

Denne rapport  
tilhører



UND DOK.SENTER

L.NR. 92058123

KODE well 30/2-1-2049

Returneres etter bruk

Reservoir Fluid Study

UNIONOIL NORGE A/S

30/2-1 Well

DST No. 3

Wildcat

Norway

REF. 920180

Reservoir Fluid Study

UNIONOIL NORGE A/S

30/2-1 Well

DST No. 3

Wildcat

Norway

RFL 830180



July 1, 1983

CORE LABORATORIES, INC.



Unionoil Norge A/S  
Postboks 280  
4301 Sandnes  
Norway

P. L. Moses  
Manager  
Reservoir Fluid Analysis

Attention: Mr. V. E. Roe

Subject: Reservoir Fluid Study  
30/2-1 Well  
DST No. 3  
Wildcat  
Norway  
RFL 830180

Gentlemen:

Two separator gases and one separator liquid were collected from the Ness formation of the subject well by a representative of Flopetrol on October 7, 1982. The results of this study are presented in the following report.

As a quality check, the opening pressures of the separator gases and the ambient bubble point pressure of the separator liquid were determined in our laboratory. These results are tabulated on page two.

The producing gas/liquid ratio was 12603 cubic feet of gas at 14.696 psia and 60°F. per barrel of primary separator liquid at 920 psig and 156°F. The separator samples were recombined to this ratio and the resulting fluid was used for the study. The extended composition of the separator gas was determined by chromatography, and the composition of the separator liquid was determined through eicosanes plus by low temperature distillation, routine and temperature-programmed chromatography. These compositions were used with the producing ratio to calculate the well stream composition.

The heptanes fraction of the separator liquid was analyzed through heptadecanes with an octadecanes plus fraction by high temperature distillation. The density and the molecular weight were determined on the heptanes and heavier fractions. Since there was foaming and temperature fluctuation, the distillation could not be performed beyond heptadecanes. An atmospheric separator test at 73°F. was performed on the separator liquid.

A portion of the reservoir fluid was charged to a high pressure visual cell for pressure-volume measurements, and during the constant composition expansion at 300°F., the fluid indicated a retrograde dew point pressure of 7959 psig. The pressure-volume relations are shown on page seven.

A constant volume depletion was performed by making a series of expansions and constant pressure displacements, with each displacement terminating at the original saturated volume. The produced gas phase and the 700 psig liquid were charged to the low temperature distillation equipment for volume measurement and compositional analysis. The results of the constant volume depletion are presented on page eight.

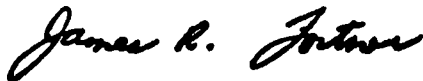
The smooth well stream compositions were used with published equilibrium ratios to calculate the cumulative and instantaneous surface recoveries, which may be expected during the depletion of the reservoir. These recoveries are based upon one MMSCF of original fluid and these results are presented on pages nine and ten.

Visual measurements of the retrograde condensate were performed during the constant volume depletion at the reservoir temperature of 300°F. The retrograde liquid volumes are shown on page eleven.

We thank you for the opportunity to be of service to Unionoil Norge A/S. Should you have any questions concerning the data, please do not hesitate to contact us.

Very truly yours,

CORE LABORATORIES, INC.



James R. Fortner  
Area Manager  
Reservoir Fluid Analysis

JRF:SW:mc  
15 cc: Addressee

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Company Unionoil Norge A/S Date Sampled October 7, 1982

Well 30/2-1, DST No. 3 State \_\_\_\_\_

Field Wildcat Country Norway

**FORMATION CHARACTERISTICS**

Formation Name	<u>Ness</u>
Date First Well Completed	_____
Original Reservoir Pressure	_____ PSIG @ _____ Ft.
Original Produced Gas/Liquid Ratio	_____ SCF/Bbl
Production Rate	_____ Bbls/Day
Separator Pressure and Temperature	_____ PSIG _____ °F.
Liquid Gravity at 60°F.	_____ °API
Datum	_____ Ft. Subsea

**WELL CHARACTERISTICS**

Elevation	_____ Ft.
Total Depth	_____ Ft.
Producing Interval	<u>12205-12231</u> Ft.
Tubing Size and Depth	<u>3-1/2</u> In. to _____ Ft.
Open Flow Potential	_____ MMSCF/Day
Last Reservoir Pressure	<u>9365</u> PSIG @ _____ Ft.
Date	_____
Reservoir Temperature	<u>300</u> °F. @ _____ Ft.
Status of Well	_____
Pressure Gauge	_____

**SAMPLING CONDITIONS**

Flowing Tubing Pressure on 3/4 inch choke	<u>3491</u>	PSIG
Flowing Bottom Hole Pressure	_____	PSIG
Primary Separator Pressure	<u>920</u>	PSIG
Primary Separator Temperature	<u>156</u>	°F.
Secondary Separator Pressure	_____	PSIG
Secondary Separator Temperature	_____	°F.
Field Stock Tank Liquid Gravity	_____	°API @ 60°F.
Primary Separator Gas Production Rate	<u>36012.3</u>	MSCF/Day
Pressure Base	<u>14.696</u>	PSIA
Temperature Base	<u>60</u>	°F.
Compressibility Factor (F <sub>pv</sub> )	<u>1.052</u>	
Gas Gravity (Laboratory)	<u>0.687</u>	
Gas Gravity Factor (F <sub>g</sub> )	<u>1.2065</u>	
Separator Liquid Production Rate @ 156°F.	<u>2857.5</u>	Bbls/Day
Primary Separator Gas/Separator Liquid Ratio	<u>12603</u>	SCF/Bbl
or	<u>79.35</u>	Bbls/MMSCF
Sampled by	<u>Flopetrol</u>	

REMARKS:

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Reservoir Fluid Analysis

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Well 30/2-1, DST No. 3

SUMMARY OF SAMPLES RECEIVED IN LABORATORY

Separator Gas

<u>Cylinder Number</u>	<u>Separator Conditions</u>		<u>Laboratory Opening Conditions</u>	
	<u>Pressure, PSIG</u>	<u>Temperature, °F.</u>	<u>Pressure, PSIG</u>	<u>Temperature, °F.</u>
A-14049	920	156	710	73
A-14056	920	156	780	73

Separator Liquid

<u>Cylinder Number</u>	<u>Separator Conditions</u>		<u>Laboratory Bubble Point Pressure</u>	
	<u>Pressure, PSIG</u>	<u>Temperature, °F.</u>	<u>Pressure, PSIG</u>	<u>Temperature, °F.</u>
8208516	920	156	710	73

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Well 30/2-1, DST No. 3

HYDROCARBON ANALYSES OF SEPARATOR PRODUCTS AND CALCULATED WELL STREAM

Component	Separator Liquid,	Separator Gas		Well Stream	
	Mol Percent	Mol Percent	GPM	Mol Percent	GPM
Hydrogen Sulfide	0.00	0.00		0.00	
Carbon Dioxide	1.43	3.73		3.59	
Nitrogen	0.01	0.46		0.43	
Methane	17.84	84.87		80.89	
Ethane	4.19	6.28	1.675	6.16	1.643
Propane	4.03	2.54	0.697	2.63	0.722
iso-Butane	1.00	0.36	0.118	0.40	0.130
n-Butane	2.61	0.70	0.220	0.81	0.255
iso-Pentane	1.97	0.29	0.106	0.39	0.142
n-Pentane	1.64	0.20	0.072	0.29	0.105
Hexanes	3.58	0.21	0.086	0.41	0.167
Heptanes	9.04	0.21	0.163*	0.73	2.566*
Octanes	12.09	0.10		0.80	
Nonanes	8.03	0.02		0.50	
Decanes	5.46	0.02		0.34	
Undecanes	3.86	0.01		0.24	
Dodecanes	3.12	0.00		0.19	
Tridecanes	3.10	0.00		0.18	
Tetradecanes	2.63	0.00		0.16	
Pentadecanes	2.31	0.00		0.14	
Hexadecanes	1.78	0.00		0.11	
Heptadecanes	1.52	0.00		0.09	
Octadecanes	1.44	0.00		0.09	
Nonadecanes	1.20	0.00		0.07	
Eicosanes plus	6.12	0.00		0.36	
	<u>100.00</u>	<u>100.00</u>	<u>3.137</u>	<u>100.00</u>	<u>5.730</u>

Properties of Heptanes plus

API gravity @ 60°F.	41.5	
Density, Gm/Cc @ 60°F.	0.8170	0.812
Molecular weight	171	98
		165

Calculated separator gas gravity (air=1.000) = 0.687  
 Calculated gross heating value for separator gas = 1117 BTU  
 per cubic foot of dry gas @ 14.696 psia and 60°F.

Primary separator gas collected @ 920 psig and 156°F.  
 Primary separator liquid collected @ 920 psig and 156°F.

Primary separator gas/separator liquid ratio = 12603 SCF/Bbl @ 156°F. (2245 Sm<sup>3</sup>/m<sup>3</sup>)  
 Primary separator gas/well stream ratio = 940.69 MSCF/MMSCF.

\*Heptanes plus

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Well 30/2-1, DST No. 3

HYDROCARBON ANALYSIS OF HEPTANES PLUS FRACTION OF SEPARATOR LIQUID SAMPLE\*

<u>Component</u>	<u>Weight Percent</u>	<u>Mol Percent</u>
Methyl-Cyclopentane	0.89	1.82
Benzene	0.85	1.87
Cyclohexane	1.66	3.39
Heptanes	4.40	7.57
Methyl-Cyclohexane	3.20	5.59
Toluene	2.87	5.32
Octanes	5.78	8.67
Ethylbenzene	0.46	0.75
Meta & Para Xylenes	2.42	3.91
Orthoxylene	0.63	1.01
Nonanes	5.50	7.35
iso-Propyl Benzene	0.15	0.22
n-Propyl Benzene	0.17	0.25
1,2,4 Trimethylbenzene	0.68	0.96
Decanes	6.17	7.42
Undecanes	5.72	6.26
Dodecanes	5.03	5.06
Tridecanes	5.40	5.02
Tetradecanes	4.93	4.26
Pentadecanes	4.64	3.74
Hexadecanes	3.82	2.89
Heptadecanes	3.47	2.47
Octadecanes	3.47	2.33
Nonadecanes	3.06	1.95
Eicosanes plus	<u>24.63</u>	<u>9.92</u>
	100.00	100.00

\*Temperature-programmed chromatography.



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Well 30/2-1, DST No. 3

HIGH TEMPERATURE DISTILLATION OF  
HEPTANES PLUS FRACTION OF SEPARATOR LIQUID

<u>Component</u>	<u>Mol Percent</u>	<u>Weight Percent</u>	<u>Density, Gm/Cc @ 60°F.</u>	<u>Molecular Weight</u>
Heptanes	12.73	6.96	0.7396	97
Octanes	15.27	8.96	0.7614	104
Nonanes	12.91	8.45	0.7751	116
Decanes	8.67	6.45	0.7793	132
Undecanes	6.84	5.67	0.7839	147
Dodecanes	5.01	4.52	0.7978	160
Tridecanes	5.11	4.95	0.8118	172
Tetradecanes	6.51	6.83	0.8340	186
Pentadecanes	3.15	3.65	0.8364	205
Hexadecanes	3.69	4.60	0.8369	221
Heptadecanes	2.82	3.73	0.8381	234
Octadecanes plus	<u>17.29</u>	<u>35.23</u>	0.8745	361
	100.00	100.00		

<u>Properties of Heptanes plus</u>	<u>Measured</u>	<u>Calculated</u>
Density @ 60°F. Gm/Cc	0.8170	0.8187
Gravity °API @ 60°F.	41.5	41.2
Molecular weight	171	177

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Well 30/2-1, DST No. 3

SEPARATOR TEST OF SEPARATOR LIQUID SAMPLE

<u>Separator Pressure, PSIG</u>	<u>Temp., °F.</u>	<u>Separator Gas/Oil Ratio(1)</u>	<u>Stock Tank Gas/Oil Ratio(1)</u>	<u>Tank Oil Gravity, °API @ 60°F.</u>	<u>Shrinkage Factor Vr/Vsat(2)</u>	<u>Formation Volume Factor(3)</u>	<u>Gas Gravity</u>
0	73	310		44.3	0.8217	1.217	1.006

- (1) Separator and Stock Tank Gas/Oil Ratio in cubic feet of gas @ 60°F. and 14.696 psia per barrel of stock tank oil @ 60°F.
- (2) Shrinkage Factor: Vr/Vsat is barrels of stock tank oil @ 60°F. per barrel of saturated oil @ 920 psig and 156°F.
- (3) Formation Volume Factor is barrels of saturated oil at 920 psig and 156°F. per barrel of stock tank oil at 60°F.

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Well 30/2-1, DST No. 3

PRESSURE-VOLUME RELATIONS OF RESERVOIR FLUID AT 300°F.  
(Constant Composition Expansion)

Pressure, PSIG	Relative Volume	Deviation Factor, Z
9500	0.9276	1.441
9365 Reservoir Pressure	0.9331	1.428*
9000	0.9478	1.394
8500	0.9710	1.349
8200	0.9869	1.323
8100	0.9922	1.314
8000	0.9981	1.305
7959 Dew Point	1.0000	1.301**
7900	1.0027	
7800	1.0091	
7650	1.0185	
7450	1.0314	
7200	1.0490	
6900	1.0722	
6600	1.0976	
6300	1.1267	
6000	1.1587	
5500	1.2223	
5000	1.3022	
4500	1.4038	
4000	1.5342	
3500	1.7130	
3000	1.9615	
2682	2.1705	
2199	2.6230	
1879	3.0549	
1550	3.7070	
1318	4.3587	
1098	5.2358	
880	6.5410	

\*Gas Expansion Factor = 1.717 MCF/Bbl.

\*\*Gas Expansion Factor = 1.602 MCF/Bbl.

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Reservoir Fluid Analysis

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Well 30/2-1, DST No. 3

DEPLETION STUDY AT 300°F.

Hydrocarbon Analyses of Produced Well Stream - Mol Percent

Component	Reservoir Pressure - PSIG					
	7959	6800	5400	4000	2500	700*
Hydrogen Sulfide	0.00	0.00	0.00	0.00	0.00	0.00
Carbon Dioxide	3.59	3.58	3.57	3.57	3.61	3.78
Nitrogen	0.43	0.43	0.44	0.45	0.45	0.42
Methane	80.89	81.31	81.90	82.52	83.13	81.96
Ethane	6.16	6.14	6.12	6.11	6.19	6.43
Propane	2.63	2.60	2.54	2.51	2.55	2.87
iso-Butane	0.40	0.39	0.38	0.37	0.37	0.45
n-Butane	0.81	0.79	0.76	0.75	0.75	0.90
iso-Pentane	0.39	0.37	0.35	0.34	0.34	0.45
n-Pentane	0.29	0.27	0.26	0.25	0.25	0.34
Hexanes	0.41	0.39	0.37	0.36	0.34	0.46
Heptanes plus	4.00	3.73	3.31	2.77	2.02	1.94
	100.00	100.00	100.00	100.00	100.00	100.00

Molecular weight of heptanes plus 165  
Density of heptanes plus 0.812

114 120 128 138 144 155 165 172 180 190 200 210 217 220 230 240 250 260 270 280 290 300 310 320 330 340 350 360 370 380 390 400 410 420 430 440 450 460 470 480 490 500 510 520 530 540 550 560 570 580 590 600 610 620 630 640 650 660 670 680 690 700 710 720 730 740 750 760 770 780 790 800 810 820 830 840 850 860 870 880 890 900 910 920 930 940 950 960 970 980 990 1000

Deviation Factor - Z

Equilibrium gas	1.301	1.196	1.087	1.004	0.953	0.972
Two-phase	1.301	1.199	1.090	1.005	0.955	0.936

Well Stream produced-

Cumulative percent of initial	0.000	7.234	18.938	34.827	57.027	79.148	87.538
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\*Experimental composition of equilibrium liquid phase.

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Well 30/2-1, DST No. 3

CALCULATED CUMULATIVE RECOVERY DURING DEPLETION

Cumulative Recovery per MMSCF of Original Fluid	Initial in Place	Reservoir Pressure - PSIG						
		7959	6800	5400	4000	2500	1200	700
Well Stream - MSCF	1000	0	72.34	189.38	348.27	570.27	791.48	875.38
Normal Temperature Separation*								
Stock Tank Liquid - Barrels	60.24	0	3.85	8.83	14.05	18.86	22.83	
Primary Separator Gas-MSCF	938.28	0	68.23	179.47	331.91	547.64	763.40	
Stock Tank Gas - MSCF	19.75	0	1.31	3.15	5.20	7.20	8.99	
Total "Plant Products" in Primary Separator Gas - Gallons								
Ethane	1561	0	113	296	547	905	1272	
Propane	648	0	47	122	224	372	531	
Butanes (total)	315	0	23	59	108	180	261	
Pentanes plus	411	0	29	77	143	241	347	
Total "Plant Products" in Stock Tank Gas - Gallons								
Ethane	76	0	5	12	20	28	34	
Propane	57	0	4	9	15	21	26	
Butanes (total)	36	0	2	6	9	13	17	
Pentanes plus	29	0	2	5	8	11	14	
Total "Plant Products" in Well Stream - Gallons								
Ethane	5,730	0	5,397	4,901	4,480	4,058	4,064	4,310
Propane	4,087	0	3,759	3,269	2,850	2,407	2,373	2,595
Butanes (total)	3,365	0	3,045	2,572	2,162	1,707	1,623	1,808
Pentanes plus	2,980	0	2,670	2,209	1,805	1,350	1,229	1,378

\*Primary separator at 920 psig and 155°F., stock tank at 70°F.

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Well 30/2-1, DST No. 3

CALCULATED INSTANTANEOUS RECOVERY DURING DEPLETION

	Reservoir Pressure - PSIG			
	7959	6800	5400	4000
			2500	1200
				700
<u>Normal Temperature Separation</u>				
Stock Tank Liquid Gravity, °API at 60°F.	45.9	48.3	52.0	54.4
Separator Gas/Well Stream Ratio, MSCF/MMSCF				56.3
Primary Separator Gas Only	938.28	943.16	950.44	959.43
Primary Separator and Stock Tank Gases	958.02	961.28	966.18	972.30
Separator Gas/Stock Tank Liquid Ratio, SCF/STB				
Primary Separator Gas Only	15576	17737	22335	29165
Primary Separator and Stock Tank Gases	15903	18078	22705	29557
				44847
				45264
				54466
				54917

GPM from Smooth Well Stream Compositions

Ethane plus	1643	118	310	568	935	1309	1453
Propane plus	722	52	133	243	398	564	630
Butanes plus	385	27	70	126	205	293	329
Pentanes plus	2980	193	452	738	1038	1310	1426

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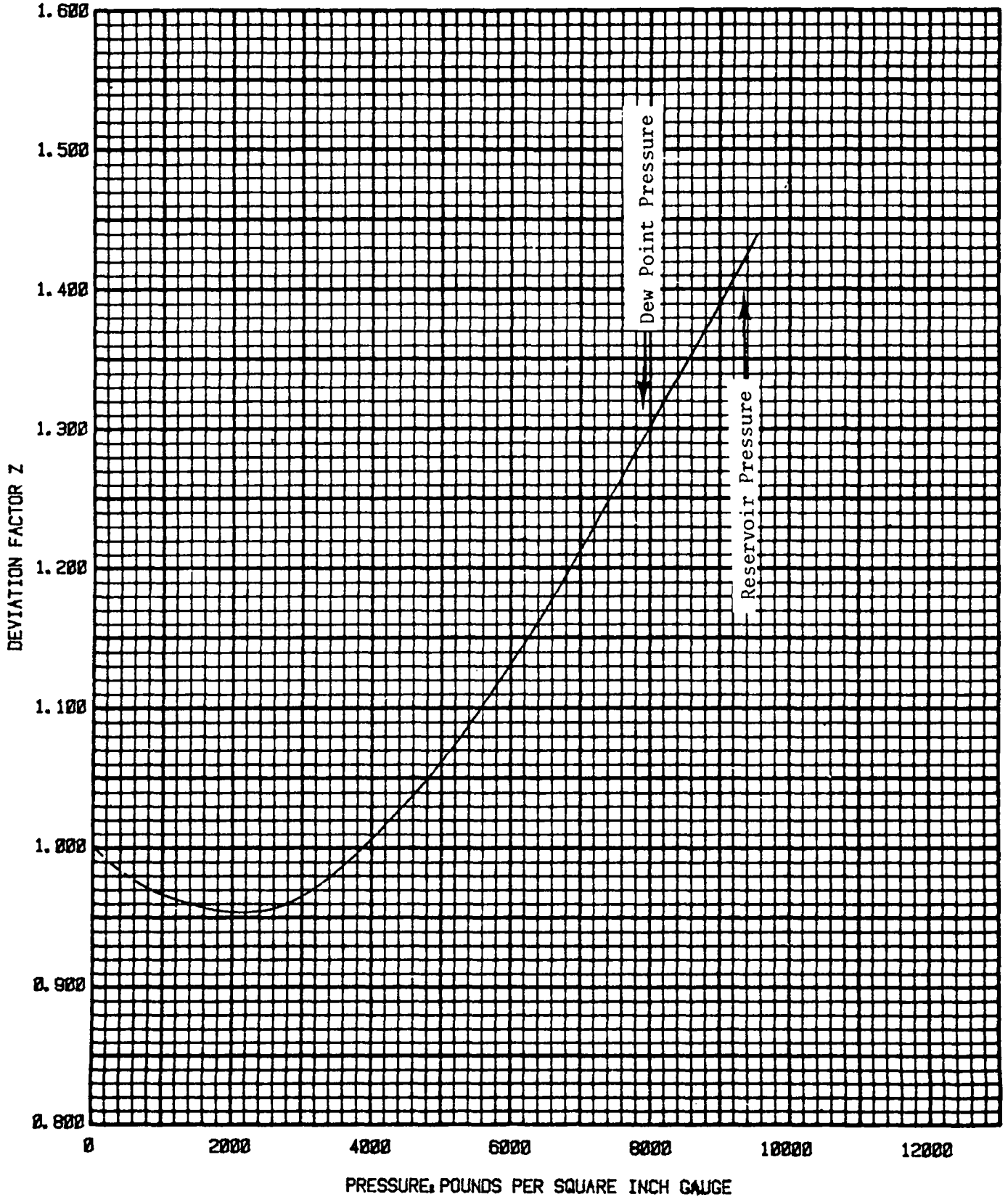
Well 30/2-1, DST No. 3

RETROGRADE CONDENSATION DURING GAS DEPLETION AT 300°F.

<u>Pressure,</u> <u>PSIG</u>	<u>Retrograde Liquid Volume,</u> <u>Percent of Hydrocarbon Pore Space</u>
7959 Dew Point	0.0
<u>7900</u>	0.1
7800	0.2
7650	0.3
7450	0.4
7200	0.6
6900	0.9
6800 First Depletion Pressure	1.0
5400	3.4
4000	5.4
2500	7.0
1200	7.2
700	6.8
0	6.2

DEVIATION FACTOR Z OF WELL STREAM DURING DEPLETION AT 300°F.

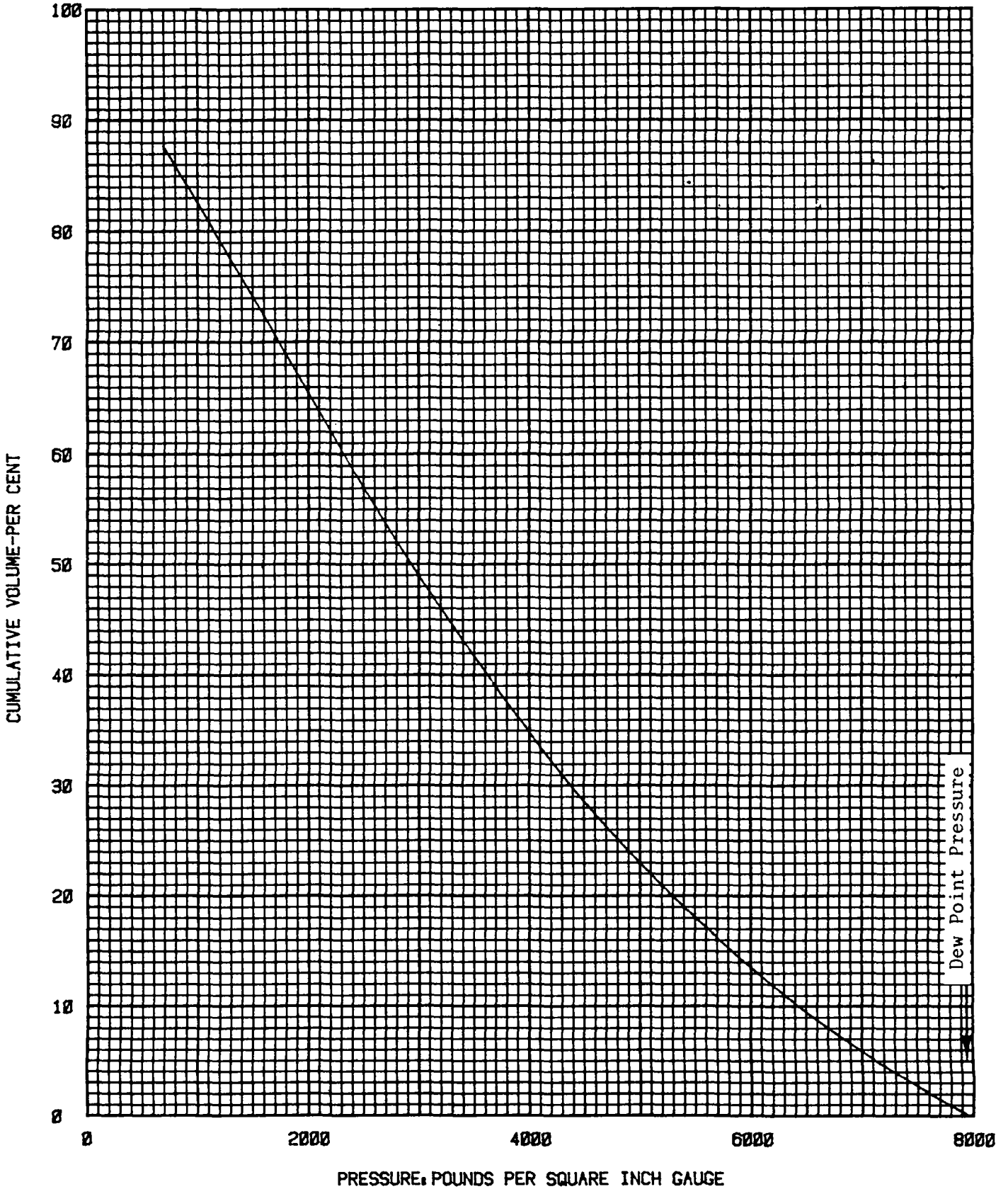
Company UNIONOIL NORGE A/S Formation NESS  
 Well 30/2-1 DST NO. 3 State \_\_\_\_\_  
 Field WILDCAT Country NORWAY





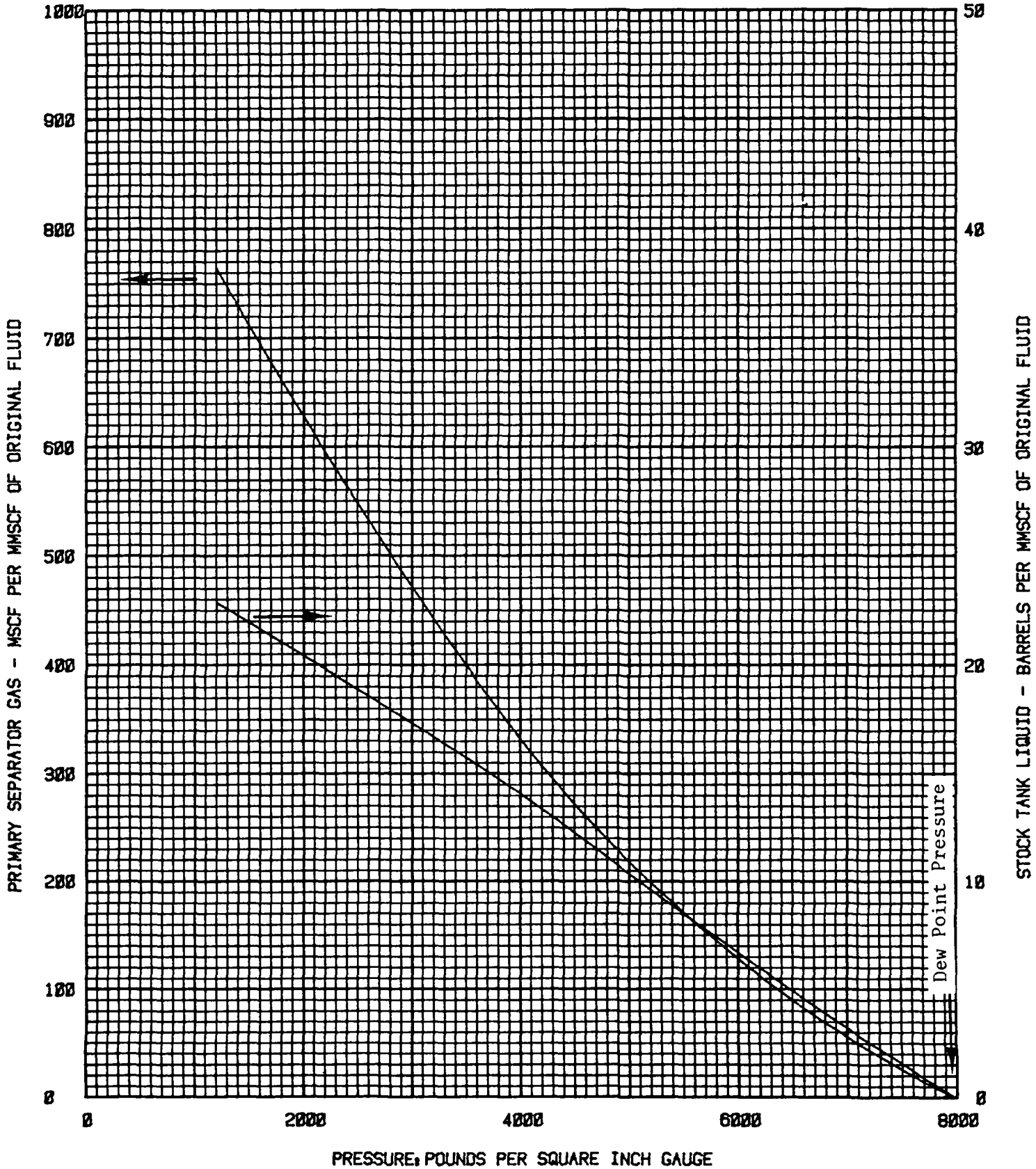
VOLUME OF WELL STREAM PRODUCED DURING DEPLETION

Company UNIONOIL NORGE A/S Formation NESS  
Well 30/2-1 DST NO. 3 State \_\_\_\_\_  
Field WILDCAT Country NORWAY



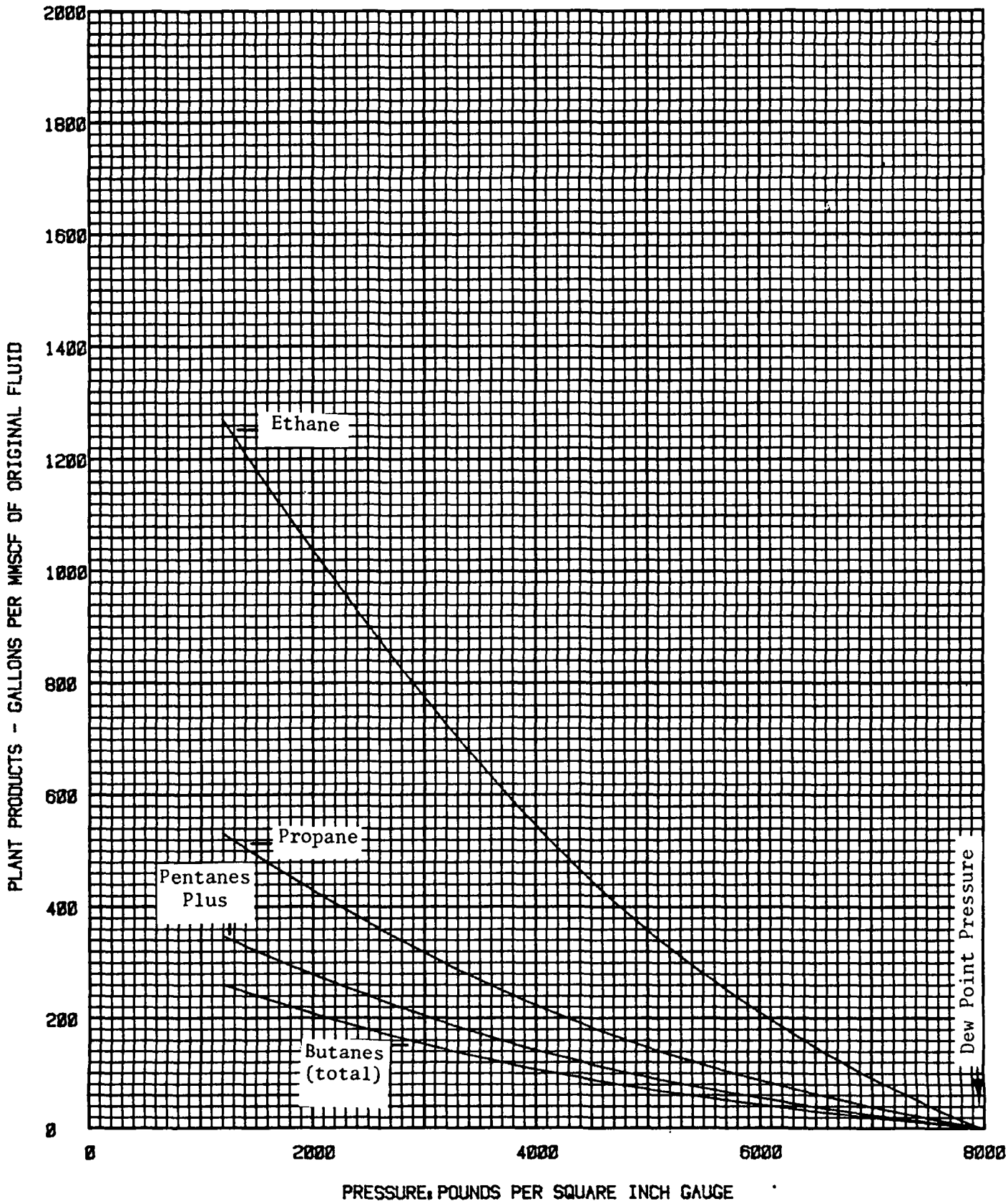
CUMULATIVE RECOVERY DURING DEPLETION

Company UNIONOIL NORGE A/S Formation NESS  
 Well 30/2-1 DST NO. 3 State \_\_\_\_\_  
 Field WILDCAT Country NORWAY



CUMULATIVE RECOVERY-PLANT PRODUCTS IN PRIMARY SEPARATOR GAS

Company UNIONOIL NORGE A/S Formation NESS  
 Well 30/2-1 DST NO. 3 State \_\_\_\_\_  
 Field WILDCAT Country NORWAY



RETROGRADE CONDENSATION DURING DEPLETION

Company UNIONOIL NORGE A/S Formation NESS  
Well 30/2-1 DST NO. 3 State \_\_\_\_\_  
Field WILDCAT Country NORWAY

