

TOM
COLEMAN

~~late~~
~~bill~~

~~John F~~
~~Conroy~~

Bill + Jim

If you have any comments please
write memo to Sonny

Reservoir Fluid Study
SANTA FE ENERGY COMPANY
State UTP No. 1 Well
Lea County, New Mexico
RFL 820121

BEFORE EXAMINER CATANACH
OIL CONSERVATION DIVISION
EXHIBIT NO. 16
CASE NO. _____

H. L. BROWN, JR.
RECEIVED

BCP JUN 21 1982 ACP

Land _____ Eng. 876/24
Geol. _____ Acctg. _____

OK HLD

May 26, 1982

CORE LABORATORIES, INC.

LAB

Santa Fe Energy Company
One Security Park
7200 I-40 West
Amarillo, TX 79106

P. L. Moses
Manager
Reservoir Fluid Analysis

Attention: Mr. Patrick Gaume

806-359-2000

Subject: Reservoir Fluid Study
State UTP No. 1 Well
Lea County, New Mexico
RFL 820121

Gentlemen:

Samples of separator gas and condensate were collected from the subject well on February 2, 1982 by a representative of Tefteller, Inc. The samples were submitted to our Dallas laboratory for use in a reservoir fluid study, the results of which are presented in the following report.

The hydrocarbon composition of the separator gas was measured through pentanes by routine gas chromatography. The compositional analysis of the gas was then extended through undecanes plus by the use of temperature programmed chromatography. The overall hydrocarbon composition of the separator gas may be found on page four.

The hydrocarbon composition of the separator condensate was measured through hexanes by low temperature fractional distillation. The heptanes plus fraction of the separator liquid was then subjected to temperature programmed chromatographic analysis, the results of which may be found on page three.

After correction for the factors shown on page one, the producing gas/liquid ratio was calculated to be 5342 cubic feet of primary separator gas at 15.025 psia and 60°F. per barrel of stock tank liquid at 39°F. The shrinkage of the primary separator liquid to stock tank conditions was measured in the laboratory and the producing gas/liquid ratio was found to be equivalent to 4028 standard cubic feet of primary separator gas per barrel of primary separator liquid at 510 psig and 69°F. The separator gas and liquid samples were physically recombined in this gas/liquid ratio and the resulting fluid was used for the entire study. The hydrocarbon composition of the producing wellstream material was calculated by using the measured hydrocarbon compositions of the separator products in conjunction with the producing gas/liquid ratio. All of the aforementioned compositional data may be found on page two.

A small portion of the reservoir fluid was then charged to a high pressure visual cell and thermally expanded to the reported reservoir temperature of 174°F. During a constant composition expansion at this temperature, the fluid was found to have a retrograde dew point at 5368

psig. Presented on page five are the results of the pressure-volume measurements at the reservoir temperature, along with the deviation factor measurements at the dew point pressure and above.

A large portion of the reservoir fluid was then subjected to constant volume depletion at the reservoir temperature. After determining the saturated sample volume, a series of expansions and constant pressure displacements were made, with each displacement terminating at the original saturated volume. Each displaced wellstream was charged to low temperature fractional distillation equipment for compositional analysis, deviation factor measurement and determination of the produced volume. A summary of the constant volume depletion test data may be found on page six.

The smooth wellstream compositions were then used with published equilibrium ratios to calculate the cumulative and instantaneous surface recoveries that may be expected during pressure depletion of the reservoir. The cumulative surface recovery calculations were based upon one MMSCF of original fluid and they are presented on page seven. A summary of the instantaneous surface recovery calculations may be found on page eight.

Visual measurements of the retrograde condensate were performed at several points during the constant composition expansion and at each point during constant volume depletion at the reservoir temperature. The maximum observed volume of retrograde condensate was 27.6 percent of the hydrocarbon pore space. A tabulation of the retrograde liquid measurements may be found on page nine; a graphical interpretation of these data is given on page 14.

Thank you for the opportunity to perform this reservoir fluid study. It is always a pleasure to serve Santa Fe Energy Company and we look forward to assisting you again in the near future.

Very truly yours,

CORE LABORATORIES, INC.



James R. Fortner
Area Manager
Reservoir Fluid Analysis

JRF:1a
7 cc: Addressee

1 cc: Tefteller, Inc.
P.O. Box 5247
14 East Industrial Loop
Midland, TX 79701
Attn: Mr. D. A. Warren

CORE LABORATORIES, INC.

Reservoir Fluid Analysis

Page 1 of 14File RFL 820121Company Santa Fe Energy Company Date Sampled February 2, 1982Well State UTP No. 1 County LeaField Undesignated State New Mexico

FORMATION CHARACTERISTICS

Formation Name	Morrow
Date First Well Completed	September 16, 1981 ✓
Original Reservoir Pressure	5539 PSIG @ 12373 Ft.
Original Produced Gas/Liquid Ratio	6586 SCF/Bbl
Production Rate	120 Bbls/Day
Separator Pressure and Temperature	PSIG °F.
Liquid Gravity at 60°F.	47.7 °API
Datum	Ft. Subsea

WELL CHARACTERISTICS

Elevation	4310.1 GL, 4325 KB	Ft.
Total Depth	13558 PB	Ft.
Producing Interval	12364-12383	Ft.
Tubing Size and Depth	2-3/8 In. to 12303	Ft.
Open Flow Potential	8.391	MMSCF/Day
Last Reservoir Pressure	5298 PSIG @ 12374	Ft.
Date	February 18, 1982	
Reservoir Temperature	174 °F. @ 12224	Ft.
Status of Well	Flowing	
Pressure Gauge	Amerada	

SAMPLING CONDITIONS

Flowing Tubing Pressure	2265	PSIG
Flowing Bottom Hole Pressure	4620	PSIG
Primary Separator Pressure	510	PSIG
Primary Separator Temperature	69	°F.
Secondary Separator Pressure	33	PSIG
Secondary Separator Temperature	130	°F.
Field Stock Tank Liquid Gravity	47.7	°API @ 60°F.
Primary Separator Gas Production Rate	334.35	MSCF/Day
Pressure Base	15.025	PSIA
Temperature Base	60	°F.
Compressibility Factor (F_{pv})	1.057	
Gas Gravity (Laboratory)	0.705	
Gas Gravity Factor (F_g)	1.1910	
Stock Tank Liquid Production Rate @ 39°F.	62.593	Bbls/Day
Primary Separator Gas/Stock Tank Liquid Ratio	5342	SCF/Bbl
or	187.2	Bbls/MMSCF
Sampled by	Tefteller, Inc.	

REMARKS:

CORE LABORATORIES, INC.
Reservoir Fluid Analysis

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Well State UTP No. 1

HYDROCARBON ANALYSES OF SEPARATOR PRODUCTS AND CALCULATED WELL STREAM

<u>Component</u>	<u>Separator Liquid,</u>	<u>Separator Gas</u>		<u>Well Stream</u>	
	<u>Mol Percent</u>	<u>Mol Percent</u>	<u>GPM</u>	<u>Mol Percent</u>	<u>GPM</u>
Hydrogen Sulfide	0.00	0.00		0.00	
Carbon Dioxide	0.17	0.43		0.38	
Nitrogen	0.03	1.74		1.41	
Methane	12.08	79.37		66.20	
Ethane	8.95	11.05	3.013	10.64	2.902
Propane	13.25	5.28	1.482	6.84	1.919
iso-Butane	3.04	0.55	0.183	1.04	0.347
n-Butane	8.16	1.05	0.337	2.44	0.784
iso-Pentane	2.83	0.17	0.063	0.69	0.258
n-Pentane	3.20	0.16	0.059	0.75	0.277
Hexanes	6.22	0.09	0.037	1.29	0.537
Heptanes plus	42.07	0.11	0.055	8.32	5.127
	<u>100.00</u>	<u>100.00</u>	<u>5.229</u>	<u>100.00</u>	<u>12.151</u>

Properties of Heptanes plus

API gravity @ 60°F.	41.4		
Density, Gm/Cc @ 60°F.	0.8174		0.817
Molecular weight	157	97	156

Calculated separator gas gravity (air=1.000) = 0.705

Calculated gross heating value for separator gas = 1233 BTU
per cubic foot of dry gas @ 15.025 psia and 60°F.

Primary separator gas collected @ 510 psig and 69°F.

Primary separator liquid collected @ 510 psig and 69°F.

Primary separator gas/separator liquid ratio = 4028 SCF/Bbl @ 69°F.

Primary separator liquid/stock tank liquid ratio = 1.326 Bbls @ 69°F./Bbl @ 39°F.

Primary separator gas/well stream ratio = 804.39 MSCF/MMSCF

Stock tank liquid/well stream ratio = 150.6 Bbls/MMSCF

CORE LABORATORIES, INC.
Reservoir Fluid Analysis

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Well State UTP No. 1

HYDROCARBON ANALYSIS OF HEPTANES PLUS FRACTION OF SEPARATOR LIQUID SAMPLE

<u>Component</u>	<u>Weight Percent</u>	<u>Mol Percent</u>
Methylcyclopentane	0.85	1.58
Benzene	0.00	0.00
Cyclohexane	3.62	6.71
Heptanes	5.15	8.01
Methylcyclohexane	6.23	9.88
Toluene	1.76	2.98
Octanes	7.39	10.08
Ethylbenzene	0.64	0.95
Meta & Para Xylenes	1.86	2.73
Orthoxylene	0.50	0.74
Nonanes	6.28	7.63
iso-Propyl Benzene	0.15	0.19
n-Propyl Benzene	0.40	0.52
1,2,4 Trimethylbenzene	0.56	0.73
Decanes	5.95	6.52
Undecanes	5.99	5.97
Dodecanes	4.92	4.51
Tridecanes	5.75	4.85
Tetradecanes	5.46	4.29
Pentadecanes	5.72	4.20
Hexadecanes	4.89	3.37
Heptadecanes	4.52	2.93
Octadecanes	4.21	2.58
Nonadecanes	3.40	1.97
Eicosanes plus	13.80	6.08
	<u>100.00</u>	<u>100.00</u>

CORE LABORATORIES, INC.
Reservoir Fluid Analysis

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Well State UTP No. 1

EXTENDED HYDROCARBON ANALYSIS OF SEPARATOR GAS SAMPLE

<u>Component</u>	<u>Mol Percent</u>	<u>GPM</u>
Hydrogen Sulfide	0.00	
Carbon Dioxide	0.43	
Nitrogen	1.74	
Methane	79.37	
Ethane	11.05	3.013
Propane	5.28	1.482
iso-Butane	0.55	0.183
n-Butane	1.05	0.337
iso-Pentane	0.17	0.063
n-Pentane	0.16	0.059
Hexanes	0.09	0.037
Heptanes	0.07	0.033
Octanes	0.03	0.016
Nonanes	0.01	0.006
Decanes	Trace	Trace
Undecanes plus	Trace	Trace
	<u>100.00</u>	<u>5.229</u>

Calculated gas gravity (air = 1.000) = 0.705

Calculated gross heating value = 1233 BTU per
cubic foot of dry gas at 15.025 psia and 60°F.

Collected at 510 psig and 69°F.

CORE LABORATORIES, INC.
Reservoir Fluid Analysis

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Well State UTP No. 1

PRESSURE-VOLUME RELATIONS OF RESERVOIR FLUID AT 174°F.
(Constant Composition Expansion)

<u>Pressure, PSIG</u>	<u>Relative Volume</u>	<u>Deviation Factor, Z</u>
7000	0.9365	1.331
6500	0.9527	1.257
6000	0.9713	1.184
5500	0.9944	1.111
5400	0.9991	1.096
5368 Dew Point Pressure	1.0000	1.091*
5298	1.0038	
5200	1.0094	
5050	1.0184	
4850	1.0318	
4600	1.0512	
4350	1.0738	
3850	1.1340	
3350	1.2264	
2850	1.3770	
2350	1.6206	
1850	2.0456	
1328	2.8926	
1109	3.5030	
950	4.1307	
763	5.2090	
652	6.1425	

*Gas Expansion Factor = 1.513 MSCF/Bbl.

CORE LABORATORIES, INC.
Reservoir Fluid Analysis

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Well State UTP No. 1

DEPLETION STUDY AT 174°F.

Hydrocarbon Analyses of Produced Well Stream - Mol Percent

Component	Reservoir Pressure - PSIG						
	5368	4600	3800	3000	2100	1300	700
Carbon Dioxide	0.38	0.38	0.39	0.39	0.40	0.42	0.44
Nitrogen	1.41	1.50	1.58	1.64	1.67	1.63	1.54
Methane	66.20	68.73	71.59	73.89	75.34	75.26	73.70
Ethane	10.64	10.61	10.59	10.58	10.72	11.23	11.97
Propane	6.84	6.64	6.46	6.28	6.20	6.30	6.91
iso-Butane	1.04	0.97	0.90	0.86	0.84	0.86	0.93
n-Butane	2.44	2.25	2.08	1.94	1.86	1.89	2.04
iso-Pentane	0.69	0.60	0.52	0.47	0.43	0.43	0.45
n-Pentane	0.75	0.65	0.55	0.49	0.44	0.43	0.45
Hexanes	1.29	1.00	0.78	0.63	0.52	0.49	0.51
Heptanes plus	8.32	6.67	4.56	2.83	1.58	1.06	1.06
	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>
							700*
							0.15
							0.10
							12.86
							6.97
							9.22
							2.10
							5.66
							2.28
							2.69
							6.23
							51.74
							<u>100.00</u>

Molecular weight of heptanes plus	156				109	105	106
Density of heptanes plus	0.817	0.804	0.791	0.780	0.769	0.765	0.766
							166
							0.825

Deviation Factor - Z

Equilibrium gas	1.091	0.955	0.842	0.793	0.797	0.853	0.915
Two-phase	1.091	0.984	0.889	0.816	0.739	0.684	0.587

Well Stream produced-

Cumulative percent of initial	0.000	5.022	13.112	25.190	42.016	61.081	75.332
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*Equilibrium liquid phase.

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Reservoir Fluid Analysis

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Well State UTP No. 1

CALCULATED CUMULATIVE RECOVERY DURING DEPLETION

Cumulative Recovery per MMSCF of Original Fluid	Initial in Place	Reservoir Pressure - PSIG				
		5368	4600	3800	3000	2100
Well Stream - MSCF	1000	0	50.22	131.12	251.90	420.16
						610.81
						753.22
<u>Normal Temperature Separation*</u>						
Stock Tank Liquid - Barrels	140.82	0	5.22	10.45	14.80	17.68
Primary Separator Gas-MSCF	888.70	0	45.88	122.15	238.84	404.22
Second Stage Gas - MSCF	1.97	0	0.08	0.15	0.22	0.27
Stock Tank Gas - MSCF	3.03	0	0.11	0.23	0.32	0.39
						0.44
						0.48
<u>Total "Plant Products" in</u>						
Primary Separator Gas - Gallons						
Ethane	2847	0	143	375	721	1212
Propane	1796	0	89	231	440	730
Butanes (total)	921	0	45	115	219	362
Pentanes plus	574	0	28	74	144	244
						1795
						1065
						529
						359
						2259
						1339
						664
						448
<u>Total "Plant Products" in</u>						
Second Stage Gas - Gallons						
Ethane	9.37	0	0.35	0.71	1.01	1.23
Propane	6.90	0	0.25	0.51	0.72	0.87
Butanes (total)	3.78	0	0.14	0.27	0.38	0.46
Pentanes plus	2.27	0	0.08	0.17	0.24	0.29
						1.38
						0.97
						0.51
						0.35
						1.51
						1.06
						0.56
						0.35
<u>Total "Plant Products" in</u>						
Well Stream - Gallons						
Ethane	2902	0	145	379	727	1219
Propane	1919	0	94	240	453	746
Butanes (total)	1131	0	53	131	241	389
Pentanes plus	6199	0	236	491	734	946
						1803
						1083
						559
						1135
						2268
						1359
						697
						1280

*Primary separator at 50 psig and 70°F., second stage at 25 psig and 80°F., stock tank at 75°F.

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CORE LABORATORIES, INC.
Reservoir Fluid Analysis

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Well State UTP No. 1

CALCULATED INSTANTANEOUS RECOVERY DURING DEPLETION

	Reservoir Pressure - PSIG					
	5368	4600	3800	3000	2100	1300
Normal Temperature Separation*						
Stock Tank Liquid Gravity, °API at 60°F.	48.3	50.8	53.6	56.3	59.0	60.2
Separator Gas/Well Stream Ratio, MSCF/MSCF						
Primary Separator Gas Only	888.70	913.50	942.78	966.13	982.91	989.75
Primary and Second Stage Separator Gases	890.68	915.00	943.75	966.69	983.20	989.92
Separator Gas/Stock Tank Liquid Ratio, SCF/STB						
Primary Separator Gas Only	6311	8791	14589	26806	57339	98945
Primary and Second Stage Separator Gases	6325	8805	14604	26822	57355	98962

GPM from Smooth Well Stream Compositions

Ethane plus	12.151	10.512	8.810	7.570	6.803	6.717
Propane plus	9.249	7.619	5.922	4.684	3.880	3.655
Butanes plus	7.330	5.755	4.109	2.922	2.140	1.887
Pentanes plus	6.199	4.709	3.140	2.012	1.262	0.993
						7.189
						3.925
						1.986
						1.020

*Primary separator at 50 psig and 70°F., second stage at 25 psig and 80°F., stock tank at 75°F.

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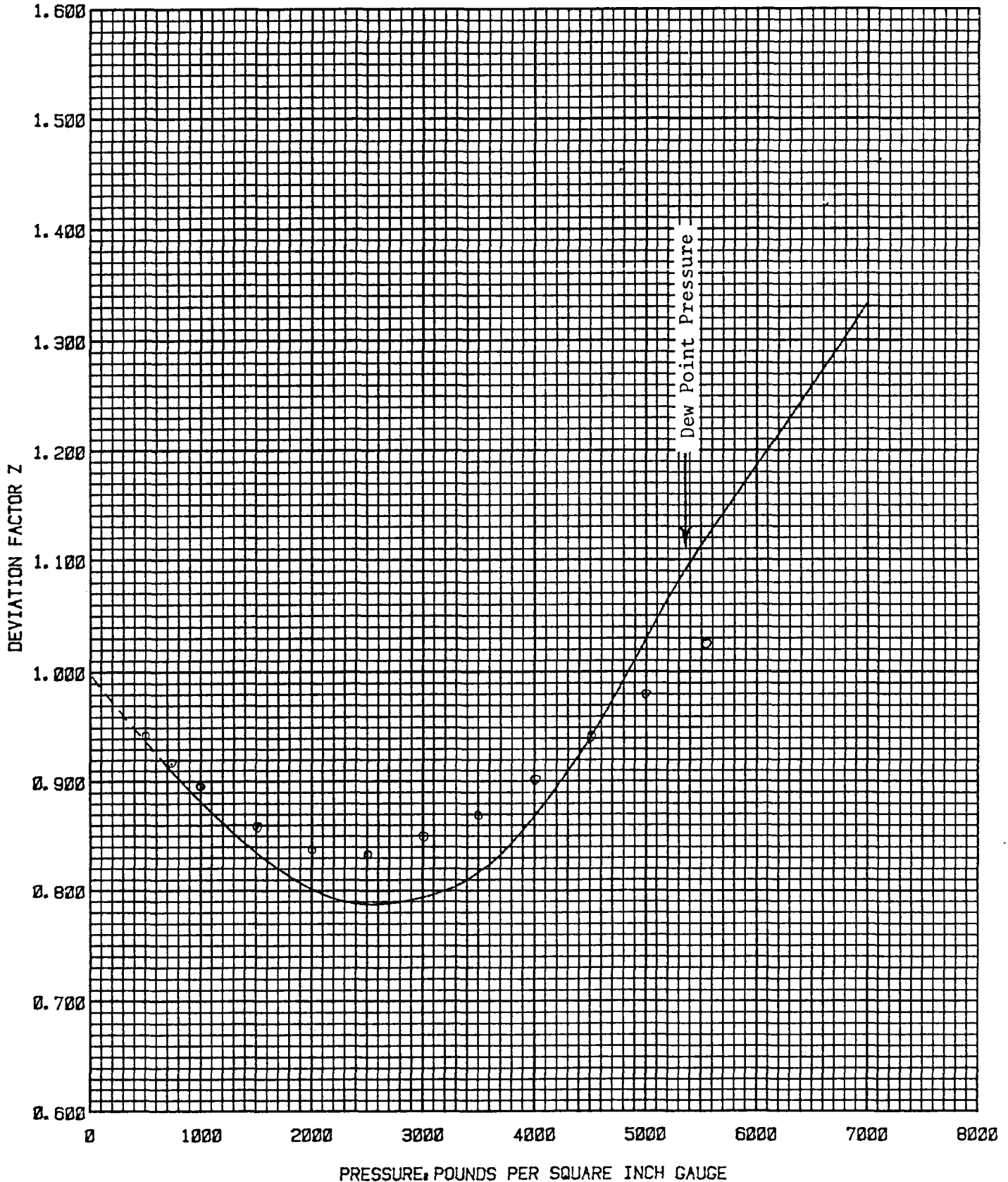
Well State UTP No. 1

RETROGRADE CONDENSATION DURING GAS DEPLETION AT 174°F.

<u>Pressure,</u> <u>PSIG</u>	<u>Retrograde Liquid Volume,</u> <u>Percent of Hydrocarbon Pore Space</u>
5368 Dew Point Pressure	0.0
5298	0.3
5200	1.1
5050	2.6
4850	6.2
4600	11.5
3800	21.4
3000	27.0
2100	27.6
1300	25.9
700	23.7
0	17.7

DEVIATION FACTOR Z OF WELL STREAM DURING DEPLETION AT 174°F.

Company	SANTE FE ENERGY COMPANY	Formation	MORROW
Well	STATE UTP NO. 1	County	LEA
Field	UNDESIGNATED	State	NEW MEXICO



VOLUME OF WELL STREAM PRODUCED DURING DEPLETION

Company SANTE FE ENERGY COMPANY

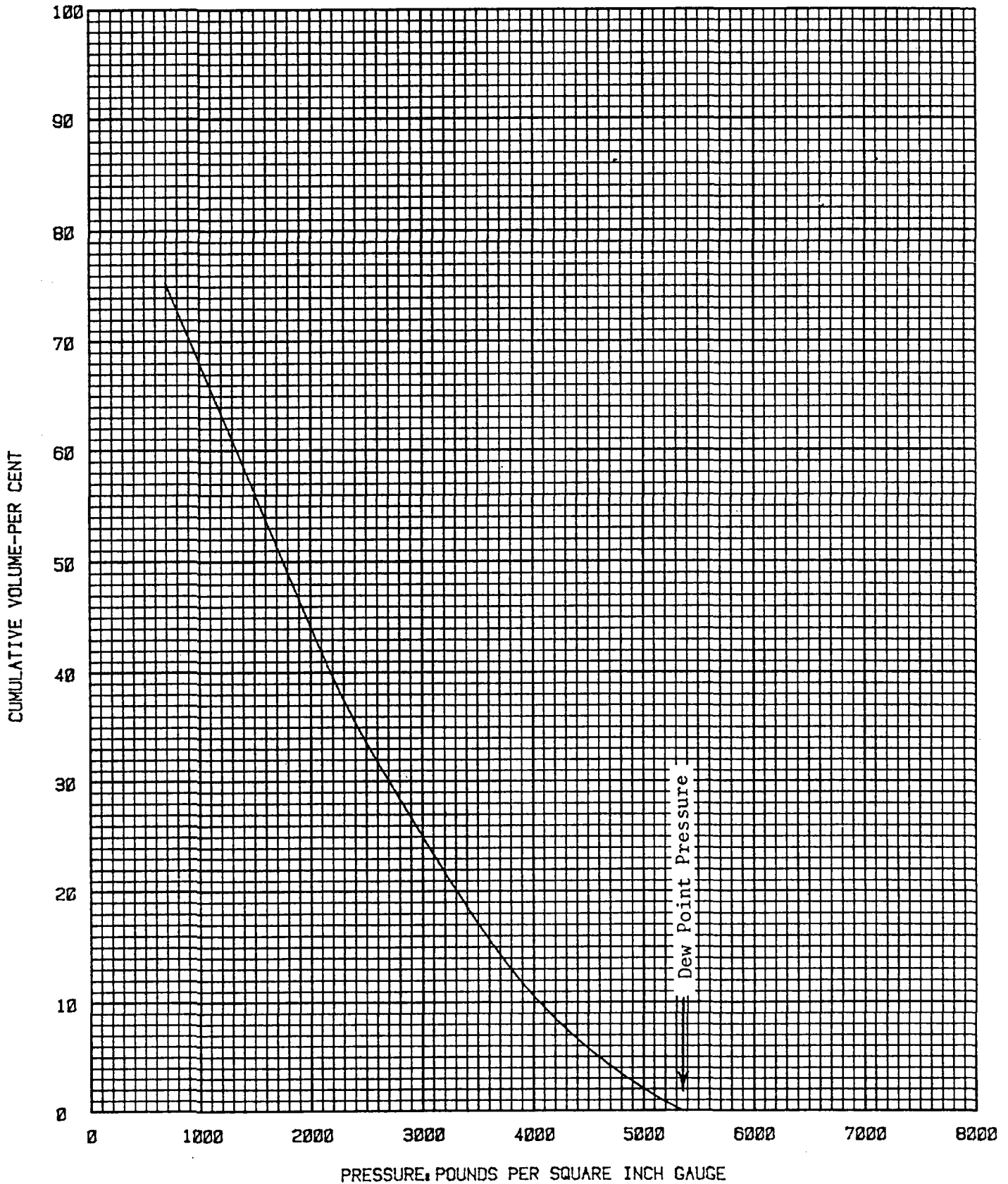
Formation MORROW

Well STATE UTP NO. 1

County LEA

Field UNDESIGNATED

State NEW MEXICO



CUMULATIVE RECOVERY DURING DEPLETION

Company SANTE FE ENERGY COMPANY

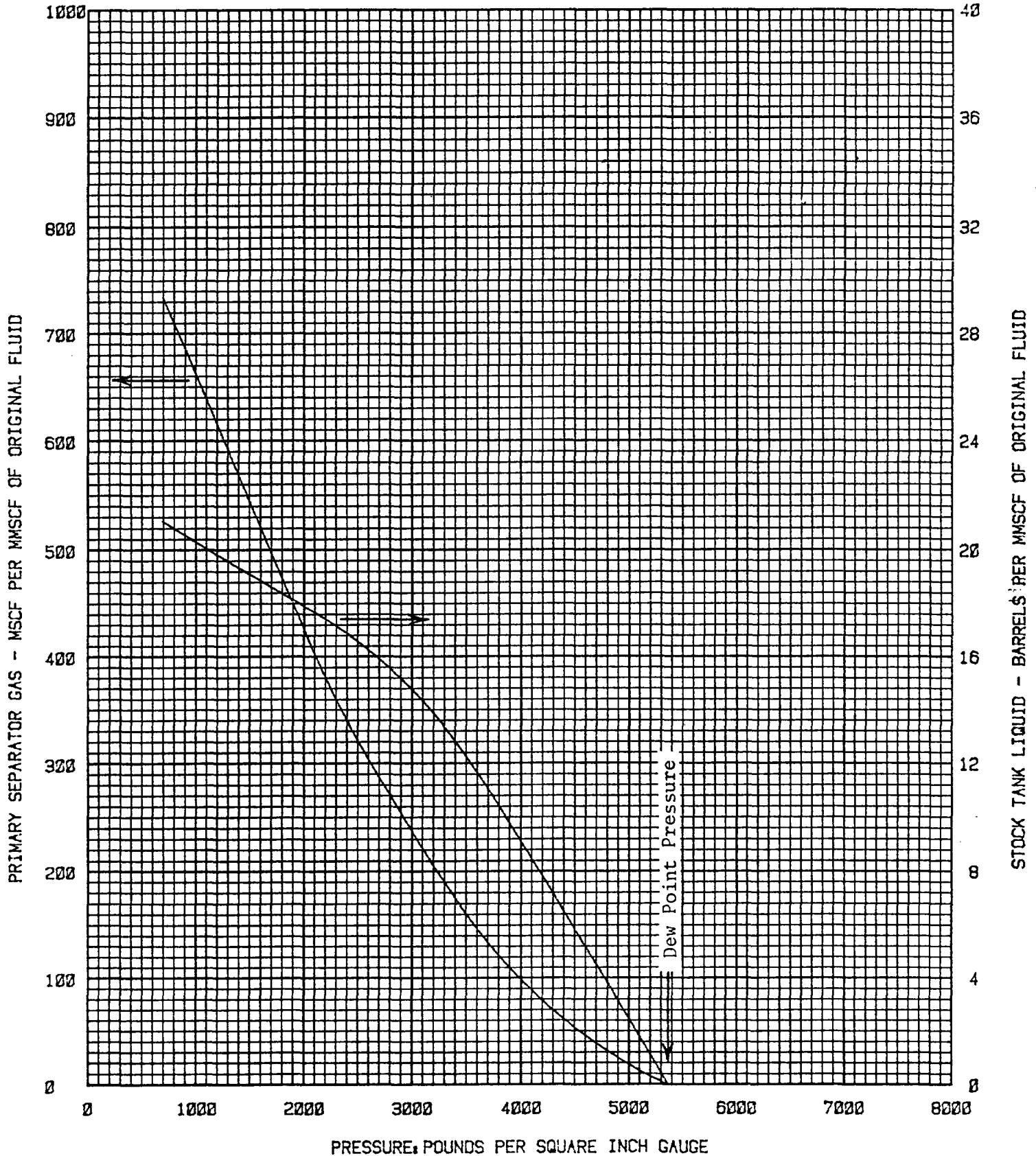
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CUMULATIVE RECOVERY-PLANT PRODUCTS IN PRIMARY SEPARATOR GAS

Company SANTE FE ENERGY COMPANY

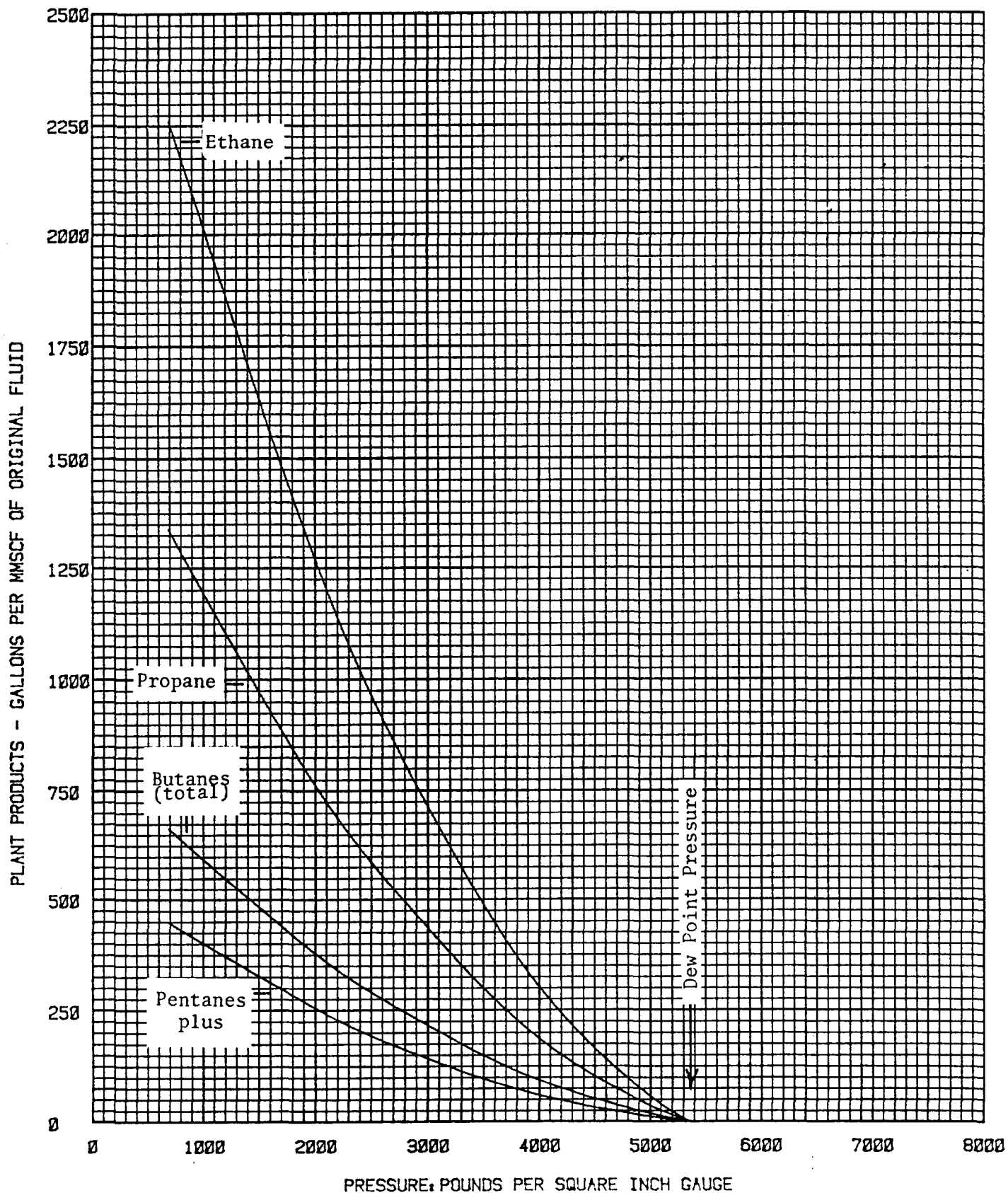
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State NEW MEXICO



RETROGRADE CONDENSATION DURING DEPLETION

Company	SANTE FE ENERGY COMPANY	Formation	MORROW
Well	STATE UTP NO. 1	County	LEA
Field	UNDESIGNATED	State	NEW MEXICO

