Below bubble-point, well producing rate was equal to rate above bubble-point, subject to abandonment conditions.
6. From bubble-point to abandonment.
7. Total time from initial production to abandonment.
8. GOR increased very rapidly with gas saturation and well did not produce for any substantial period at high GOR.
9. Gas saturation in cell adjoining wellbore.

BENSON DEEP WELL SPACING EVALUATION

APRIL, 1980

CASE DESCRIPTION: 320 acre, set 1 permeability

RESULTS INITIAL PRODUCTION TO BUBBLE-POINT[1]

RATE (BOPD)	CASE NO.	RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME[1] (DAYS)
20	34	66,000	4.93	3792.	3852.	3300.
40	35	39,600	2.96	4430.	4532.	990.
70	36	8,610	.64	5222.	5369.	123.

RESULTS BUBBLE-POINT TO ABANDONMENT[4]

RATE[5] (BOPD)	CASE NO.	RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME[6] (DAYS)
20	34	17,847	1.33	3406.	3470.	879.
40	35	10,809	.81	4165.	4282.	270.
70	36	8,470	.63	5006.	5183.	121.

ENGINEERING and CONSULTING DEPARTMENT

SUMMARY OF RESULTS

RATE OIL (BOPD)	CASE NO.	TOTAL RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME (DAYS)
20	34	83,847.	6.27	3406.	3470.	4179.
40	35	50,409	3.77	4165.	4282.	1260.
70	36	17,080	1.28	5006.	5183.	244.

CONDITIONS AT ABANDONMENT

RATE OIL (BOPD)	CASE NO.	GOR[8] (SCF/BBL)	BHFP (PSIA)	GAS SATURATION[9] (PCT)
20	34	2578.	<2000	10.41
40	35	6817.	<2000	13.35
70	36	2984.	<2000	10.80

NOTES:

1. Time at which gas saturation is formed in cell adjoining wellbore.
2. Average reservoir pressure within well-spacing at time bubble-point reached or abandonment.
3. Pressure at the center of the outermost cell within well-spacing at time bubble-point reached or abandonment.
4. See notes on abandonment conditions.
5. Below bubble-point, well producing rate was equal to rate above bubble-point, subject to abandonment conditions.
6. From bubble-point to abandonment.
7. Total time from initial production to abandonment.
8. GOR increased very rapidly with gas saturation and well did not produce for any substantial period at high GOR.
9. Gas saturation in cell adjoining wellbore.

ENGINEERING and CONSULTING DEPARTMENT

BENSON DEEP WELL SPACING EVALUATION

APRIL, 1980

CASE DESCRIPTION: 40 acre, set 2 permeability

RESULTS INITIAL PRODUCTION TO BUBBLE-POINT[1]

RATE (BOPD)	CASE NO.	RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME[1] (DAYS)
20	6	12,120	7.26	3135.8	3162.9	606.
40	7	11,780	7.05	3188.5	3242.6	294.5
70	8	10,920	6.54	3325.2	3420.1	156.

RESULTS BUBBLE-POINT TO ABANDONMENT[4]

RATE[5] (BOPD)	CASE NO.	RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME[6] (DAYS)
20	6	5,880	3.52	2736.	2873.	294.
40	7	4,460	2.67	2843.	2984.	111.5
70	8	3,780	2.26	2948.	3066.	54.

ENGINEERING and CONSULTING DEPARTMENT

SUMMARY OF RESULTS

RATE OIL (BOPD)	CASE NO.	TOTAL RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY[3] PRESSURE (PSIA)	TIME (DAYS)
20	6	18,000	10.78	2736.	2875.	900.
40	7	16.240	9.72	2843.	2984.	406.
70	8	14,700	8.80	2848.	3066.	210

CONDITIONS AT ABANDONMENT

RATE OIL (BOPD)	CASE NO.	GOR[8] (SCF/BBL)	BHFP (PSIA)	GAS SATURATION[9] (PCT)
20	6	23,186	=2222.	16.16
40	7	18,736	=2000	15.56
70	8	11,269	<2000	14.42

NOTES:

1. Time at which gas saturation is formed in cell adjoining wellbore.
2. Average reservoir pressure within well-spacing at time bubble-point reached or abandonment.
3. Pressure at the center of the outermost cell within well-spacing at time bubble-point reached or abandonment.
4. See notes on abandonment conditions.
5. Below bubble-point, well producing rate was equal to rate above bubble-point, subject to abandonment conditions.
6. From bubble-point to abandonment.
7. Total time from initial production to abandonment.
8. GOR increased very rapidly with gas saturation and well did not produce for any substantial period at high GOR.
9. Gas saturation in cell adjoining wellbore.

ENGINEERING and CONSULTING DEPARTMENT

ENGINEERING and CONSULTING DEPARTMENT

BENSON DEEP WELL SPACING EVALUATION

APRIL, 1980

CASE DESCRIPTION: 160 acre, set 2 permeability

RESULTS INITIAL PRODUCTION TO BUBBLE-POINT[1]

RATE (BOPD)	CASE NO.	RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME[1] (DAYS)
20	22	44,400	6.64	3296.	3348.	2220.
40	23	40,800	6.10	3445.	3547.	1020.
70	24	33,740	5.04	3761.	3933.	482.

RESULTS BUBBLE-POINT TO ABANDONMENT[4]

RATE[5] (BOPD)	CASE NO.	RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME[6] (DAYS)
20	22	12,500	1.87	2965.	3060.	625.
40	23	9,920	1.48	3106.	3211.	248.
70	24	9,730	1.45	3380.	3542.	139.

SUMMARY OF RESULTS

RATE OIL (BOPD)	CASE NO.	TOTAL RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME (DAYS)
20	22	56,900	8.51	2965.	3060.	2845.
40	23	50,720	7.58	3106.	3211.	1268.
70	24	43,470	6.50	3380.	3542.	621.

CONDITIONS AT ABANDONMENT

RATE OIL (BOPD)	CASE NO.	GOR[8] (SCF/BBL)	BHFP (PSIA)	GAS SATURATION[9] (PCT)
20	22	24,736	=2000	16.17
40	23	16,007	=2000	15.27
70	24	8,036	=2000	13.55

NOTES:

1. Time at which gas saturation is formed in cell adjoining wellbore.
2. Average reservoir pressure within well-spacing at time bubble-point reached or abandonment.
3. Pressure at the center of the outermost cell within well-spacing at time bubble-point reached or abandonment.
4. See notes on abandonment conditions.
5. Below bubble-point, well producing rate was equal to rate above bubble-point, subject to abandonment conditions.
6. From bubble-point to abandonment.
7. Total time from initial production to abandonment.
8. GOR increased very rapidly with gas saturation and well did not produce for any substantial period at high GOR.
9. Gas saturation in cell adjoining wellbore.

ENGINEERING and CONSULTING DEPARTMENT

BENSON DEEP WELL SPACING EVALUATION

APRIL, 1980

CASE DESCRIPTION: 320 acre, set 2 permeability

RESULTS INITIAL PRODUCTION TO BUBBLE-POINT[1]

RATE (BOPD)	CASE NO.	RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME[1] (DAYS)
20	38	85,800	6.41	3359.1	3415.7	4290.
40	39	74,360	5.56	3603.0	3713.0	1859.
70	40	56,700	4.24	4013.7	4198.0	810.

RESULTS BUBBLE-POINT TO ABANDONMENT[4]

RATE[5] (BOPD)	CASE NO.	RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME[6] (DAYS)
20	38	18,500	1.38	3045.	3118.	930.
40	39	16,000	1.20	3292.	3405.	400.
70	40	15,470	1.16	3688.	3868.	221.

ENGINEERING and CONSULTING DEPARTMENT

SUMMARY OF RESULTS

RATE OIL (BOPD)	CASE NO.	TOTAL RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME (DAYS)
20	38	104,300	7.80	3045.	3118.	5220.
40	39	90,360	6.75	3292.	3405.	2259.
70	40	72,170	5.39	3688.	3868.	1031.

CONDITIONS AT ABANDONMENT

RATE OIL (BOPD)	CASE NO.	GOR[8] (SCF/BBL)	BHFP (PSIA)	GAS SATURATION[9] (PCT)
20	38	24,925	=2000	16.14
40	39	13,425	=2000	14.93
70	40	7,292	=2000	13.18

NOTES:

1. Time at which gas saturation is formed in cell adjoining wellbore.
2. Average reservoir pressure within well-spacing at time bubble-point reached or abandonment.
3. Pressure at the center of the outermost cell within well-spacing at time bubble-point reached or abandonment.
4. See notes on abandonment conditions.
5. Below bubble-point, well producing rate was equal to rate above bubble-point, subject to abandonment conditions.
6. From bubble-point to abandonment.
7. Total time from initial production to abandonment.
8. GOR increased very rapidly with gas saturation and well did not produce for any substantial period at high GOR.
9. Gas saturation in cell adjoining wellbore.

ENGINEERING and CONSULTING DEPARTMENT

Benson Deep Unit No. 1
Eddy County, New Mexico
Economic Evaluation

BASIC DATA

1. Gas reserves based on GOR of 2000/1 plus an additional 20 mmcf.

2. Oil Flow Rates - 20, 40, or 70 bopd
   Gas Flow Rates - based on GOR until oil depletion, 200 mcfpd thereafter

3. Costs - Well--$912,767 (70% intangible)
   Operating--$1000/well/month

4. Prices:
   Oil - $32/bbl for life (after windfall profits tax)
   Gas - $2.428/mcf x 1274 $\frac{\text{mmbtu}}{\text{mcf}}$ adjustment = $3.093/mcf

5. Other - Royalties - 18.5%
   E & D Salvageable - 10%

BEFORE THE OIL CONSERVATION DIVISION
Case No. 8
Order No. 6609
Submitted by
Hearing Date

BENSON DEEP UNIT NO. 1, Eddy County, New Mexico, ECONOMIC EVALUATION

Based on drilling 1 well on 160. Four wells would quadruple loss.

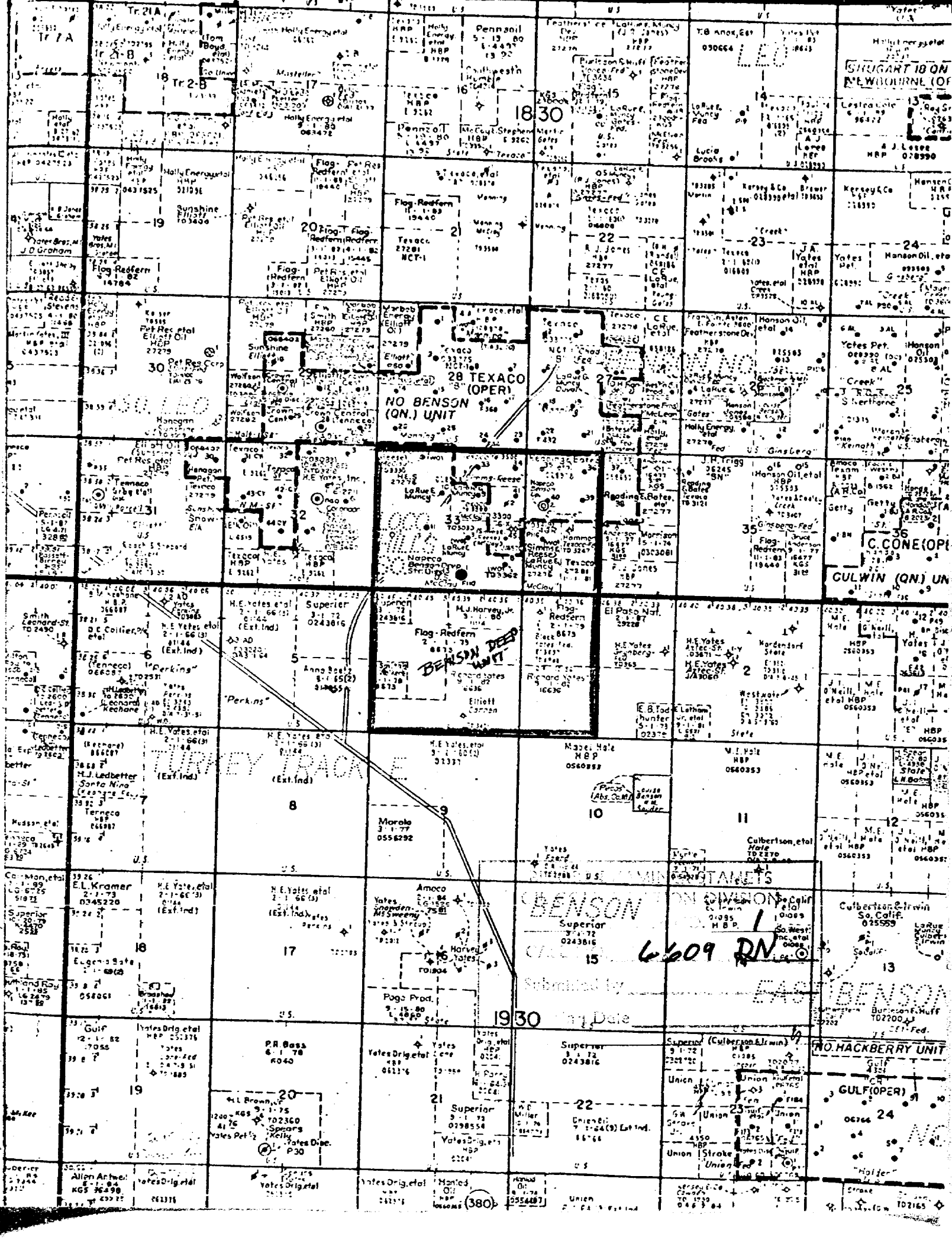
	40-Acre Spacing			160-Acre Spacing			320 ~~360~~-Acre Spacing		
	DAILY FLOW RATES			DAILY FLOW RATES			DAILY FLOW RATES		
Estimated Recoverable Reserves (8/8)	20 BOPD	40 BOPD	70 BOPD	20 BOPD	40 BOPD	70 BOPD	20 BOPD	40 BOPD	70 BOPD
Oil (BBL)	18,000	16,240	14,700	56,900	50,720	43,470	104,300	90,360	72,170
Gas (MMCF)	29	28	27	48	45	42	72	65	70
Producing Time (Days)	900 (2.46 yrs)	406 (1.11 yrs)	210 (.575 yrs)	2,845 (7.79 yrs)	1,268 (3.47 yrs)	621 (1.7 yrs)	5,215 (14.28 yrs)	2,259 (6.18 yrs)	1,031 (2.82 yrs)
After Tax:									
Net Cash Flow Discounted ($)									
0%	($179,000)	($195,000)	($213,000)	$335,000	$258,000	$172,000	$943,000	$802,000	$547,000
10%	($228,504)	($219,561)	($230,437)	$ 60,640	$135,410	$107,870	$229,800	$458,060	$400,900
20%	($266,736)	($239,939)	($245,277)	($90,880)	$ 38,010	$ 55,310	($45,700)	$277,460	$288,890
Rate of Return (%)	Negative	Negative	Negative	13.27	24.82	32.91	17.74	39.34	65.37
Payout (Years)	Negative	Negative	Negative	4.9	2.4	1.4	4.9	2.4	1.3

Note: These economics are based on one well only being drilled on a 40 acre spacing, 160 acre spacing, and 320 acre spacing. For instance, to compare the net cash flow discounted for four wells drilled on a 40 acre spacing and produced at a flow rate of 70 BOPD versus one well drilled on a 160 acre spacing and produced at a flow rate of 70 BOPD, the net cash flow discounted for the 40 acre spacing must be multiplied by four:

4 x ($245,277) versus $55,310

Net cash flow discounted at 20% for 70 BOPD flow rate for four wells each drilled on 40 acre spacing.

Net cash flow discounted at 20% for 70 BOPD flow rate for one well on 160 acre spacing.


Tr 2A
Tr 2-B
Tr 2-8
Tom Boyd etal
Holly Energy etal
Pennzoil
Southwestern Pub. Svc.
Texaco
Flag-Redfern
Pet Res etal
Elliott Oil
Sunshine
Yates Bros. M.I.
J.D. Graham
Holly Energy etal HBP
Flag-Redfern
Pet Res etal
Elliott Oil HBP
Texaco
Flag-Redfern
Yarbob Energy (Elliott Oil)
Texaco
Sunshine
Elliott
Wolfson
Crown Central
28 Tennaco
Texaco
28 TEXACO (OPER)
NO BENSON (ON.) UNIT
Texaco
C.E. LaRue etal
Pet Res Corp
Honegan
Ellott Oil
Pet Res etal
Honegan Pet.
Tennaco
Sinclair
Snow-Ella
Tennaco
Sibley etal
Texaco
H.E. Yates, Inc.
Texaco
Texaco
Texaco

P-V-T, Inc.

Physical and Design Data Research
K-Values • PVT • Enthalpy
Chemical Process & Petroleum Fluids
Reservoir Analysis and Computer Programs

P. O. Box 36272 / Houston, Texas 77036 / A C 713 782-3577

March 29, 1980

NAPECO
P. O. Box 283
Houston, Texas 77001

Attn: Mr. Rusty Smith

Subject: Reservoir Fluid Study
Benson Deep Unit No. 1
Eddy Co., New Mexico
Lab No. A-79535

Gentlemen:

Samples of separator liquid and vapor were collected from the subject well by a representative of TefTeller, Inc. on December 19, 1979. Presented in this report are the results of a reservoir fluid study performed using these samples.

The producing gas-liquid ratio was measured to be 1304 cubic feet of separator gas at 15.025 psia and 60°F. per barrel of stock tank liquid at 60°F. This ratio has been corrected for gas gravity and supercompressibility. In the laboratory it was found that the ratio is equivalent to 1268 standard cubic feet of separator gas per barrel of separator liquid. This ratio was used in conjunction with the measured compositions of the separator products to calculate the composition of the well stream material. These data are reported on page two.

The separator products were physically recombined to the producing ratio and examined in a visual cell at the reservoir temperature of 166°F. During a constant composition expansion a bubble point was observed at 3023 psig. Comparison of this value to the reservoir pressure indicates that the fluid exists in an undersaturated condition. Observation of the system at pressures immediately below the bubble point pressure shows that the liquid exhibits a rapid shrinkage which indicates this system to be a volatile oil.

Since a large amount of the production from this type of reservoir comes from the gaseous phase, a constant volume depletion study was performed on a sample of the recombined fluid to enable calculation of the production during depletion

Exhibit No. 3
Case No. 6609 DN
Submitted by
Hearing Date

below the bubble point pressure. The depletion consisted of a series of expansions and constant pressure displacements terminating at the original cell volume. This has the effect of maintaining a constant reservoir volume. The produced gas phase was charged to low temperature, fractional distillation equipment for analysis and volume measurement. The results of the depletion are tabulated on page five of the report.

The quantity of plant products available in the gas phase alone is shown on page six. A plant efficiency of 100 per cent has been assumed.

The well stream composition and equilibrium ratios from the literature were used to calculate the stock tank liquid and sales gas recoveries that will be obtained as the pressure declines from reservoir pressure to the bubble point pressure. These recoveries are based upon one MMSCF of fluid in place at the bubble point pressure. One MMSCF is the gaseous equivalent of 938.012 barrels of bubble point liquid.

The viscosity of the liquid phase was measured from pressures exceeding reservoir pressure to atmospheric pressure. These data are presented on page eight together with the calculated gas phase viscosity.

The data concerning the shrinkage of the liquid in the reservoir are shown on page nine of this report.

Thank you for this opportunity to be of service. If you have and questions or if we may assist you further, please do not hesitate to contact us.

Very truly yours,

Allen E. Barron

AEB/cam

P-V-T, Inc.

Physical and Design Data Research
K-Values • PVT • Enthalpy
Chemical Process & Petroleum Fluids
Reservoir Analysis and Computer Programs

P. O. Box 38272 / Houston, Texas 77038 / A C 713 782-3577

File A-79535

Company NAPECO — Date Sampled December 19, 1979

Well Benson Deep Unit No. 1 — County Eddy

Field Wildcat — State New Mexico

FORMATION CHARACTERISTICS

Formation Name	Strawn
Date First Well Completed	May 10, , 1979
Original Reservoir Pressure	5450 PSIG @ 10720 Ft.
Original Produced Gas-Liquid Ratio	5682 SCF/Bbl
Production Rate	110 Bbls/Day
Separator Pressure and Temperature	PSIG ° F.
Liquid Gravity at 60° F.	48.9 ° API
Datum	Ft. Subsea

WELL CHARACTERISTICS

Elevation	3404 GL Ft.
Total Depth	12071 Ft.
Producing Interval	10648-10718 Ft.
Tubing Size and Depth	2-7/8 In. to 10543 Ft.
Open Flow Potential	0.625 MMSCF/Day
Last Reservoir Pressure	5448 PSIG @ 10720 Ft.
Date	May 11, , 1979
Reservoir Temperature	181 ° F. @ 10720 Ft.
Status of Well	Shut in
Pressure Gauge	Amerada RPG-3

SAMPLING CONDITIONS

Flowing Tubing Pressure		1123 PSIG
Flowing Bottom Hole Pressure		? PSIG
Primary Separator Pressure		350 PSIG
Primary Separator Temperature		67 ° F.
Secondary Separator Pressure		PSIG
Secondary Separator Temperature		° F.
Field Stock Tank Liquid Gravity		48.9 ° API @ 60° F.
Primary Separator Gas Production Rate		78.167 MSCF/Day
Pressure Base	15.025 PSIA	
Temperature Base	60 ° F.	
Compressibility Factor (F_{pv})	1.028	
Gas Gravity (Laboratory)	0.745	
Gas Gravity Factor (F_g)	1.159	

Separator Liquid Production Rate @ 60° F. * 71.39 Bbls/Day

Primary Separator Gas/ Separator Liquid Ratio * 1095 SCF/Bbl

or * 887.654 Bbls/MMSCF

ENGINEER: Tefteller, Inc.

REMARKS: *96 hours gross fluids 307.06833 bbls.oil;345.9835 MCF gas.

P-V-T, Inc.

File A-79535

Well Benson Deep Unit No. 1

Hydrocarbon Analyses of Separator Products and Calculated Well Stream

Component	Separator Liquid Mol Per Cent	Separator Gas Mol Per Cent	GPM	Well Stream Mol Per Cent	GPM
Hydrogen Sulfide	--	--		--	
Carbon Dioxide	0.10	0.45		0.29	
Nitrogen	0.06	2.11		1.19	
Methane	8.06	72.74		43.68	
Ethane	9.80	15.80	4.309	13.10	
Propane	14.61	6.44	1.807	10.11	
iso-Butane	2.91	0.61	0.204	1.64	
n-Butane	8.92	1.32	0.424	4.74	
iso-Pentane	3.33	0.20	0.075	1.61	
n-Pentane	3.58	0.19	0.070	1.71	
Hexane	7.41	0.08	0.033	3.37	
Heptanes plus	41.22	0.06	0.028	18.56	
	100.00	100.00	6.950	100.00	

Properties of Heptanes Plus			
API Gravity @ 60° F.	42.3		
Specific gravity @ 60/60° F.	0.8134		0.813
Molecular weight	181	103	181

Calculated separator gas gravity (air=1.000) = 0.745

Calculated gross heating value for separator gas = 1290 BTU per cubic foot of dry gas @15.025 psia and 60° F.

Primary separator gas collected - @ 350 psig and 67 °F.

Primary separator liquid collected @ 350 psig and 67 °F.

Primary separator gas/separator liquid ratio 1093 SCF/Bbl @ 60° F.

Primary separator liquid/stock tank liquid ratio 1.0292 Bbls @ 60° F./Bbl.

File A-79535

Well Benson Deep Unit No. 1

VOLUMETRIC DATA OF RECOMBINED SAMPLE

1. Saturation pressure (bubble-point pressure) 3023 PSIG @ 166 °F.

2. Specific volume at saturation pressure: ft³/lb 0.02814 @ 166 °F.

3. Thermal expansion of saturated oil @ 6000 PSI = $\frac{V\ @\ 166\ °F}{V\ @\ \ °F}$ = 1.0178

4. Compressibility of saturated oil @ reservoir temperature: Vol/Vol/PSI:

   From 6000 PSI to 5396 PSI = 15.29×10^{-6}

   From 5396 PSI to 4500 PSI = 17.32×10^{-6}

   From 4500 PSI to 3500 PSI = 21.41×10^{-6}

   From 3500 PSI to 3023 PSI = 26.94×10^{-6}

5. One MMSCF is the gaseous equivalent of 938.012 barrels of reservoir fluid at the bubble point.

File A-79535

Well Benson Deep Unit No. 1

Pressure-Volume Relations at 166 °F.

	Pressure PSIG	Relative Volume (1)	Density gm/cc
	6000	0.9422	0.6041
	5500	0.9494	0.5995
Res.Press.	5396	0.9510	0.5985
	5000	0.9573	0.5946
	4500	0.9660	0.5892
	4000	0.9758	0.5833
	3500	0.9871	0.5767
Sat.Press.	3023	1.0000	0.5692
	2900	1.0049	
	2800	1.0102	
	2700	1.0192	
	2500	1.0840	
	2000	1.2357	
	1500	1.5397	
	1229	1.8444	
	1048	2.1428	
	918	2.4488	
	821	2.7263	
	763	2.9410	

(1) Relative Volume: V/Vsat is barrels at indicated pressure per barrel at saturation pressure.

Depletion Study at 166 °F.

Hydrocarbon Analyses of Produced Gas Phase Produced -Mol Percent

Component	Reservoir Pressure - PSIG							
	3023	2600	2200	1800	1400	1000	600	600Liq.
Carbon dioxide	0.29	0.39	0.40	0.41	0.42	0.42	0.43	0.09
Nitrogen	1.19	3.21	2.90	2.51	2.12	1.61	1.36	0.06
Methane	43.68	70.11	71.71	72.73	72.78	71.24	66.89	8.96
Ethane	13.10	12.69	12.70	12.89	13.43	14.78	17.57	11.18
Propane	10.11	7.02	6.63	6.37	6.45	7.18	8.60	13.54
iso-Butane	1.64	1.02	0.95	0.88	0.85	0.87	0.97	2.63
n-Butane	4.74	2.42	2.15	1.99	1.92	1.95	2.13	8.25
iso-Pentane	1.61	0.74	0.63	0.57	0.54	0.52	0.58	2.86
n-Pentane	1.71	0.74	0.63	0.57	0.53	0.53	0.56	3.45
Hexanes	3.37	0.44	0.37	0.30	0.28	0.27	0.28	7.31
Heptanes plus	18.56	1.22	0.93	0.78	0.68	0.63	0.63	41.67
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Molecular weight of heptanes plus	180	137	129	122	117	113	114	187
Specific gravity of heptanes plus	0.811	0.776	0.768	0.761	0.756	0.752	0.753	0.821
Deviation Factor - Z								
Equilibrium gas	--	0.803	0.796	0.810	0.838	0.874	0.917	--
Gas phase produced- Cumulative percent of initial	0	5.722	13.073	20.840	30.840	41.307	51.412	--
GPM from Smooth Compositions								
Propane plus	--	4.516	3.995	3.673	3.564	3.740	4.629	
Butanes plus	--	2.547	2.134	1.885	1.754	1.725	1.856	
Pentanes plus	--	1.429	1.127	0.952	0.854	0.808	0.840	

Calculated Cumulative Recovery During Depletion
(Per MMSCF of Original Fluid)

Reservoir Pressure, PSIG	Gas Phase, MMSCF	"Plant Products" in Gas Phase, Gallons*		
		Propane	Butanes	Pentanes plus
3023	0	--	--	--
2600	57.22	97	--	18
2200	130.73	218	--	42
1800	208.40	344	159	68
1400	308.40	510	234	101
1000	413.07	703	312	134
600	514.12	921	392	164

*Assumes 100% plant efficiency

Primary separator at 350 psig and 67°F.
Stock tank at 0 psig and 60°F.

Results of Separator Calculation
Using Well Stream Composition

Primary gas/well stream ratio	525.06 MSCF/MMSCF
Tank gas/well stream ratio	200.88 MSCF/MMSCF
Tank liquid/well stream ratio	369.52 Bbls/MMSCF
Primary gas/tank liquid ratio	1354 SCF/Bbl
Tank gas/tank liquid ratio	518 SCF/Bbl
Tank liquid gravity at 60°F.	52.0
Formation volume factor at 3023 psig	2.001 Bbls/bbl

Separator Condition = 350 psig @ 67°F.
0 psig @ 60°F.

Viscosity Data at 166°F.

	Pressure PSIG	Oil Viscosity Centipoise
	6000	
Res.Press.	5396	0.189
	5000	0.181
	4500	0.176
	4000	0.171
	3500	0.164
Pg	3023	0.156
	2800	0.151
	2600	0.157
	2200	0.167
	1800	0.192
	1400	0.224
	1000	0.267
	600	0.318
	250	0.328
	0	0.475
		1.071

Gravity of residual oil = 47.3 °API @60°F.

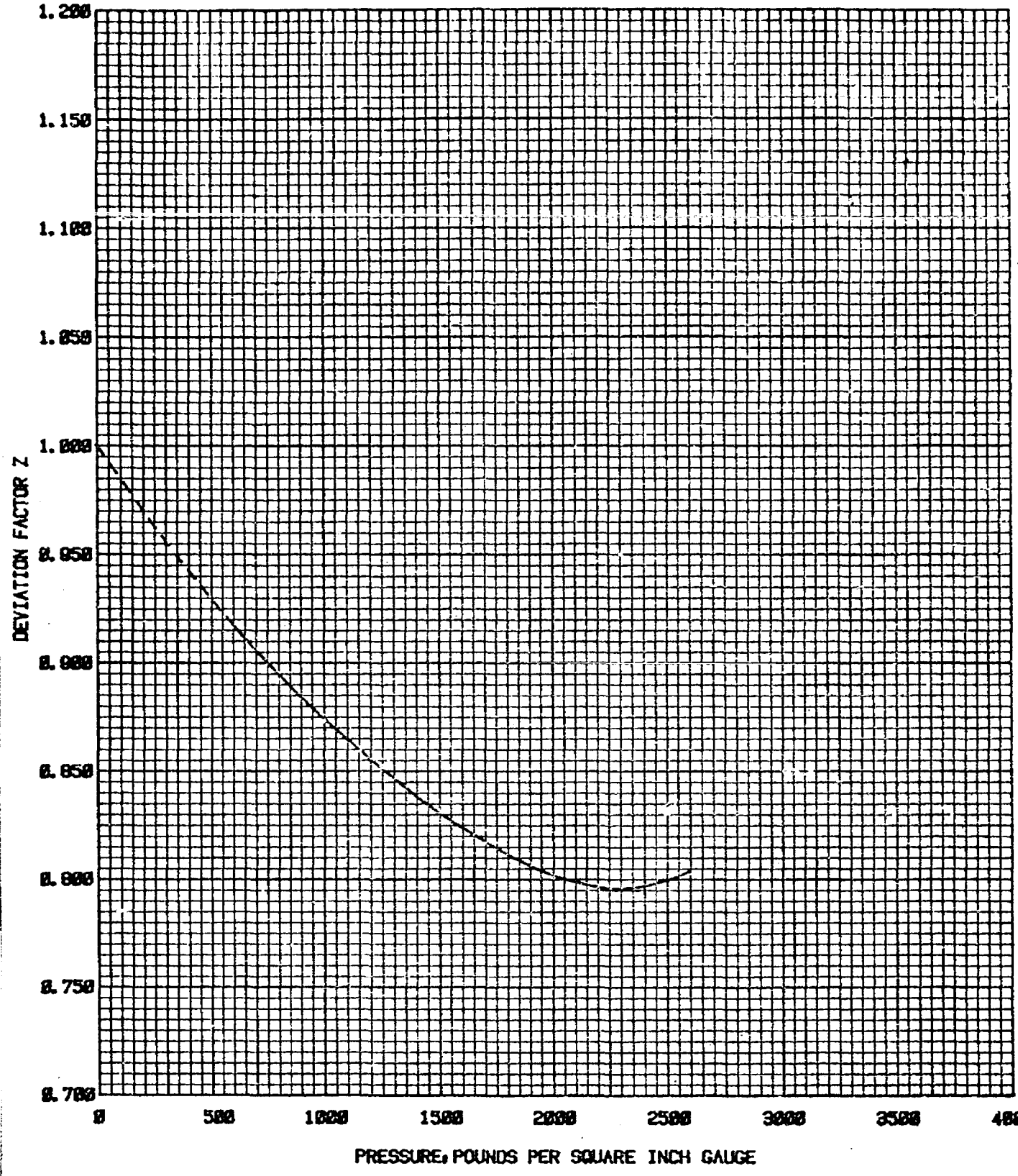
Volume of Liquid Phase at 166°F.

Pressure, PSIG	Liquid Phase Volume, Percent of Saturated Volume
3023	100.00
2900	95.65
2800	93.02
2600	88.94
2200	83.08
1800	78.14
1400	72.82
1000	68.39
600	65.47
0	48.26

Properties of residual oil = molecular weight = 169
density at 60°F. = 0.7919

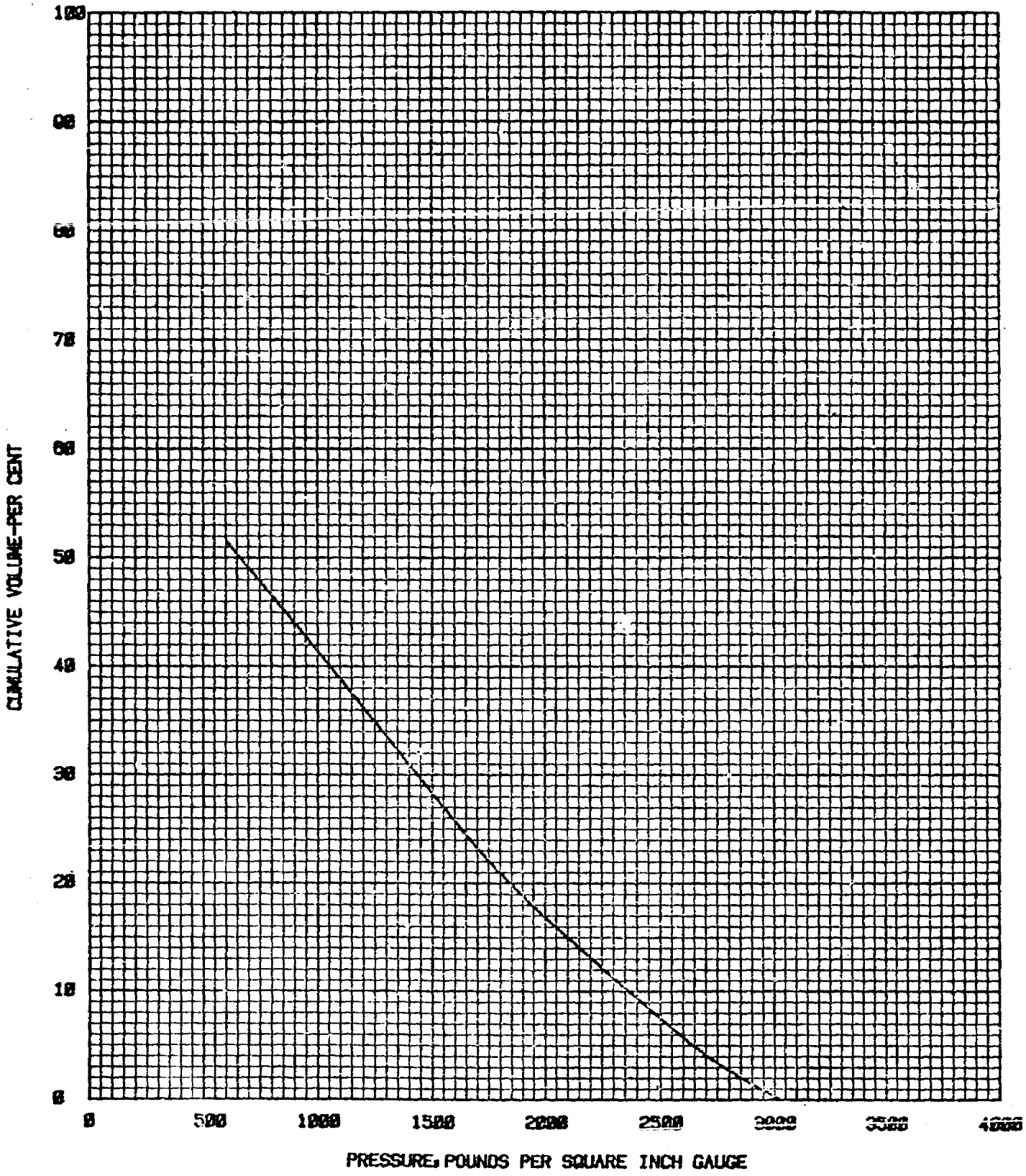
DEVIATION FACTOR Z OF WELL STREAM DURING DEPLETION AT 186°F.

Company NAPECO Formation STRAWN
Well BENSON DEEP UNIT NO. 1 County EDDY
Field WILDCAT State NEW MEXICO



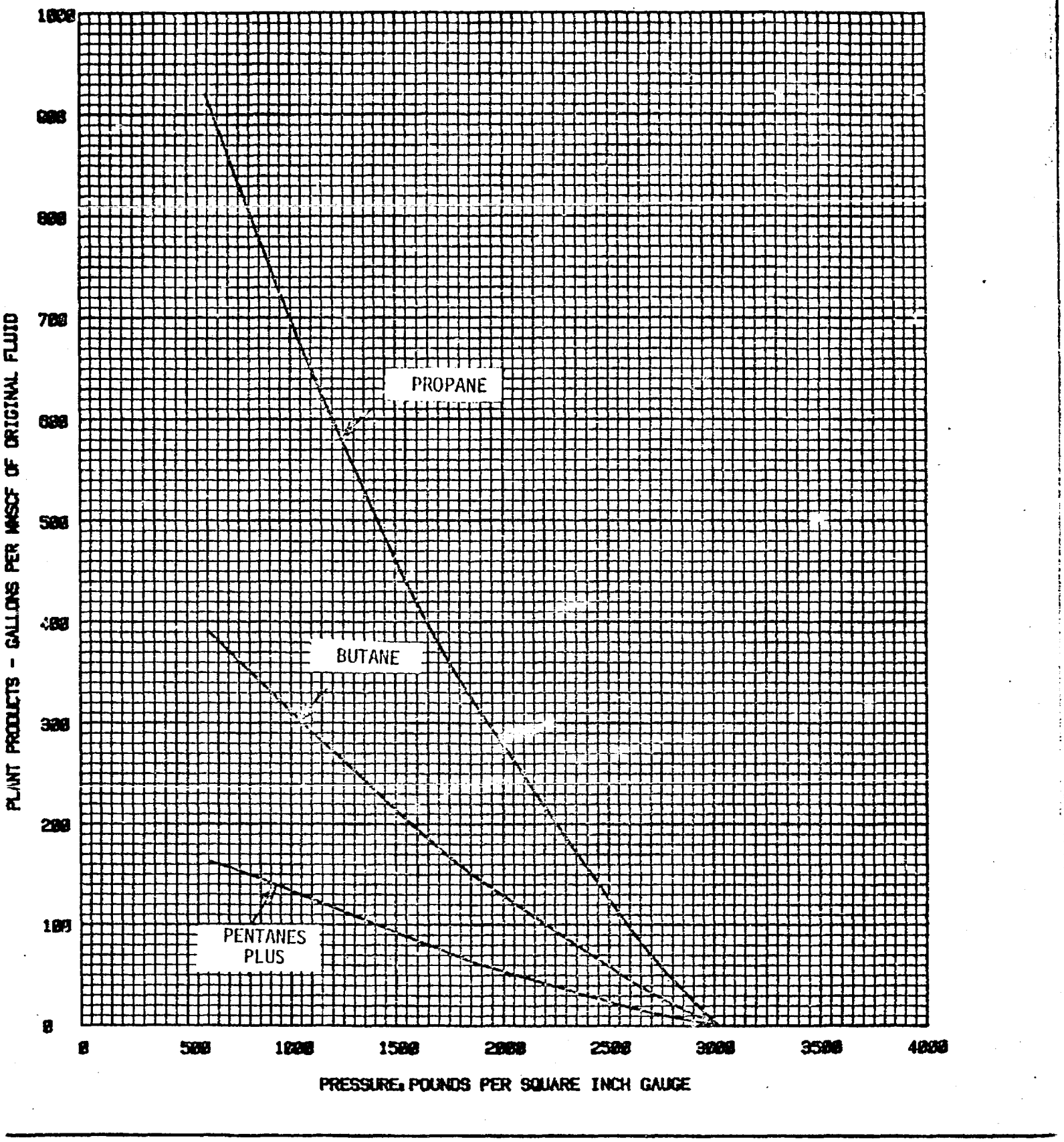
VOLUME OF GAS PHASE PRODUCED DURING DEPLETION

Company NAPECO Formation STRAWN
Well BENSON DEEP UNIT NO. 1 County EDDY
Field WILDCAT State NEW MEXICO



CUMULATIVE RECOVERY-PLANT PRODUCTS IN PRIMARY SEPARATOR GAS

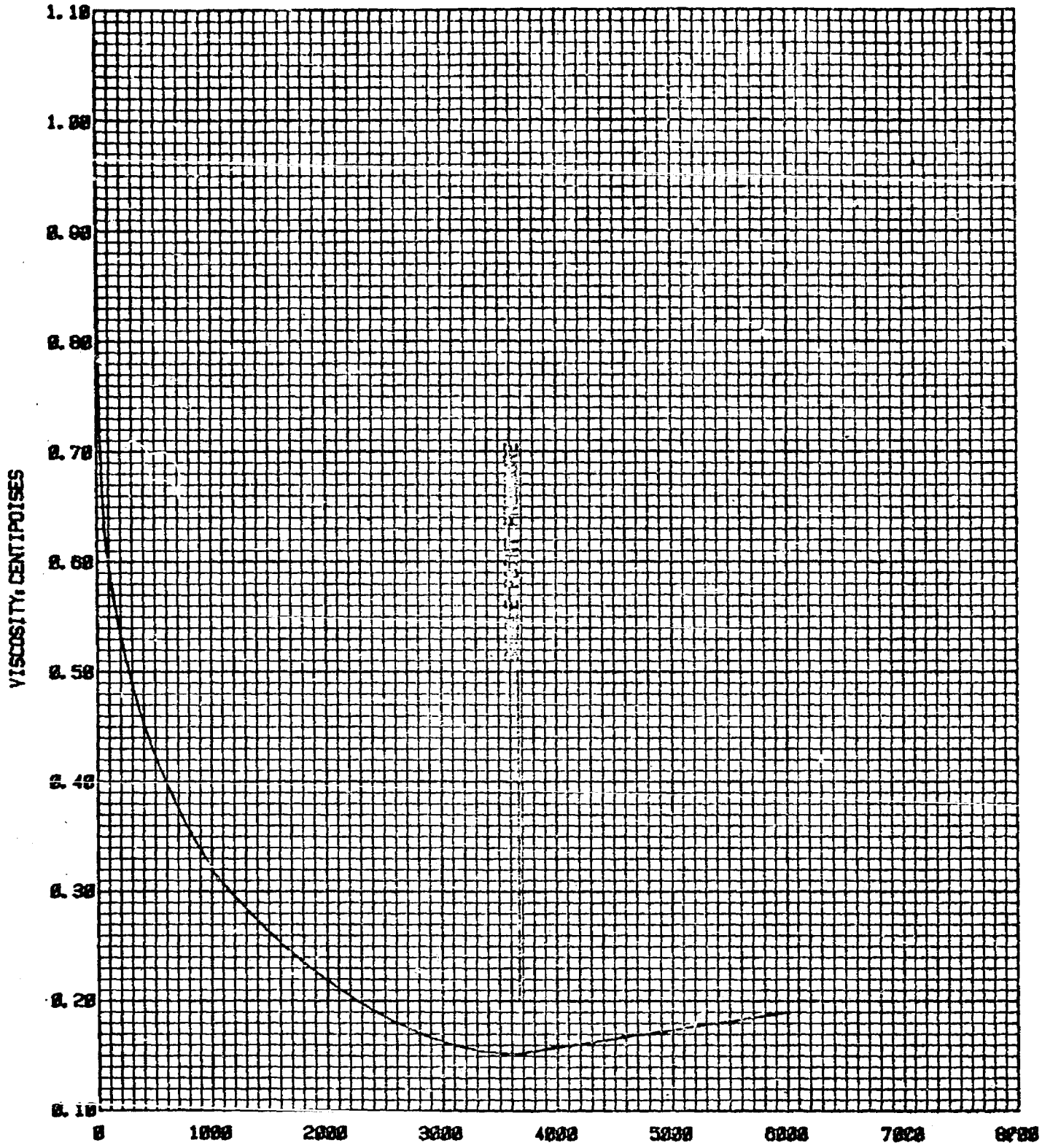
Company NAPECO Formation STRAWN
Well BENSON DEEP UNIT NO. 1 County EDDY
Field WILDCAT State NEW MEXICO



P-V-T, Inc.

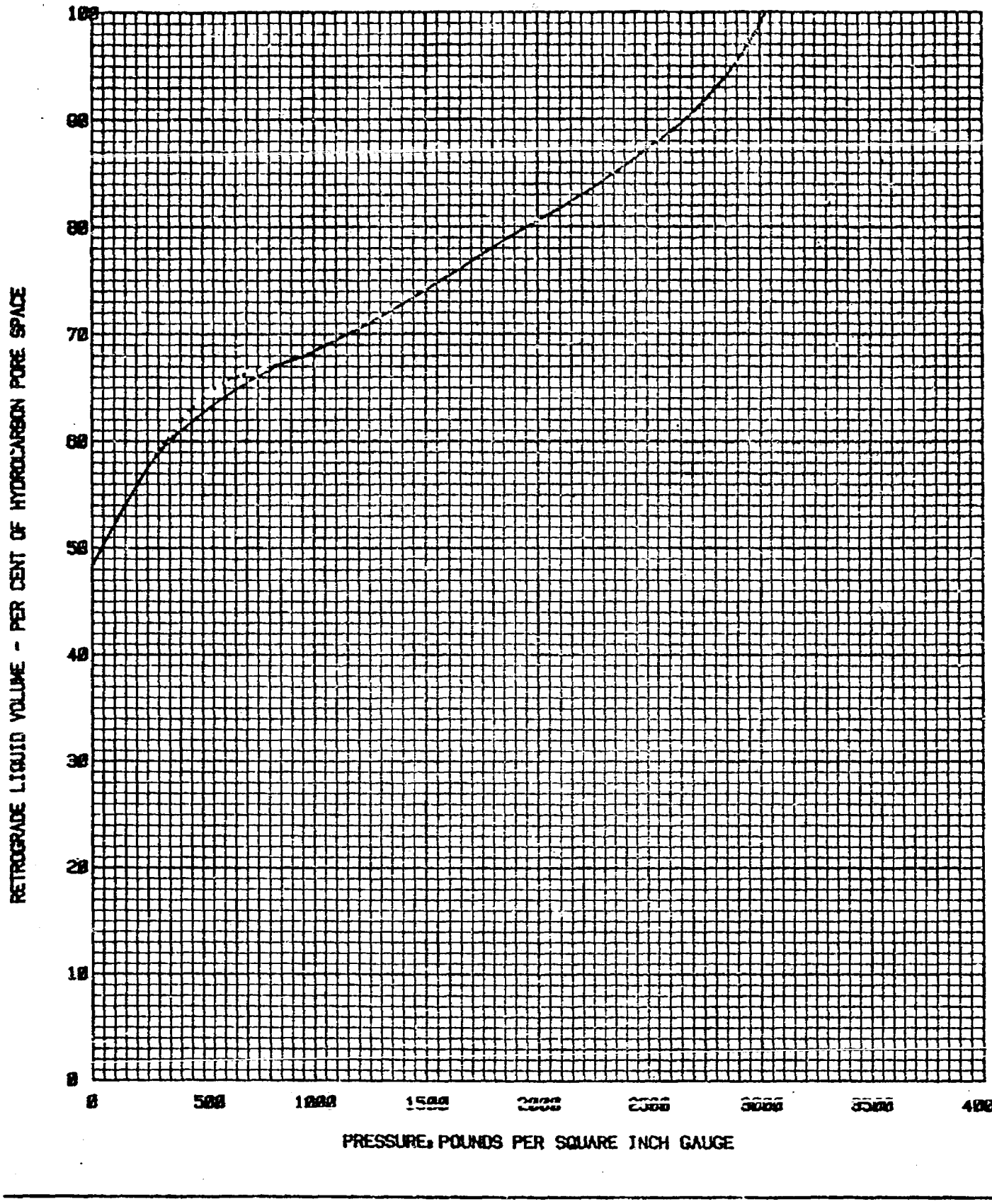
VISCOSITY OF RESERVOIR FLUID AT 166 °F.

Company NAPECO — Formation STRAWN
Well BENSON DEEP UNIT NO. 1 — County EDDY
Field WILDCAT — State NEW MEXICO



VOLUME OF LIQUID PHASE DURING DEPLETION

Company NAPECO Formation STRAWN
Well BENSON DEEP UNIT NO. 1 County EDDY
Field WILDCAT State NEW MEXICO



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CORE LABORATORIES, INC.
ENGINEERING AND CONSULTING DEPARTMENT



Leon L. Crain
Manager
International Engineering Services

80-1122.01

4
6609 DN

Submitted
Hearing Date

April 14, 1980

NAPECO
P. O. Box 283
Houston, Texas 77001

Attention: Mr. Rusty Smith

Subject: Reservoir Fluid Properties
Benson Deep
Eddy County, New Mexico

Gentlemen:

A reservoir fluid study was performed by P-V-T, Inc. in Houston using separator gas and liquid samples from the Benson Deep. The study was identified as A-79535, dated February 14, 1980. At present, this is the only fluid analysis available.

In the laboratory, separator gas and liquid were recombined to yield a representative reservoir fluid sample, which was used in further testing. The recombined fluid was found to be a highly undersaturated liquid with a bubble-point pressure of 3038 psia at 166°F. The fluid exhibited some of the characteristics of a volatile oil, and a constant-volume depletion study and viscosity measurements were performed at 166°F. The compositions of the separator gas and liquid were determined, and the recombined reservoir fluid composition was calculated.

The reservoir temperature was subsequently determined to be 181°F, and it is estimated that the bubble point of the fluid would be 3098 psia at this temperature. The reservoir fluid properties were adjusted to 181°F, and these values were used in a reservoir simulator computer model. It was found that the reservoir fluid composition in the laboratory study had been miscalculated, and this was corrected. The composition and the major fluid properties at initial and bubble-point conditions are shown in Table 1. The effects of pressure upon the physical properties of the fluid at 181°F are shown in Table 2 and on Figure 1.

Based upon its behavior during expansion at reservoir temperature, any reservoir fluid can be classified as either dry gas, gas condensate (retrograde), volatile oil, or black oil. Dry gases are single-phase systems at all pressures. Condensates are single-phase gas systems above the dewpoint pressure, and expansion below the dew point will cause some liquid to drop out of solution and accumulate. Oils exhibit bubble points when expanded, and further expansion causes the release of gas from solution.

Some of the criteria used to distinguish whether an oil is volatile or not are that volatile oils usually have flash formation volume factors above 2 bbl/STB, contain large amounts of intermediate components, release more than 2000 scf/STB at the surface, and will be found in reservoirs where the temperature is over 250°F. These are all arbitrary rules of thumb. The Benson Deep reservoir fluid satisfies the first two items above, and is considered to be a borderline volatile oil system.

Depletion drive performance calculations will tend to give conservative results for very volatile (near critical) systems. Since the Benson Deep fluid is on the low side of the volatile category, recovery calculations should be within accepted limits of engineering accuracy.

Very truly yours,

CORE LABORATORIES, INC.

James A. Brown

James A. Brown
Petroleum Consultant

JAB:mr
Encl.

TABLE 1

SUMMARY OF INITIAL RESERVOIR FLUID PROPERTIES

BENSON DEEP

Datum depth	7316 ft subsea
Initial pressure at datum	5455 psia
Temperature at datum	181°F
Bubble-point pressure at datum	3098 psia

Differential Data

Formation volume factor at Pi	2.1072 bbl/bbl @ 60°F
Formation volume factor at Pb	2.2242 bbl/bbl @ 60°F
Solution gas-oil ratio at Pb	1981 scf/bbl @ 60°F
Oil density at Pb	0.5318 gm/cc
Oil viscosity at Pi.	0.174 centipoise
Oil viscosity at Pb	0.146 centipoise
Residual oil gravity	47.0°API @ 60°F
Total liberated gas gravity	0.9033

Separator Data*

Formation volume factor at Pi	2.0257 bbl/bbl @ 60°F
Formation volume factor at Pb	2.1382 bbl/bbl @ 60°F
Total gas-oil ratio at Pb	1870 scf/bbl @ 60°F
Stock-tank oil gravity	51.4°API @ 60°F
Total liberated gas gravity	0.8946

*Separator at 115 psia and 80°F, stock tank at 70°F.
Standard conditions are 14.7 psia and 60°F.

Reservoir Fluid Composition

Component	Mol %
N2	1.19
CO2	0.29
C1	43.68
C2	13.10
C3	10.11
iC4	1.64
nC4	4.74
iC5	1.61
NC5	1.71
C6	3.37
C7+	18.56
	100.00

C7+ Density = 0.8125 gm/cc @ 60°F
C7+ Molecular Weight = 181

Formation Water Properties at Reservoir Temperature

Salinity	100,000 ppm NaCl
Density	1.051 gm/cc
Compressibility	3.24 x 10^{-6} psi^{-1}
Viscosity	0.44 centipoise

TABLE 2

RESERVOIR FLUID PROPERTIES AT 181°F

BENSON DEEP

Pressure, psia	Liquid Expansion		Differential Liberation						Surface Separation*	
	Relative Volume V/VB	Liquid Compressibility, $10^{-6}psi^{-1}$	Formation Volume Factor, bbl/STB	Solution Gas-Oil Ratio, scf/STB	Liberated Gas Gravity, (Air=1.0)	Gas Deviation Factor Z	Liquid Density, gm/cc	Liquid Viscosity, cps	Formation Volume Factor, bbl/STB	Solution Gas-Oil Ratio, scf/STB
6098	0.9361	21.3	2.0821	1981			0.5681	0.182	2.0016	1870
5598	0.9450	22.0	2.1019	1981			0.5628	0.176	2.0206	1870
5455(Pi)	0.9474	22.3	2.1072	1981			0.5613	0.174	2.0257	1870
5098	0.9540	23.0	2.1219	1981			0.5574	0.170	2.0398	1870
4598	0.9635	24.3	2.1430	1981			0.5519	0.164	2.0602	1870
4098	0.9738	26.2	2.1659	1981			0.5461	0.158	2.0822	1870
3598	0.9855	29.0	2.1919	1981			0.5396	0.152	2.1072	1870
3098(Pb)	1.0000	33.0	2.2242	1981	0.901	0.792	0.5318	0.146	2.1382	1870
2815			1.9857	1616	0.872	0.782	0.5608	0.157	1.9301	1545
2615			1.8658	1424	0.856	0.779	0.5777	0.167	1.8223	1369
2415			1.7721	1267	0.842	0.779	0.5920	0.179	1.7364	1223
2215			1.6959	1135	0.832	0.781	0.6044	0.192	1.6657	1097
2015			1.6314	1019	0.823	0.787	0.6157	0.206	1.6051	986
1815			1.5753	914	0.818	0.795	0.6257	0.224	1.5520	886
1615			1.5255	819	0.815	0.805	0.6351	0.243	1.5048	795
1415			1.4807	732	0.815	0.818	0.6438	0.265	1.4622	710
1215			1.4396	650	0.820	0.833	0.6520	0.289	1.4232	631
1015			1.4009	571	0.831	0.849	0.6599	0.317	1.3867	555
815			1.3632	495	0.852	0.866	0.6677	0.347	1.3513	482
615			1.3244	416	0.891	0.884	0.6758	0.388	1.3151	407
415			1.2800	330	0.967	0.904	0.6850	0.430	1.2740	325
15			1.0670	0	1.164	0.990	0.7429	0.990		
		@ 60°F =	1.0000							

Residual oil gravity = 47.0°API @ 60°F (differential)
Stock-tank oil gravity = 51.4°API @ 60°F (separator)

*Separator at 115 psia and 80°F, stock tank at 70°F.

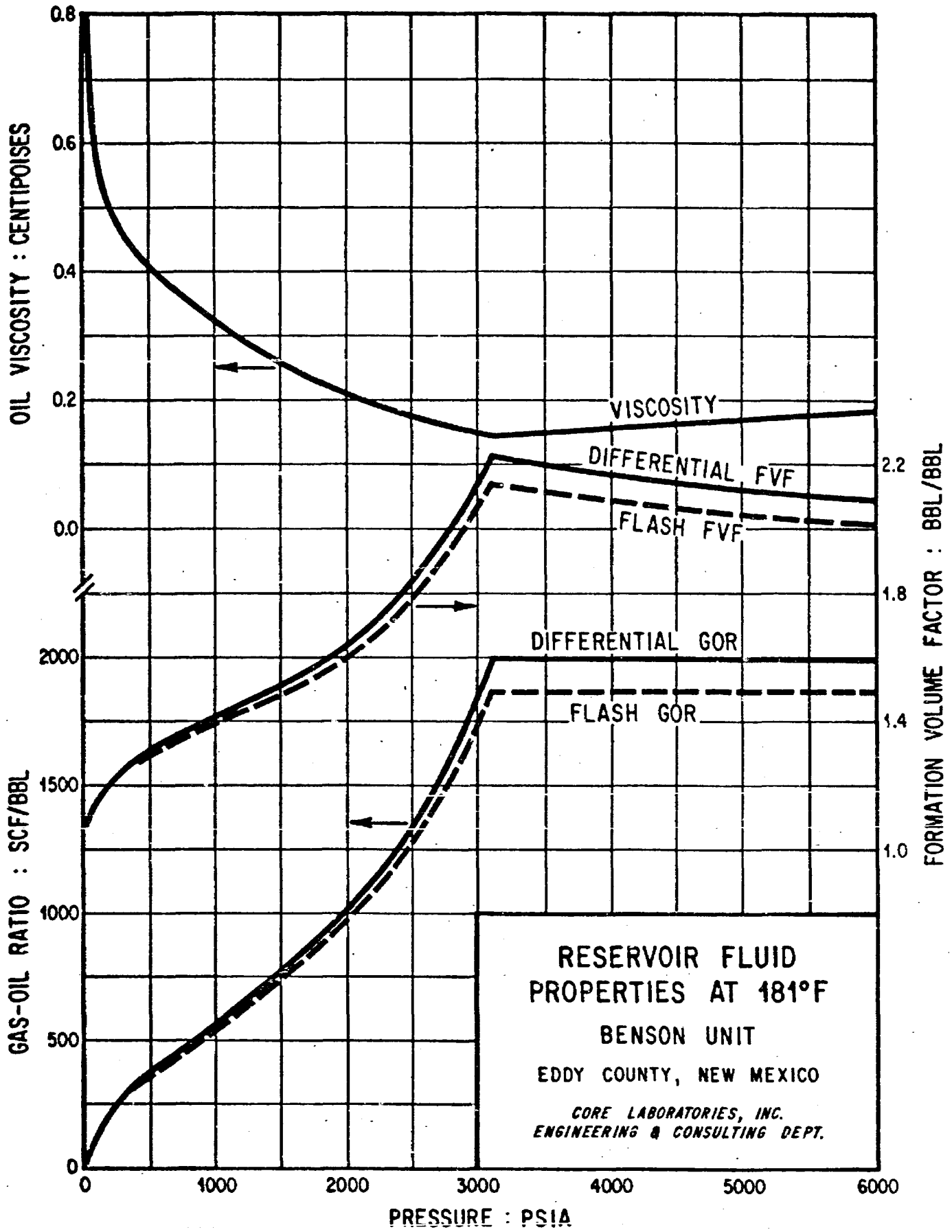

OIL VISCOSITY : CENTIPOISES
0.8
0.6
0.4
0.2
0.0
VISCOSITY
DIFFERENTIAL FVF
FLASH FVF
2.2
1.8
1.4
1.0
FORMATION VOLUME FACTOR : BBL/BBL
GAS-OIL RATIO : SCF/BBL
2000
1500
1000
500
0
DIFFERENTIAL GOR
FLASH GOR
RESERVOIR FLUID
PROPERTIES AT 181°F
BENSON UNIT
EDDY COUNTY, NEW MEXICO
CORE LABORATORIES, INC.
ENGINEERING & CONSULTING DEPT.
0
1000
2000
3000
4000
5000
6000
PRESSURE : PSIA

FIGURE 1

NAPECO INC. BENSON DEEP UNIT #1
PRESSURE BUILDUP TEST
9 April 1980

M = 1600

PRESSURE, psig

5500
5000
4500
4000
3500
3000
2500

$\frac{t+\Delta t}{\Delta t}$

10 9 8 7 6 5 4 3 2 100 9 8 7 6 5 4 3 2 10 9 8 7 6 5 4 3 2 1

46 5493

K&E SEMI-LOGARITHMIC • 3 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

~ KEPLINGER and Associates, inc.—
3430 ENTEX BUILDING
1200 MILAM STREET
HOUSTON, TEXAS 77002
AREA 713/651-3127
CABLE: KEPPET TELEX: 762-324

Pressure Build Up Calculations

309 B/D rate

31 Bbl ann ±

pseudo $t = \frac{31(24)}{309} \cong 2.408$ hrs

real time = 137.7 min. = 2.295 hrs O'c

Δt	$\frac{t+\Delta t}{\Delta t}$	P
.0334	69.8	2651
.05	46.9	3087
.0667	35.4	3269
.0833	28.5	3372
.1	23.95	3450
.1167	20.6	3510
.1333	18.2	3566
.15	16.3	3611
.1667	14.8	3652
.2	12.5	3723
.2333	10.8	3783
.2667	9.6	3837
.3	8.6	3886
.3333	7.9	3932
.3667	7.3	3976
.4	6.7	4016
.433	6.3	4055
.4667	5.9	4092
.5	5.6	4127
.583	4.94	4208
.6667	4.44	4281
.8333	3.75	4405
1.0	3.3	4504
1.1667	2.97	4581
1.333	2.72	4645
1.5	2.53	4694

Reorder from KWIK-KOPY (Over Foley's Garage) 652-3906

KEPLINGER and Associates, inc.—
3430 ENTEX BUILDING
1200 MILAM STREET
HOUSTON, TEXAS 77002
AREA 713/651-3127
CABLE: KEPPET TELEX: 762-324

	Δt	$\frac{t+\Delta t}{\Delta t}$	P
	1.667	2.38	4735
	1.833	2.25	4768
	2.0	2.15	4798
	2.167	2.06	4823
	2.33	1.98	4844
	2.5	1.92	4863
	2.67	1.86	4882
	2.83	1.81	4898
	3.0	1.77	4914
	3.1667	1.73	4930
	3.33	1.69	4946
	3.5	1.66	4961
	3.67	1.63	4975
	3.83	1.60	4989
	4.0	1.57	5002
	4.1	1.55	5010

Differential Liberation $kh = \frac{(162.6)(309)(2.11)(.175)}{1600}$

$= 11.60$ md ft

$k = .446$ md

Flash Liberation $kh = \frac{(162.6)(309)(2.03)(.175)}{1600}$

$= 11.16$ md ft

$k = .429$ md

Reorder from KWIK-KOPY (Over Foley's Garage) 652-3906

JOHNSTON
Schlumberger

COMPUTERIZED DATA ANALYSIS

APRIL 24, 1979

GENTLEMEN:

THE ENCLOSED TEST APPEARS TO BE A GOOD MECHANICAL DRILL STEM TEST DURING WHICH THE TOOLS DID FUNCTION PROPERLY. THE FORMATION PRODUCED ENOUGH RESERVOIR FLUID FOR PROPER IDENTIFICATION. RESERVOIR PRESSURE DRAWDOWN WAS SUFFICIENT AND ADEQUATE SHUT-IN BUILD-UPS DID OCCUR FOR RELIABLE QUANTITATIVE ANALYSIS. RESERVOIR PARAMETERS WERE CALCULATED BY THE HORNER METHOD.

1. FLOW RATE: A FLOW RATE OF 509 MCF/DAY OF GAS AND A TOTAL LIQUID RATE OF 309 BBLS/DAY WAS NOTED DURING THIS TEST.

2. RESERVOIR PRESSURE: EXTRAPOLATION OF THE INITIAL SHUT-IN PRESSURE BUILD-UP INDICATES A MAXIMUM RESERVOIR PRESSURE OF 5469 P.S.I.G. AT RECORDER DEPTH. EXTRAPOLATION OF THE FINAL SHUT-IN PRESSURE BUILD-UP INDICATES A MAXIMUM RESERVOIR PRESSURE OF 5418 P.S.I.G. AT RECORDER DEPTH. THE DIFFERENCE BETWEEN THE INITIAL AND FINAL SHUT-IN PRESSURE OF 51 P.S.I.G. IS SIGNIFICANT BUT PROBABLY DUE TO INSUFFICIENT SHUT-IN TIME.

3. PERMEABILITY: THE CALCULATED TRANSMISSIBILITY FACTOR OF 68 MD.-FT./CP. INDICATES AN AVERAGE EFFECTIVE PERMEABILITY TO GAS OF .036 MD. FOR THE REPORTED 40 FOOT NET INTERVAL. THE CALCULATIONS WERE BASED ON A SLOPE OF 953 P.S.I./LOG CYCLE OBTAINED FROM THE FINAL SHUT-IN BUILD-UP PLOT. IT WAS ASSUMED FOR THESE CALCULATIONS: (A) GAS GRAVITY 0.70 (B) VISCOSITY .0213 CP. (C) AND GAS DEVIATION FACTOR .842. THESE FIGURES WERE OBTAINED FROM THE AVAILABLE TECHNICAL LITERATURE.

4. WELL BORE DAMAGE: THE CALCULATED DAMAGE RATIO OF 1.50 INDICATES THAT WELL BORE DAMAGE IS PRESENT AT THE TIME AND CONDITIONS OF THIS TEST.

5. RADIUS OF INVESTIGATION: THE CALCULATED RADIUS OF INVESTIGATION OF THIS TEST IS 14 FEET BASED ON AN ASSUMED POROSITY OF 10%, COMPRESSIBILITY OF 2.34×10^{-4}, AND OTHER ASSUMPTIONS MADE IN NUMBER 3 ABOVE.

6. GEL COMMENTS: THE FORMATION EXHIBITS THE CHARACTERISTICS OF RELATIVELY LOW PERMEABILITY EFFECTIVE TO THE RESERVOIR FLUID AND INDICATES THE PRESENCE OF WELL BORE DAMAGE. AN ANOMALY WAS NOTED AT THE END OF THE FINAL SHUT-IN. THIS UPWARD BREAK IN SLOPE IS REPRESENTATIVE OF A DECREASE IN EFFECTIVE TRANSMISSIBILITY AWAY FROM THE WELL BORE. THE ANOMALY GIVES THE INDICATION THAT THE WELL WILL NOT SUSTAIN THIS RATE AND GAS PRODUCTION IS EXPECTED TO DECREASE.

DENNIS MYREN
RESERVOIR EVALUATION
DEPARTMENT

NAPECO, INC.
BENSON DEEP UNIT #1; EDDY COUNTY, NEW MEXICO
TEST #3; 10635' TO 10695'
LOCATION: 660' FSL, 2180' FEL, SEC. 33 - T18S - R30E
FIELD REPORT # 19556 D

In making any interpretation, our employees will give Customer the benefit of their best judgment as to the correct interpretation. Nevertheless, since all interpretations are opinions based on inferences from electrical, mechanical or other measurements, we cannot, and do not guarantee the accuracy or correctness of any interpretations, and we shall not be liable or responsible, except in the case of gross or wilful negligence on our part, for any loss, costs, damages or expenses incurred or sustained by Customer resulting from any interpretation made by any of our agents or employees.

KEPLINGER *and Associates, inc.*—

3430 ENTEX BUILDING
1200 MILAM STREET
HOUSTON, TEXAS 77002
AREA 713/651-3127
CABLE: KEPPET TELEX: 762-324

Reservoir Properties

ϕ	6%
S_w	.30
B_o	2.0257
h	26'
K_o	.446 md (Diff) .429 md (Flash)
T	181°F
P_o	5245 psia
P_s	3098 psia
R_s	1870

0.1 in Place

40 Acres	167000 Bbl
160 Acres	669000 Bbl
320 Acres	1338000 Bbl

Exhibit 59
Case 6609 DN

BENSON DEEP WELL SPACING EVALUATION

APRIL, 1980

CASE DESCRIPTION: Set 3 permeability

Case 50 - 40 acre spacing
Case 51 - 160 acre spacing
Case 52 - 320 acre spacing

RESULTS INITIAL PRODUCTION TO BUBBLE-POINT[1]

RATE (BOPD)		CASE NO.	RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME[1] (DAYS)
20	(40)	50	7740.	4.63	3897.	3958.	387.
40	(160)	51	27000.	4.04	4083.	4142.	1350.
70	(320)	52	52380	3.91	4122.	4181.	2619.

Total recovery

RESULTS BUBBLE-POINT TO ABANDONMENT[4]

RATE[5] (BOPD)	CASE NO.	RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME[6] (DAYS)
20	50	2280.	1.37	3486.	3553.	114.
40	51	10700	1.60	3585.	3648.	535.
70	52	18480	1.38	3687.	3749.	924.

ENGINEERING AND CONSULTING DEPARTMENT

BEFORE EXAMINER STAMETS
OIL CONSERVATION DIVISION
EXHIBIT NO. 6
CASE NO. 6609 ON
Submitted by
Hearing Date

SUMMARY OF RESULTS

RATE OIL (BOPD)	CASE NO.	TOTAL RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME (DAYS)
20	50	10020	6.00	3486.	3553.	501.
40	51	37700	5.64	3585.	3648.	1885.
70	52	70860	5.30	3687.	3749.	3543.

CONDITIONS AT ABANDONMENT

RATE OIL (BOPD)	CASE NO.	GOR[8] (SCF/BBL)	BHFP (PSIA)	GAS SATURATION[9] (PCT)
20	50	4224	<2000	11.60
40	51	2032	<2000	9.65
70	52	1993	<2000	9.54

NOTES:

1. Time at which gas saturation is formed in cell adjoining wellbore.
2. Average reservoir pressure within well-spacing at time bubble-point reached or abandonment.
3. Pressure at the center of the outermost cell within well-spacing at time bubble-point reached or abandonment.
4. See notes on abandonment conditions.
5. Below bubble-point, well producing rate was equal to rate above bubble-point, subject to abandonment conditions.
6. From bubble-point to abandonment.
7. Total time from initial production to abandonment.
8. GOR increased very rapidly with gas saturation and well did not produce for any substantial period at high GOR.
9. Gas saturation in cell adjoining wellbore.

BENSON DEEP

PERMEABILITY EFFECTS ON RECOVERY[1]

40-ACRE SPACING

CASE	PERM SET	ULT REC (BBL)	PER CENT OIP REC (PCT)
50	3	10,020	6.00
2	1	11,840	7.10
6	2	18,000	10.78

160-ACRE SPACING

51	3	37,700	5.64
18	1	45,120	6.74
22	2	56,720	7.58

320-ACRE SPACING

52	3	70,860	5.30
34	1	83,847	6.27
38	2	104,300	7.80

1. All cases used a producing rate of 20 BOPD.

No attempt was made in the model to optimize vertical flow. The wells had a tubing diameter of 1.441 inches, which is not considered an optimum value. Preliminary external calculations indicate the well will flow under assumed model conditions. The initial well productivity index was assumed to be about six barrels per psi, which represents a significant improvement upon that noticed in the limited test of an unstimulated section.

In each case, the assigned rate was held constant until the cell adjoining the wellbore passed through the bubble point. In most cases, the well retained the same rate from bubble point to abandonment, although in some cases some slight tapering was noticed. Increased drawdown pressures would have created additional tapering.

Cases to be run were specified by Keplinger and Associates. Run results are tabulated in a separate summary.

BENSON DEEP

SIMULATION MODEL PERMEABILITY VALUES[1]

DISTANCE[2] (ft.)	SET 1[3] (Md.)	SET 2[3] (Md.)
2	89.2 (200)	89.2 (200)
4	44.6 (100)	66.9 (150)
8	22.3 (50)	44.6
16	11.2 (25)	33.5 (75)
32	4.5 (10)	22.3 (50)
64	2.2 (5)	15.6 (35)
128		11.2 (25)
256		4.5 (10)
387		2.2 (5)

BEFORE EXAMINER STAMETS
OIL CONSERVATION DIVISION
EXHIBIT NO. 7
CASE NO. 6609 ON
Submitted by
Hearing Date
ENGINEERING and CONSULTING DEPARTMENT
CORE LAB

Notes:

1. Values given to Core Lab.

2. Distance from center of wellbore to cell face at which corresponding permeability was applied.

3. Values in parentheses represent factors by which the matrix permeability was scaled upward.

BENSON DEEP WELL SPACING EVALUATION

APRIL, 1980

CASE DESCRIPTION: 40 acre, set 1 permeability

RESULTS INITIAL PRODUCTION TO BUBBLE-POINT[1]

RATE (BOPD)	CASE NO.	RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME[1] (DAYS)
20	2	8,300	4.97	3782	3842	415.
40	3	7,480	4.48	3938	4055	187.
70	4	4,725	2.83	4478	4670	67.5

RESULTS BUBBLE-POINT TO ABANDONMENT[4]

RATE[5] (BOPD)	CASE NO.	RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME[6] (DAYS)
20	2	3,540	2.12	3194	3263	177.
40	3	2,040	1.22	3571	3699	51.
70	4	1.365	.82	4216	4412	19.5

ENGINEERING AND CONSULTING DEPARTMENT

SUMMARY OF RESULTS

RATE OIL (BOPD)	CASE NO.	TOTAL RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME (DAYS)
20	2	11,840	7.10	3194	3263	592.
40	3	9,520	5.70	3571	3699	238
70	4	6,090	3.65	4216	4412	87

CONDITIONS AT ABANDONMENT

RATE OIL (BOPD)	CASE NO.	GOR[8] (SCF/BBL)	BHFP (PSIA)	GAS SATURATION[9] (PCT)
20	2	22,359	<2000	16.03
40	3	6,615	<2000	13.05
70	4	7,641	=2000	13.28

NOTES:

1. Time at which gas saturation is formed in cell adjoining wellbore.
2. Average reservoir pressure within well-spacing at time bubble-point reached or abandonment.
3. Pressure at the center of the outermost cell within well-spacing at time bubble-point reached or abandonment.
4. See notes on abandonment conditions.
5. Below bubble-point, well producing rate was equal to rate above bubble-point, subject to abandonment conditions.
6. From bubble-point to abandonment.
7. Total time from initial production to abandonment.
8. GOR increased very rapidly with gas saturation and well did not produce for any substantial period at high GOR.
9. Gas saturation in cell adjoining wellbore.

ENGINEERING and CONSULTING DEPARTMENT

BENSON DEEP WELL SPACING EVALUATION

APRIL, 1980

CASE DESCRIPTION: 160 acre, set 1 permeability

RESULTS INITIAL PRODUCTION TO BUBBLE-POINT[1]

RATE (BOPD)	CASE NO.	RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME[1] (DAYS)
20	18	35,360	5.29	3683.	3744.	1768.
40	19	23,600	3.53	4242.	4356.	590.
70	20	8,365	1.25	5013.	5189.	119.5

RESULTS BUBBLE-POINT TO ABANDONMENT[4]

RATE[5] (BOPD)	CASE NO.	RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME[6] (DAYS)
20	18	9,760	1.46	3273.	3332.	488.
40	19	7,600	1.14	3997.	3872.	190.
70	20	5,705	.85	4725.	4913.	81.5

ENGINEERING AND CONSULTING DEPARTMENT

SUMMARY OF RESULTS

RATE OIL (BOPD)	CASE NO.	TOTAL RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME (DAYS)
20	18	45,120	6.74	3273.	3332.	2256.
40	19	31,200	4.66	3997.	3872.	780.
70	20	14,070	2.10	4725.	4913.	201.

CONDITIONS AT ABANDONMENT

RATE OIL (BOPD)	CASE NO.	GOR[8] (SCF/BBL)	BHFP (PSIA)	GAS SATURATION[9] (PCT)
20	18	7572.	<2000	13.45
40	19	6074	<2000	12.90
70	20	3012	<2000	10.83

NOTES:

1. Time at which gas saturation is formed in cell adjoining wellbore.
2. Average reservoir pressure within well-spacing at time bubble-point reached or abandonment.
3. Pressure at the center of the outermost cell within well-spacing at time bubble-point reached or abandonment.
4. See notes on abandonment conditions.
5. Below bubble-point, well producing rate was equal to rate above bubble-point, subject to abandonment conditions.
6. From bubble-point to abandonment.
7. Total time from initial production to abandonment.
8. GOR increased very rapidly with gas saturation and well did not produce for any substantial period at high GOR.
9. Gas saturation in cell adjoining wellbore.

BENSON DEEP WELL SPACING EVALUATION

APRIL, 1980

CASE DESCRIPTION: 320 acre, set 1 permeability

RESULTS INITIAL PRODUCTION TO BUBBLE-POINT[1]

RATE (BOPD)	CASE NO.	RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME[1] (DAYS)
20	34	66,000	4.93	3792.	3852.	3300.
40	35	39,600	2.96	4430.	4532.	990.
70	36	8,610	.64	5222.	5369.	123.

RESULTS BUBBLE-POINT TO ABANDONMENT[4]

RATE[5] (BOPD)	CASE NO.	RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME[6] (DAYS)
20	34	17,847	1.33	3406.	3470.	879.
40	35	10,809	.81	4165.	4282.	270.
70	36	8,470	.63	5006.	5183.	121.

ENGINEERING and CONSULTING DEPARTMENT

SUMMARY OF RESULTS

RATE OIL (BOPD)	CASE NO.	TOTAL RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME (DAYS)
20	34	83,847.	6.27	3406.	3470.	4179.
40	35	50,409	3.77	4165.	4282.	1260.
70	36	17,080	1.28	5006.	5183.	244.

CONDITIONS AT ABANDONMENT

RATE OIL (BOPD)	CASE NO.	GOR[8] (SCF/BBL)	BHFP (PSIA)	GAS SATURATION[9] (PCT)
20	34	2578.	<2000	10.41
40	35	6817.	<2000	13.35
70	36	2984.	<2000	10.80

NOTES:

1. Time at which gas saturation is formed in cell adjoining wellbore.
2. Average reservoir pressure within well-spacing at time bubble-point reached or abandonment.
3. Pressure at the center of the outermost cell within well-spacing at time bubble-point reached or abandonment.
4. See notes on abandonment conditions.
5. Below bubble-point, well producing rate was equal to rate above bubble-point, subject to abandonment conditions.
6. From bubble-point to abandonment.
7. Total time from initial production to abandonment.
8. GOR increased very rapidly with gas saturation and well did not produce for any substantial period at high GOR.
9. Gas saturation in cell adjoining wellbore.

ENGINEERING and CONSULTING DEPARTMENT

BENSON DEEP WELL SPACING EVALUATION

APRIL, 1980

CASE DESCRIPTION: 40 acre, set 2 permeability

RESULTS INITIAL PRODUCTION TO BUBBLE-POINT[1]

RATE (BOPD)	CASE NO.	RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME[1] (DAYS)
20	6	12,120	7.26	3135.8	3162.9	606.
40	7	11,780	7.05	3188.5	3242.6	294.5
70	8	10,920	6.54	3325.2	3420.1	156.

RESULTS BUBBLE-POINT TO ABANDONMENT[4]

RATE[5] (BOPD)	CASE NO.	RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME[6] (DAYS)
20	6	5,880	3.52	2736.	2873.	294.
40	7	4,460	2.67	2843.	2984.	111.5
70	8	3,780	2.26	2948.	3066.	54.

ENGINEERING and CONSULTING DEPARTMENT

SUMMARY OF RESULTS

RATE OIL (BOPD)	CASE NO.	TOTAL RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY[3] PRESSURE (PSIA)	TIME (DAYS)
20	6	18,000	10.78	2736.	2875.	900.
40	7	16,240	9.72	2843.	2984.	406.
70	8	14,700	8.80	2848.	3066.	210

CONDITIONS AT ABANDONMENT

RATE OIL (BOPD)	CASE NO.	GOR[8] (SCF/BBL)	BHFP (PSIA)	GAS SATURATION[9] (PCT)
20	6	23,186	=2222.	16.16
40	7	18,736	=2000	15.56
70	8	11,269	<2000	14.42

NOTES:

1. Time at which gas saturation is formed in cell adjoining wellbore.
2. Average reservoir pressure within well-spacing at time bubble-point reached or abandonment.
3. Pressure at the center of the outermost cell within well-spacing at time bubble-point reached or abandonment.
4. See notes on abandonment conditions.
5. Below bubble-point, well producing rate was equal to rate above bubble-point, subject to abandonment conditions.
6. From bubble-point to abandonment.
7. Total time from initial production to abandonment.
8. GOR increased very rapidly with gas saturation and well did not produce for any substantial period at high GOR.
9. Gas saturation in cell adjoining wellbore.

ENGINEERING and CONSULTING DEPARTMENT

BENSON DEEP WELL SPACING EVALUATION

APRIL, 1980

CASE DESCRIPTION: 160 acre, set 2 permeability

RESULTS INITIAL PRODUCTION TO BUBBLE-POINT[1]

RATE (BOPD)	CASE NO.	RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME[1] (DAYS)
20	22	44,400	6.64	3296.	3348.	2220.
40	23	40,800	6.10	3445.	3547.	1020.
70	24	33,740	5.04	3761.	3933.	482.

RESULTS BUBBLE-POINT TO ABANDONMENT[4]

RATE[5] (BOPD)	CASE NO.	RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME[6] (DAYS)
20	22	12,500	1.87	2965.	3060.	625.
40	23	9,920	1.48	3106.	3211.	248.
70	24	9,730	1.45	3380.	3542.	139.

ENGINEERING and CONSULTING DEPARTMENT

SUMMARY OF RESULTS

RATE OIL (BOPD)	CASE NO.	TOTAL RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME (DAYS)
20	22	56,900	8.51	2965.	3060. 5358 (90 days)	2845.
40	23	50,720	7.58	3106.	3211. 5270	1268.
70	24	43,470	6:50	3380.	3542. 5140	621.

CONDITIONS AT ABANDONMENT

RATE OIL (BOPD)	CASE NO.	GOR[8] (SCF/BBL)	BHFP (PSIA)	GAS SATURATION[9] (PCT)
20	22	24,736	=2000	16.17
40	23	15,007	=2000	15.27
70	24	8,036	=2000	13.55

NOTES:

1. Time at which gas saturation is formed in cell adjoining wellbore.
2. Average reservoir pressure within well-spacing at time bubble-point reached or abandonment.
3. Pressure at the center of the outermost cell within well-spacing at time bubble-point reached or abandonment.
4. See notes on abandonment conditions.
5. Below bubble-point, well producing rate was equal to rate above bubble-point, subject to abandonment conditions.
6. From bubble-point to abandonment.
7. Total time from initial production to abandonment.
8. GOR increased very rapidly with gas saturation and well did not produce for any substantial period at high GOR.
9. Gas saturation in cell adjoining wellbore.

ENGINEERING and CONSULTING DEPARTMENT

BENSON DEEP WELL SPACING EVALUATION

APRIL, 1980

CASE DESCRIPTION: 320 acre, set 2 permeability

RESULTS INITIAL PRODUCTION TO BUBBLE-POINT[1]

RATE (BOPD)	CASE NO.	RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME[1] (DAYS)
20	38	85,800	6.41	3359.1	3415.7	4290.
40	39	74,360	5.56	3603.0	3713.0	1859.
70	40	56,700	4.24	4013.7	4198.0	810.

RESULTS BUBBLE-POINT TO ABANDONMENT[4]

RATE[5] (BOPD)	CASE NO.	RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME[6] (DAYS)
20	38	18,500	1.38	3045.	3118.	930.
40	39	16,000	1.20	3292.	3405.	400.
70	40	15,470	1.16	3688.	3868.	221.

ENGINEERING AND CONSULTING DEPARTMENT

SUMMARY OF RESULTS

RATE OIL (BOPD)	CASE NO.	TOTAL RECOVERY (BBL)	PER CENT OIP REC (PCT)	AVERAGE PRESSURE[2] (PSIA)	BOUNDARY PRESSURE[3] (PSIA)	TIME (DAYS)
20	38	104,300	7.80	3045.	3118.	5220.
40	39	90,360	6.75	3292.	3405.	2259.
70	40	72,170	5.39	3688.	3868.	1031.

CONDITIONS AT ABANDONMENT

RATE OIL (BOPD)	CASE NO.	GOR[8] (SCF/BBL)	BHFP (PSIA)	GAS SATURATION[9] (PCT)
20	38	24,925	=2000	16.14
40	39	13,425	=2000	14.93
70	40	7,292	=2000	13.18

NOTES:

1. Time at which gas saturation is formed in cell adjoining wellbore.
2. Average reservoir pressure within well-spacing at time bubble-point reached or abandonment.
3. Pressure at the center of the outermost cell within well-spacing at time bubble-point reached or abandonment.
4. See notes on abandonment conditions.
5. Below bubble-point, well producing rate was equal to rate above bubble-point, subject to abandonment conditions.
6. From bubble-point to abandonment.
7. Total time from initial production to abandonment.
8. GOR increased very rapidly with gas saturation and well did not produce for any substantial period at high GOR.
9. Gas saturation in cell adjoining wellbore.

ENGINEERING and CONSULTING DEPARTMENT

Benson Deep Unit No. 1
Eddy County, New Mexico
Economic Evaluation

BASIC DATA

1. Gas reserves based on GOR of 2000/1 plus an additional 20 mmcf.

2. Oil Flow Rates - 20, 40, or 70 bopd
   Gas Flow Rates - based on GOR until oil depletion, 200 mcfpd thereafter

3. Costs - Well--$912,767 (70% intangible)
   Operating--$1000/well/month

4. Prices:
   Oil - $32/bbl for life (after windfall profits tax)
   Gas - $2.428/mcf x 1274 $\frac{\text{mmbtu}}{\text{mcf}}$ adjustment = $3.093/mcf

5. Other - Royalties - 18.5%
   E & D Salvageable - 10%

EXHIBITS
OIL CONSERVATION DIVISION
EXHIBIT NO. 8
CASE NO. 6609 DN
Submitted by:
Hearing Date:

BENSON DEEP UNIT NO. 1, Eddy County, New Mexico, ECONOMIC EVALUATION

	40-Acre Spacing			160-Acre Spacing			320 ~~360~~-Acre Spacing		
	DAILY FLOW RATES			DAILY FLOW RATES			DAILY FLOW RATES		
	20 BOPD	40 BOPD	70 BOPD	20 BOPD	40 BOPD	70 BOPD	20 BOPD	40 BOPD	70 BOPD
Estimated Recoverable Reserves (8/8)									
Oil (BBL)	18,000	16,240	14,700	56,900	50,720	43,470	104,300	90,360	72,170
Gas (MMCF)	29	28	27	48	45	42	72	65	70
Producing Time (Days)	900 (2.46 yrs)	406 (1.11 yrs)	210 (.575 yrs)	2,845 (7.79 yrs)	1,268 (3.47 yrs)	621 (1.7 yrs)	5,215 (14.28 yrs)	2,259 (6.18 yrs)	1,031 (2.82 yrs)
After Tax:									
Net Cash Flow Discounted ($)									
0%	($179,000)	($195,000)	($213,000)	$335,000	$268,000	$172,000	$943,000	$802,000	$547,000
10%	($228,504)	($219,561)	($230,437)	$ 60,640	$135,410	$107,870	$229,800	$458,060	$400,900
20%	($266,736)	($239,939)	($245,277)	($90,880)	$ 38,010	$ 55,310	($45,700)	$277,460	$288,890
Rate of Return (%)	Negative	Negative	Negative	13.27	24.82	32.91	17.74	39.34	65.37
Payout (Years)	Negative	Negative	Negative	4.9	2.4	1.4	4.9	2.4	1.3

Note: These economics are based on one well only being drilled on a 40 acre spacing, 160 acre spacing, and 320 acre spacing. For instance, to compare the net cash flow discounted for four wells drilled on a 40 acre spacing and produced at a flow rate of 70 BOPD, the net cash flow discounted for the 40 acre spacing must be multiplied by four on a 160 acre spacing and produced at a flow rate of 70 BOPD, the net cash flow discounted for the 40 acre spacing must be multiplied by four:

$$4 \times (\$245,277)$$

Net cash flow discounted at 20% for 70 BOPD flow rate for four wells each drilled on 40 acre spacing.

versus

$$\$55,310$$

Net cash flow discounted at 20% for 70 BOPD flow rate for one well on 160 acre spacing.

Docket No. 6-80

Dockets Nos. 8-80 and 9-80 are tentatively set for March 26 and April 9, 1980. Applications for hearing must be filed at least 22 days in advance of hearing date.

DOCKET: COMMISSION HEARING - TUESDAY - MARCH 11, 1980

OIL CONSERVATION COMMISSION - 9 A.M. - ROOM 205
STATE LAND OFFICE BUILDING, SANTA FE, NEW MEXICO

CASE 6609: (DE NOVO) (Continued and Readvertised)

Application of Napeco Inc. for pool creation and special pool rules, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks the creation of a new Strawn oil pool for its Benson Deep Unit Well No. 1 located in Unit O of Section 33, Township 18 South, Range 30 East, and special rules therefor, including 160-acre spacing and standard well locations.

Upon application of Yates Petroleum Corporation and Napeco Inc., this case will be heard De Novo pursuant to the provisions of Rule 1220. Applicants allege this is not an "oil" pool but is a "volatile" oil pool.

CASE 6823: Application of Amoco Production Company for 640-acre carbon dioxide gas well spacing, Harding, Quay, and Union Counties, New Mexico. Applicant, in the above-styled cause, seeks the amendment of Rule 104 of the Division Rules and Regulations to require that wildcat and development carbon dioxide gas wells projected to the Tubb or older formations in Harding, Quay, and Union Counties must be located on 640-acre spacing and proration units, and must be located no nearer than 1650 feet to the outer boundary of the tract and not nearer than 330 feet to any interior quarter-quarter section line.

****

Docket No. 7-80

DOCKET: EXAMINER HEARING - WEDNESDAY - MARCH 12, 1980

9 A.M. - OIL CONSERVATION DIVISION CONFERENCE ROOM,
STATE LAND OFFICE BUILDING, SANTA FE, NEW MEXICO

The following cases will be heard before Daniel S. Nutter, Examiner, or Richard L. Stamets, Alternate Examiner:

ALLOWABLE: (1) Consideration of the allowable production of gas for April, 1980, from fifteen prorated pools in Lea, Eddy, and Chaves County, New Mexico.

(2) Consideration of the allowable production of gas for April, 1980, from four prorated pools in San Juan, Rio Arriba, and Sandoval Counties, New Mexico.

CASE 6813: (Continued from February 27, 1980, Examiner Hearing) (This case will be dismissed.)

Application of Petroleum Development Corporation to amend Order No. R-6196, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks to amend Order No. R-6196 which authorized re-entry of a well at an unorthodox location in the Lusk-Morrow Gas Pool to be dedicated to the N/2 of Section 13, Township 19 South, Range 31 East. Applicant now seeks approval for a new revised location 750 feet from the North line and 660 feet from the West line of said Section 13.

CASE 6834: Application of Conoco Inc. for a dual completion and unorthodox well location, Lea County, New Mexico. (This case will be continued to March 26 and readvertised.)

Applicant, in the above-styled cause, seeks approval for the dual completion (conventional) of its SEMU Burger Well No. 107 at an unorthodox location 2615 feet from the South and East lines of Section 24, Township 20 South, Range 38 East, to produce oil from the Blinebry Oil and Gas and Drinkard Pools.

CASE 6824: Application of American Trading and Production Corporation for a unit agreement, Lea County, New Mexico. Applicant, in the above-styled cause, seeks approval for the Talco Unit Area, comprising 4,800 acres, more or less, of State and Federal lands in Township 26 South, Range 35 East.

CASE 6815: (Continued and Readvertised)

Application of Florida Exploration Company for an unorthodox gas well location, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks approval for the unorthodox location of its Ross Draw Unit Well No. 8, a Wolfcamp gas well 1650 feet from the North and East lines of Section 27, Township 26 South, Range 30 East, the E/2 of said Section 27 being dedicated to the well.

CASE 6825: Application of Husky Oil Company for approval of infill drilling, Lea County, New Mexico. Applicant, in the above-styled cause, seeks a finding that the drilling of its North Shore Woolworth Well No. 5 to be located in Unit E of Section 33, Township 24 South, Range 37 East, Jalmat Pool, is necessary to effectively and efficiently drain that portion of the proration unit which cannot be so drained by the existing well.

CASE 6826: Application of Tahoe Oil and Cattle Company for compulsory pooling, Lea County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests in the Penrose Skelly Pool underlying the SE/4 SE/4 of Section 25, Township 21 South, Range 36 East, to be dedicated to its Bromlee Well No. 1 located thereon. Also to be considered will be the cost of recompleting said well and the allocation of the cost thereof as well as actual operating costs and charges for supervision. Also to be considered will be the designation of applicant as operator of the well and a charge for risk involved in recompleting said well.

CASE 6827: Application of Consolidated Oil & Gas, Inc. for compulsory pooling, San Juan County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests in the Gallup formation underlying the SE/4 of Section 2, Township 30 North, Range 12 West, and in the Mesaverde formation underlying the S/2 of said Section 2, to be dedicated to a well to be drilled at a standard location thereon. Also to be considered will be the cost of drilling and completing said well and the allocation of the cost thereof as well as actual operating costs and charges for supervision. Also to be considered will be the designation of applicant as operator of the well and a charge for risk involved in drilling said well.

CASE 6828: Application of Etheldred T. Ross for three non-standard gas proration units, Harding County, New Mexico. Applicant, in the above-styled cause, seeks approval of the three following non-standard gas proration units, all in Township 19 North, Range 30 East: a 40-acre unit comprising the SW/4 NE/4 of Section 12; and two 80-acre units in Section 14, the first comprising the N/2 NW/4 and the second comprising the N/2 SE/4; each of said units would be dedicated to a well to be drilled to the Tubb formation at a standard location thereon.

CASE 6829: Application of Alpha Twenty-One Production Company for approval of infill drilling, Lea County, New Mexico. Applicant, in the above-styled cause, seeks findings that the drilling of its El Paso Tom Federal Wells Nos. 1, 2, and 3, in Units D, E, and F, respectively, of Section 33, Township 25 South, Range 37 East, Langlie Mattix Pool, is necessary to effectively and efficiently drain that portion of the existing proration unit which cannot be drained by the existing well on each of said well's respective proration unit.

CASE 6830: Application of Enserch Exploration, Inc. for special pool rules or, in the alternative, a special gas-oil ratio, Roosevelt County, New Mexico. Applicant, in the above-styled cause, seeks an order promulgating special pool rules for the South Peterson-Pennsylvanian Field including a special gas-oil ratio of 4,000 to 1, or in the alternative, establishing a special gas-oil ratio of 4,000 to 1 for its Lambirth Well No. 3, located in Unit G of Section 31, Township 5 South, Range 33 East.

CASE 6831: Application of Yates Petroleum Corporation for an unorthodox gas well location, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks approval for the recompletion of its State "JM" Well No. 1 in the Wolfcamp thru Cisco formations at an unorthodox location 660 feet from the North and East lines of Section 25, Township 18 South, Range 24 East, the N/2 of said Section 25 to be dedicated to the well.

CASE 6832: Application of Yates Petroleum Corporation for an unorthodox gas well location, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks approval for the recompletion of its Cities "JG" Well No. 1 in the Wolfcamp thru Cisco formations at an unorthodox location 660 feet from the South and East lines of Section 13, Township 18 South, Range 24 East, the E/2 of said Section 13 to be dedicated to the well.

CASE 6833: Application of Harvey E. Yates Company for directional drilling, Lea County, New Mexico. Applicant, in the above-styled cause, seeks authority to directionally drill its Betenbough Well No. 1, the surface location of which is 660 feet from the North line and 1980 feet from the West line of Section 32, Township 13 South, Range 36 East, in such a manner as to bottom it within 100 feet of a point 660 feet from the North line and 1830 feet from the West line of said Section 32 in the Austin-Mississippian Pool.

CASE 6818: (Continued from February 27, 1980, Examiner Hearing)

Application of Tenneco Oil Company for an NGPA determination, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks a new onshore reservoir determination for its State HL 11 Well No. 1 located in Unit N of Section 11, Township 19 South, Range 29 East.

CASE 6835: Application of Anadarko Production Company for an NGPA determination, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks a new onshore reservoir determination for its New Mexico State "AB" Com. Well No. 1 located in Unit H of Section 36, Township 18 South, Range 28 East.

CASE 6836: Application of Anadarko Production Company for an NGPA determination, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks a new onshore reservoir determination for its New Mexico "AA" State Well No. 1 located in Unit F of Section 35, Township 18 South, Range 28 East.

CASE 6837: Application of Curtis Little for compulsory pooling, Rio Arriba County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests in the Dakota formation underlying the W/2 of Section 7, Township 25 North, Range 3 West, to be dedicated to a well to be drilled at a standard location thereon. Also to be considered will be the cost of drilling and completing said well and the allocation of the cost thereof as well as actual operating costs and charges for supervision. Also to be considered will be the designation of applicant as operator of the well and a charge for risk involved in drilling said well.

CASE 6819: (Continued from February 27, 1980, Examiner Hearing)

Application of V-F Petroleum, Inc. for compulsory pooling, Lea County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests in the McKee or Devonian formations, or both, underlying four 40-acre units, being the SE/4 SE/4, NE/4 SE/4, NW/4 SE/4, and SW/4 SE/4 of Section 21, Township 23 South, Range 37 East, North Teague Field, each to be dedicated to a well to be drilled at a standard location thereon. Also to be considered will be the cost of drilling and completing said wells and the allocation of the cost thereof as well as actual operating costs and charges for supervision. Also to be considered will be the designation of applicant as operator of the wells and a charge for risk involved in drilling said wells.

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION
STATE LAND OFFICE BLDG.
SANTA FE, NEW MEXICO
11 March 1980

COMMISSION HEARING

IN THE MATTER OF:

Application of Napeco Inc. for pool creation and special pool rules, Eddy County, New Mexico. CASE 6609

BEFORE: Commissioner Ramey
Commissioner Arnold

TRANSCRIPT OF HEARING

A P P E A R A N C E S

For the Oil Conservation Division: Ernest L. Padilla, Esq.
Legal Counsel to the Commission
State Land Office Bldg.
Santa Fe, New Mexico 87501

SALLY W. BOYD, C.S.R.
Rt. 1 Box 193-B
Santa Fe, New Mexico 87501
Phone (505) 455-7409

COMMISSIONER RAMEY: The hearing will come to order.

We'll call first Case 6609.

MR. PADILLA: Application of Napeco, Inc. for pool creation and special pool rules, Eddy County, New Mexico.

Mr. Chairman, the applicant in this hearing has asked for a continuance of the case until the next available Commission hearing.

MR. RAMEY: Case 6609 will be continued until the next Commission hearing, whenever that may be.

(Thereupon the hearing was continued.)

(Thereafter, at a later time on the afternoon of 11 March, 1980, the hearing was reopened, as follows, to-wit:)

COMMISSIONER RAMEY: We will reopen Case Number 6609 for the purpose of stating that it will be continued until the Commission Hearing to be held on 16 April 1980, at the hour of 9:00 o'clock a. m. at this same place.

(Hearing concluded.)

SALLY W. BOYD, C.S.R.
Rt. 1 Box 193-B
Santa Fe, New Mexico 87501
Phone (505) 455-7409

REPORTER'S CERTIFICATE

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

Sally W. Boyd C.S.R.

SALLY W. BOYD, C.S.R.
Rt. 1 Box 193-B
Santa Fe, New Mexico 87501
Phone (505) 455-7409

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION
STATE LAND OFFICE BLDG.
SANTA FE, NEW MEXICO
11 March 1980

COMMISSION HEARING

IN THE MATTER OF:

Application of Napeco Inc. for pool creation and special pool rules, Eddy County, New Mexico.

CASE 6609

BEFORE: Commissioner Ramey
Commissioner Arnold

TRANSCRIPT OF HEARING

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For the Oil Conservation Division: Ernest L. Padilla, Esq.
Legal Counsel to the Commission
State Land Office Bldg.
Santa Fe, New Mexico 87501

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Phone (505) 455-7409

LAW OFFICES
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300 AMERICAN HOME BUILDING
P. O. DRAWER 239
ARTESIA, NEW MEXICO 88210

A. J. LOSEE
JOEL M. CARSON
CHAD DICKERSON
DAVID R. VANDIVER

AREA CODE 505
746-3508

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OIL CONSERVATION DIVISION
SANTA FE

2 November 1979

Mr. Joe D. Ramey, Director
Energy and Minerals Department
Oil Conservation Division
P. O. Box 2088
Santa Fe, New Mexico 87501

Re: Application of Napeco Inc.
Case No. 6609
Order No. R-6129

Dear Mr. Ramey:

Enclosed for filing, please find three copies of Application of Yates Petroleum Corporation and Napeco Inc. for a de novo hearing before the Division.

Sincerely yours,

LOSEE, CARSON & DICKERSON, P.A.

Chad Dickerson

Chad Dickerson

CD:jcb
Enclosures

cc w/enclosures: Yates Petroleum Corporation
Napeco Inc.

BEFORE THE OIL CONSERVATION DIVISION

OF THE STATE OF NEW MEXICO

IN THE MATTER OF THE APPLICATION OF NAPECO INC. FOR POOL CREATION AND SPECIAL RULES, EDDY COUNTY, NEW MEXICO	:	CASE NO. 6609

APPLICATION FOR DE NOVO HEARING

COME NOW YATES PETROLEUM CORPORATION and NAPECO INC., by their attorneys, and in support hereof respectfully state:

1. That on October 10, 1979 the Oil Conservation Division entered its Order No. R-6129 denying the application for creation of a new pool for Strawn production and the promulgation of special rules therefor, including a provision for 160-acre spacing.

2. That Yates Petroleum Corporation and Napeco Inc. are adversely affected by said order.

3. The order is incorrect in finding (a) that one well will not efficiently and effectively drain 160 acres, and (b) the approval of temporary 160-acre spacing might cause waste.

WHEREFORE, applicants pray:

A. That the application of Napeco Inc. for pool creation and special rules be heard de novo by the Division.

B. That upon hearing the Division enter its order (i) creating a new pool for Strawn production based upon the discovery of the Benson Deep Unit Well No. 1 located in Unit O of Section 33, Township 18 South, Range 30 East, N.M.P.M., Eddy County, New Mexico, and (ii) promulgating special pool rules

therefor, including a provision for temporary 160-acre spacing and proration units.

C. And for such other relief as may be just in the premises.

YATES PETROLEUM CORPORATION
NAPECO INC.

By: Chad Dickerson
Chad Dickerson

P. O. Drawer 239
Artesia, New Mexico 88210

Attorneys for Applicants
Yates Petroleum Corporation
and Napeco Inc.

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NOV 2 - 1979
OIL CONSERVATION DIVISION
SANTA FE

BEFORE THE OIL CONSERVATION DIVISION

OF THE STATE OF NEW MEXICO

IN THE MATTER OF THE APPLICATION OF NAPECO INC. FOR POOL CREATION AND SPECIAL RULES, EDDY COUNTY, NEW MEXICO	:	CASE NO. 6609

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WHEREFORE, applicants pray:

A. That the application of Napeco Inc. for pool creation and special rules be heard de novo by the Division.

B. That upon hearing the Division enter its order (i) creating a new pool for Strawn production based upon the discovery of the Penson Deep Unit Well No. 1 located in Unit O of Section 33, Township 18 South, Range 30 East, N.M.P.M., Eddy County, New Mexico, and (ii) promulgating special pool rules

therefor, including a provision for temporary 160-acre spacing and proration units.

C. And for such other relief as may be just in the premises.

YATES PETROLEUM CORPORATION
NAPECO INC.

By: Chad Dickerson
Chad Dickerson

P. O. Drawer 239
Artesia, New Mexico 88210

Attorneys for Applicants
Yates Petroleum Corporation
and Napeco Inc.

RECEIVED
NOV 8 - 1979
OIL CONSERVATION DIVISION
SANTA FE

BEFORE THE OIL CONSERVATION DIVISION

OF THE STATE OF NEW MEXICO

IN THE MATTER OF THE APPLICATION OF NAPECO INC. FOR POOL CREATION AND SPECIAL RULES, EDDY COUNTY, NEW MEXICO	:	CASE NO. 6609

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B. That upon hearing the Division enter its order (i) creating a new pool for Strawn production based upon the discovery of the Benson Deep Unit Well No. 1 located in Unit O of Section 33, Township 18 South, Range 30 East, N.M.P.M., Eddy County, New Mexico, and (ii) promulgating special pool rules

therefor, including a provision for temporary 160-acre spacing and proration units.

C. And for such other relief as may be just in the premises.

YATES PETROLEUM CORPORATION
NAPECO INC.

By: Chad Dickerson
Chad Dickerson

P. O. Drawer 239
Artesia, New Mexico 88210

Attorneys for Applicants
Yates Petroleum Corporation
and Napeco Inc.

Copy & Fax -

TO _____

DATE _____ TIME _____

WHILE YOU WERE OUT

MR A. J. Lasseter

OF 746 3508

PHONE Artesia AREA CODE _____

TELEPHONED		PLEASE PHONE	
CALLED TO SEE YOU		WILL CALL AGAIN	
WANTS TO SEE YOU		RETURNED YOUR CALL	

MESSAGE Nagecco 6609 L-6129
Ready for a hearing
Cant do it : last wk
February;
Notice: volotile oil reservir;
in between gas + oil reservir;
GOR 1200:1 ; 160 sp. August

MESSAGE TAKEN BY _____

Dont call it a new oil pool ???

"volatile"

New "pool"

Docket No. 43-79

Dockets Nos. 45-79 and 1-80 are tentatively set for December 12, 1979 and January 3, 1980. Applications for hearing must be filed at least 22 days in advance of hearing date.

DOCKET: COMMISSION HEARING - TUESDAY - NOVEMBER 27, 1979

OIL CONSERVATION COMMISSION - 9 A.M. - ROOM 205
STATE LAND OFFICE BUILDING, SANTA FE, NEW MEXICO

CASE 6609: (DE NOVO)

Application of Napeco Inc. for pool creation and special pool rules, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks the creation of a new Strawn oil pool for its Benson Deep Unit Well No. 1 located in Unit O of Section 33, Township 18 South, Range 30 East, and special rules therefor, including 160-acre spacing and standard well locations.

Upon application of Yates Petroleum Corporation and Napeco Inc., this case will be heard De Novo pursuant to the provisions of Rule 1220.

****

Docket No. 44-79

DOCKET: EXAMINER HEARING - WEDNESDAY - NOVEMBER 28, 1979

9 A.M. - OIL CONSERVATION DIVISION CONFERENCE ROOM,
STATE LAND OFFICE BUILDING, SANTA FE, NEW MEXICO

The following cases will be heard before Richard L. Stamets, Examiner, or Daniel S. Nutter, Alternate Examiner:

Notice is hereby given by the Oil Conservation Division that Giant Industries, Inc., has filed an application for a determination of eligibility to purchase state royalty oil pursuant to Secs. 19-10-64 thru 19-10-70 NMSA 1978 Comp. for its Farmington, New Mexico, refinery, which will be considered by the Commission after December 1, 1979. In the event objection, and evidence to support such objection, is received by the Commission on or before December 1, 1979, to such a determination, notice will be given and the application set for public hearing at a later date.

* * *

CASE 6702: (Continued from October 17, 1979, Examiner Hearing)

Application of El Paso Natural Gas Company for downhole commingling, Rio Arriba County, New Mexico. Applicant, in the above-styled cause, seeks approval for the downhole commingling of South Blanco-Pictured Cliffs and Blanco Mesaverde production in the wellbore of its San Juan 27-5 Unit Well No. 67 located in Unit B of Section 31, Township 27 North, Range 5 West.

CASE 6732: Application of Dorchester Exploration, Inc. for an unorthodox oil well location, Lea County, New Mexico. Applicant, in the above-styled cause, seeks approval for the unorthodox location of its Morton Solid State Unit Well No. 1 located 2156 feet from the North line and 990 feet from the West line of Section 4, Township 15 South, Range 34 East, Tres Papalotes-Pennsylvanian Pool.

CASE 6733: Application of Kelloil Inc. for a unit agreement, Lea County, New Mexico. Applicant, in the above-styled cause, seeks approval for the Lea Penn South Unit Area, comprising 1,440 acres, more or less, of State lands in Township 20 South, Range 35 East.

CASE 6734: Application of Southland Royalty Company for compulsory pooling, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests in the Pennsylvanian formation underlying the S/2 of Section 27, Township 18 South, Range 29 East, to be dedicated to a well to be drilled at a standard location thereon. Also to be considered will be the cost of drilling and completing said well and the allocation of the cost thereof as well as actual operating costs and charges for supervision. Also to be considered will be the designation of applicant as operator of the well and a charge for risk involved in drilling said well.

CASE 6735: Application of Mesa Petroleum Co. for compulsory pooling, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests in the Pennsylvanian formation underlying the S/2 of Section 26, Township 18 South, Range 24 East, to be dedicated to a well to be drilled at a standard location thereon. Also to be considered will be the cost of drilling and completing said well and the allocation of the cost thereof as well as actual operating costs and charges for supervision. Also to be considered will be the designation of applicant as operator of the well and a charge for risk involved in drilling said well. (This case will be dismissed.)

CASE 6736: Application of Doyle Hartman for compulsory pooling and a non-standard gas proration unit, Lea County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests in the Jalmat Gas Pool to form a 360-acre non-standard gas proration unit comprising the S/2 SE/4 of Section 36, Township 24 South, Range 36 East; SW/4 of Section 31, Township 24 South, Range 37 East; and the N/2 NW/4 and NW/4 NE/4 of Section 6, Township 25 South, Range 37 East, to be dedicated to a well to be drilled 660 feet from the South line and 990 feet from the West line of said Section 31. Also to be considered will be the cost of drilling and completing said well and the allocation of the cost thereof as well as actual operating costs and charges for supervision. Also to be considered will be the designation of applicant as operator of the well and a charge for risk involved in drilling said well.

CASE 6707: (Continued from November 14, 1979, Examiner Hearing)

Application of Gulf Oil Corporation for a unit agreement, San Juan County, New Mexico. Applicant, in the above-styled cause, seeks approval for the Southeast Bisti Unit Area, comprising 7,048 acres, more or less, of State and Federal lands in Townships 24 and 25 North, Range 10 West.

CASE 6737: Application of Gulf Oil Corporation for compulsory pooling, Lea County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests in the Pennsylvanian formation underlying the W/2 of Section 4, Township 19 South, Range 32 East, North Lusk-Morrow Gas Pool, to be dedicated to a well to be drilled at a standard location thereon. Also to be considered will be the cost of drilling and completing said well and the allocation of the cost thereof as well as actual operating costs and charges for supervision. Also to be considered will be the designation of applicant as operator of the well and a charge for risk involved in drilling said well.

CASE 6739: Application of Mobil Oil Corporation for downhole commingling, Rio Arriba County, New Mexico. Applicant, in the above-styled cause, seeks approval for the downhole commingling of Gavilan-Pictured Cliffs and Blanco Mesaverde production in the wellbore of its Jicarilla D Well No. 1 located in Unit N of Section 24, Township 26 North, Range 3 West. Applicant further seeks the establishment of an administrative procedure for approval of downhole commingling of the aforesaid pools in others of its wells in Sections 7, 8, 17, 18, and 19, Township 26 North, Range 2 West, Sections 1, 2, 11 thru 14, 23, and 24, Township 26 North, Range 3 West, and Sections 11 thru 15, 22 thru 27, 35, and 36, Township 27 North, Range 3 West.

CASE 6740: Application of Hondo Oil and Gas Company for an unorthodox gas well location, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks approval for the unorthodox location of a Pennsylvanian test well to be drilled 1550 feet from the North line and 660 feet from the West line of Section 10, Township 18 South, Range 28 East, the N/2 of said Section 10 to be dedicated to the well.

CASE 6741: Application of ARCO Oil and Gas Company for an amendment to Order No. R-6054, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks the amendment of Order No. R-6054 to amend the findings in said order to make said findings more specific as to the necessity for the drilling of infill wells in the Empire Abo Unit in order to recover additional gas pursuant to the Natural Gas Policy Act of 1978; further to amend said order to make such findings applicable to present and future drilling operations including the drilling of horizontal drainholes.

CASE 6720: (Continued from November 14, 1979, Examiner Hearing)

Application of ARCO Oil and Gas Company to drill a horizontal drainhole, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks approval to drill and complete its Empire Abo Unit Well No. J-213, located in Unit E of Section 6, Township 18 South, Range 28 East, Empire-Abo Pool, with a single horizontal drainhole of about 200 feet in length in the Abo formation.

CASE 6742: Application of ARCO Oil and Gas Company for an administrative procedure, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks the establishment of an administrative procedure for approval of the drilling of horizontal drainholes in the Empire Abo Unit, Empire-Abo Pool.

CASE 6743: (This case will be dismissed.)

Application of Exxon Corporation for an exception to Order No. R-3221, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks an exception to Order No. R-3221 to permit disposal of produced brine in several unlined surface pits located on its Laguna Grande Unit Area in Sections 16, 21, 28, 29, 32, and 33, Township 23 South, Range 29 East.

CASE 6744: Application of Texas Oil & Gas Corporation for special pool rules, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks the promulgation of special pool rules for the Riverside-Morrow Gas Pool to provide for 320-acre spacing rather than 160 acres. In the absence of objection, this pool will be placed on the standard 320-acre spacing for Pennsylvanian gas pools rather than the present 160-acre spacing.

CASE 6745: Application of Harvey E. Yates Company for compulsory pooling, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests in the Wolfcamp-Pennsylvanian formations underlying the W/2 of Section 28, Township 23 South, Range 24 East, to be dedicated to a well to be drilled at a standard location thereon. Also to be considered will be the cost of drilling and completing said well and the allocation of the cost thereof as well as actual operating costs and charges for supervision. Also to be considered will be the designation of applicant as operator of the well and a charge for risk involved in drilling said well.

CASE 6746: Application of Yates Petroleum Corporation for compulsory pooling and an unorthodox location, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests in the Wolfcamp-Pennsylvanian formations underlying the S/2 of Section 31, Township 18 South, Range 26 East, to be dedicated to a well to be drilled at an unorthodox location 660 feet from the South line and 1100 feet from the West line of said Section 31. Also to be considered will be the cost of drilling and completing said well and the allocation of the cost thereof as well as actual operating costs and charges for supervision. Also to be considered will be the designation of applicant as operator of the well and a charge for risk involved in drilling said well.

CASE 6747: Application of Yates Petroleum Corporation for compulsory pooling and an unorthodox location, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests in the Wolfcamp-Pennsylvanian formations underlying the S/2 of Section 23, Township 18 South, Range 25 East, to be dedicated to a well to be drilled at an unorthodox location in the center of Unit P of said Section 23. Also to be considered will be the cost of drilling and completing said well and the allocation of the cost thereof as well as actual operating costs and charges for supervision. Also to be considered will be the designation of applicant as operator of the well and a charge for risk involved in drilling said well.

CASE 6748: Application of Yates Petroleum Corporation for an unorthodox gas well location, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks approval for the unorthodox location of its Rio Peces "MH" Fed. Well No. 1, a Morrow test to be drilled 1980 feet from the South line and 1100 feet from the East line of Section 29, Township 18 South, Range 27 East, the S/2 of said Section 29 to be dedicated to the well.

CASE 6749: Application of Petro-Lewis Corporation for downhole commingling, Lea County, New Mexico. Applicant, in the above-styled cause, seeks approval for the downhole commingling of Penrose Skelly, Blinebry, and Drinkard production in the wellbore of its Warlick Well No. 3 located in Unit P of Section 18, Township 21 South, Range 37 East.

CASE 6750: Application of CO_2-In-Action, Inc. for creation of a new carbon dioxide gas pool and special pool rules, Harding County, New Mexico. Applicant, in the above-styled cause, seeks the creation of the North Bueyeros-Santa Rosa CO_2 Gas Pool comprising all or parts of Sections 1, 2, 3, 10, 11, and 12, Township 20 North, Range 30 East and Sections 20 thru 23 and 26 thru 35, Township 21 North, Range 30 East, and the promulgation of special rules therefor including a provision for 160-acre spacing units with the option to drill on 40 acres, and with well locations as close as 330 feet to the unit boundary.

CASE 6725: (Continued from November 14, 1979, Examiner Hearing)

Application of Tenneco Oil Company for three non-standard gas proration units, San Juan County, New Mexico. Applicant, in the above-styled cause, seeks approval of a 291.23-acre non-standard gas proration unit comprising the W/2 of Section 6 and the NW/4 of Section 7, a 347.58-acre unit comprising the W/2 of Section 19 and the NW/4 of Section 30, and a 375.17-acre unit comprising the SW/4 of Section 30 and the W/2 of Section 31, all in Township 29 North, Range 8 West, Basin-Dakota Pool, each unit to be dedicated to a well to be drilled at a standard location thereon.

CASE 6751: Application of Tenneco Oil Company for the rescission of special pool rules, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks the rescission of the special pool rules for the Catclaw Draw-Morrow Gas Pool to provide for 320-acre spacing rather than 640 acres. In the absence of objection, the pool rules will be rescinded and the pool placed on standard 320-acre spacing for Pennsylvanian gas pools rather than the present 640-acre spacing.

CASE 6357: (Reopened and Readvertised)

In the matter of Case 6357 being reopened pursuant to the provisions of Order No. R-5853 which order established temporary special rules and regulations for the South Peterson-Pennsylvanian Pool, with provisions for 80-acre spacing. All interested parties may appear and show cause why the South Peterson-Pennsylvanian Pool should not be developed on 40-acre spacing units.

CASE 6714: (Continued and Readvertised)

Application of Jake L. Hamon for an unorthodox gas well location and approval of infill drilling, Lea County, New Mexico. Applicant, in the above-styled cause, seeks approval for the unorthodox location of a Morrow test well to be drilled 660 feet from the South and West lines of Section 20, Township 20 South, Range 36 East, North Osudo-Morrow Gas Pool; applicant further seeks a finding that the drilling of said well is necessary to effectively and efficiently drain that portion of the proration unit which cannot be so drained by the existing well.

CASE 6738: Application of Harlan Drilling Company for drilling drainholes, San Juan County, New Mexico. Applicant, in the above-styled cause, seeks authority to drill and case a vertical hole to an approximate depth of 1500 at the top of the Gallup formation from a surface location 990 feet from the North line and 990 feet from the West line of Section 1, Township 30 North, Range 16 West, Verde-Gallup Oil Pool, San Juan County, and to then drill four deviated drainholes therefrom, bottoming each of said holes in the Gallup at a vertical depth of 1700 feet and approximately 200 lateral distance from the vertical hole.

1/11/80

Talked with Jerry Losee and he verified that he had asked Joe not to set this de novo hearing until Mapeco had had a chance to produce the well to obtain some production history and some pressure data.

Losee will notify us in the near future when to set the case.

E/P

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION

IN THE MATTER OF THE HEARING
CALLED BY THE OIL CONSERVATION
COMMISSION ~~DIVISION~~ FOR THE PURPOSE OF
CONSIDERING:

CASE NO. ~~6467~~ 6609 DE NOVO
Order No. ~~R-5958~~ R-6129-A

NAPECO INC.

APPLICATION OF ~~GETTY OIL COMPANY~~
FOR POOL CREATION AND SPECIAL
POOL RULES, ~~LEA~~ EDDY COUNTY, NEW MEXICO.

ORDER OF THE ~~DIVISION~~ COMMISSION

BY THE ~~DIVISION~~ COMMISSION:

This cause came on for hearing De Novo at 9 a.m. on ~~February 28, 1979~~ April 16, 1980, at Santa Fe, New Mexico, before ~~Examiner Richard L. Stamets~~ the Oil Conservation Commission of New Mexico, hereinafter referred to as the "Commission."

NOW, on this ~~20th~~ 30th day of ~~March, 1979~~ May, 1980, the ~~Division Director~~ Commission, having considered the testimony, the record, and the ~~recommendations of the Examiner~~ exhibits, and being fully advised in the premises,

FINDS:

(1) That due public notice having been given as required by law, the Division has jurisdiction of this cause and the subject matter thereof.

(2) That the applicant, ~~Getty Oil Company~~ Napeco, Inc., seeks the creation of a new ~~oil~~ pool for ~~Wolfcamp~~ production in ~~Lea~~ EDDY County, New Mexico, and the promulgation of special rules therefor, ~~including a provision for well spacing and proration units.~~

(3) That this cause came on for hearing before Examiner Daniel S. Nutter on July 25, 1979, and the Division entered its Order No. R-6129 on October 10, 1979, denying ~~said application~~ the application on the grounds that the applicant had failed to establish that one well could effectively and efficiently drain 160 acres.

(4) That on November 4, 1979, Napeco, Inc., filed timely application for Hearing De Novo of Case No. 6609, whereupon this matter was set for hearing on November 27, 1979.

(5) That Case No. 6609 came on for Hearing De Novo on November 27, 1979, & was continued to several subsequent hearing dates, finally being heard on April 16, 1980.

(6) That subsequent to filing its application for Hearing De Novo, applicant modified its application, alleging that the subject reservoir is a volatile oil reservoir.

~~(6)(4)(11) That the applicant also seeks the promulgation of special rules for said pool, including a provision for 160-acre proration units.~~

(7)(5)(12) That the evidence ~~presently available~~ indicates that applicant's ~~Corby 35 State~~ Benson Deep Unit Well No. 1, located in Unit ~~O~~ of Section ~~35~~ 33, Township ~~21~~ 18 South, Range ~~34~~ 30 East, NMPM, ~~Lea~~ County, New Mexico, has discovered a separate common source of supply ~~in more properly defined as~~ the ~~Bone Spring~~ 8366'-8776' formation which should be designated the ~~Grama Ridge Bone Spring~~ Benson 8360-8762' Pool; that the vertical limits of the pool should be the ~~Bone Spring~~ 8273'-8776' formation, and that the horizontal limits of said pool should be as follows:

TOWNSHIP ~~21~~ 18 SOUTH, RANGE ~~34~~ 30 EAST, NMPM
Section ~~35~~ 33: ~~S/2~~ SE/4

(8)(6) That in order to prevent the economic loss caused by the drilling of unnecessary wells, to avoid the augmentation of risk arising from the drilling of an excessive number of wells, to prevent reduced recovery which might result from the drilling of too few wells, and to otherwise prevent waste and protect correlative rights, ~~temporary~~ special rules and regulations providing for 160-acre spacing units should be promulgated for the ~~Grama Ridge Bone Spring~~ Benson-Strawn Pool.

(9)(7) That the ~~temporary~~ special rules and regulations should provide for limited well locations in order to assure orderly development of the pool and protect correlative rights.

(10) That the evidence presented demonstrated that said Benson-Strawn Pool should be assigned a special ~~a 160 acre depth bracket~~ allowable of 70 barrels of oil per day pending further testing and establishment of a ~~permanent~~ permanent optimum producing rate for wells in said pool.

(11) That during the first 90 days of actual production the applicant should conduct tests on its wells in said Benson-Strawn Pool designed to establish the optimum producing rate for ~~wells~~ oil and gas from wells in said pool.

(12) That the results of such tests should be submitted to the Director of the Oil Conservation Division within 30 days following completion thereof.

(13) That the ~~Director~~ Director of the Division should be authorized to administratively ~~amend~~ establish a special depth bracket allowable and gas oil ratio limitation for the Benson-Strawn Pool based upon the results of the tests set out above, or, at his option, set this matter for public hearing.

~~(14)~~ That

IT IS THEREFORE ORDERED:

(1) That effec~~April 1, 1979~~ June 1, 1980, a new pool in ~~Lea~~ Eddy County, New Mexico, classified as an oil pool for ~~Bone Spring~~ Strawn production, is hereby created and designated the ~~Grama Ridge-Bone Spring~~ Benson-Strawn Pool, with vertical limits comprising the ~~Bone Spring~~ Strawn formation and horizontal limits comprising the following-described area:

TOWNSHIP ~~22~~ 18 SOUTH, RANGE ~~34~~ 30 EAST, NMPM
Section ~~35: C~~ 33: SE/4

(2) That ~~temporary~~ Special Rules and Regulations for the ~~Grama Ridge-Bone Spring~~ Benson-Strawn Pool, ~~Lea~~ Eddy County, New Mexico, are hereby promulgated as follows:

SPECIAL RULES AND REGULATIONS
FOR THE ~~GRAMA RIDGE-BONE SPRING~~ BENSON STRAWN POOL

RULE 1. Each well completed or recompleted in the ~~Grama Ridge-Bone Spring~~ Benson-Strawn Pool or in the ~~Bone Spring~~ Strawn formation within one mile of the ~~Grama Ridge-Bone Spring~~ Benson-Strawn Pool, and not nearer to nor within the limits of another designated ~~Bone Spring~~ Strawn pool, shall be spaced, drilled, operated, and prorated in accordance with the Special Rules and Regulations hereinafter set forth.

RULE 2. Each well completed or recompleted in the ~~Grama Ridge-Bone Spring~~ Benson-Strawn Pool shall be located on a unit containing 160 acres, more or less, substantially in the form of a square, which is a quarter section being a legal subdivision of the United States Public Lands Survey.

RULE 3. Each well completed or recompleted in said pool shall not be drilled closer than 660 feet to any quarter section line nor closer than 330 feet to any quarter-quarter section line.

RULE 4. For good cause shown, the Division Director may grant an exception to the requirements of Rule 2 without notice and hearing when the application is for a non-standard unit comprising less than 160 acres. All operators offsetting the proposed non-standard unit shall be notified of the application by registered or certified mail, and the application shall state that such notice has been furnished. The Division Director may approve the application if, after a period of 30 days, no offset operator has entered an objection to the formation of such non-standard unit.

The allowable assigned to any such non-standard unit shall bear the same ratio to a ~~standard~~ established allowable in the ~~Grama Ridge-Bone Spring~~ Benson-Strawn Pool as the acreage in such non-standard unit bears to 160 acres.

RULE 5. A standard proration unit (158 through 162 acres) in the ~~Grama Ridge-Bone Spring~~ Benson-Strawn Pool shall be assigned a depth bracket allowable of ~~560~~ 70 barrels, subject to the market demand percentage factor, and in the event there is more than one well on a 160-acre proration unit, the operator may produce the allowable assigned to the unit in any proportion.

IT IS FURTHER ORDERED:

special depth bracket allowable set forth

(1) That the ~~Benson Strawn Pool is hereby established in Rule 5 above shall remain in effect~~ ~~assigned a special 1,000 barrel allowable~~ ~~of 90 barrels of oil per day with a gas-oil~~ ~~ratio limit of 4,000 cubic feet of gas per barrel~~ ~~for purposes of testing and~~ pending establishment of a permanent depth bracket allowable and gas-oil ratio limit for said pool.

90 days

(2) That during the first ~~three months~~ of production the applicant shall conduct tests on said Benson Deep Unit Well No. 1 to establish the optimum producing rate for oil and gas from said Benson-Strawn wells in Pool, provided however, that there shall be no ~~limiting~~ gas-oil ratio limitations in effect in said pool until a permanent depth bracket allowable and gas-oil ratio limitation for said pool has been established.

(3) That the applicant shall submit the results of such tests to the Director of the Division within 30 days following the close of the 90-day test period.

(4) That based upon the results of such tests the Director of the Division may administratively ~~establish~~ revise the special depth bracket allowable set forth in Rule 5 above and may establish a special gas-oil ratio limit for the Benson-Strawn Pool, or, at his option, he may set the matter for public hearing.

with a special gas-oil

(5) ~~(3)~~ That the locations of all wells presently drilling to or completed in the ~~Grama Ridge-Bone Spring~~ Benson-Strawn Pool or in the ~~Bone Spring~~ formation within one mile thereof are hereby approved; that the operator of any well having an unorthodox location shall notify the ~~Hobbs~~ Artesia district office of the Division in writing of the name and location of the well on or before June 1, ~~1979~~ 1980.

Strawn

(6) ~~(4)~~ That, pursuant to Paragraph A. of Section 70-2-18, NMSA 1978, contained in Chapter 271, Laws of 1969, existing wells in the ~~Grama Ridge-Bone Spring~~ Benson-Strawn Pool shall have dedicated

thereto 160 acres in accordance with the foregoing pool rules; or, pursuant to Paragraph C. of said Section 70-2-18, existing wells may have non-standard spacing or proration units established by the Division and dedicated thereto.

Failure to file new Forms C-102 with the Division dedicating 160 acres to a well or to obtain a non-standard unit approved by the Division within 60 days from the date of this order shall subject the well to cancellation of allowable. Until said Form C-102 has been filed or until a non-standard unit has been approved, and subject to said 60-day limitation, each well presently drilling to or completed in the ~~Grama Ridge Bone Spring~~ Benson-Strawn Pool or in the ~~Bone Spring~~ Strawn formation within one mile thereof shall receive no more than one-quarter of a standard allowable for the pool.

~~(5) That this case shall be reopened at an examiner hearing in April, 1980, at which time the operators in the subject pool should be prepared to appear and show cause why the Grama Ridge-Bone Spring Pool should not be developed on 40-acre spacing units.~~

(7) ~~(6)~~ That jurisdiction of this cause is retained for the entry of such further orders as the Division may deem necessary.

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

STATE OF NEW MEXICO COMMISSION
OIL CONSERVATION ~~DIVISION~~

JOE D. RAMEY
Director

S E A L

fd/