

Denne rapport
tilhører



UND DOK.SENTER

L.NR. 92058073

KODE well 30/2-1 nr 35

Returneres etter bruk

Reservoir Fluid Study

UNIONOIL NORGE A/S

30/2-1 Well

DST No. 2

Wildcat

Norway

RFL 830161

Reservoir Fluid Study

UNIONOIL NORGE A/S

30/2-1 Well

DST No. 2

Wildcat

Norway

RFL 830161



CORE LABORATORIES, INC.



June 20, 1983

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. 2
Wildcat
Norway
RFL 830161

Gentlemen:

One separator liquid and two separator gases were collected on September 30, 1982 from the subject well by a representative of Flopetrol. Presented in the following report are the results of this study.

As a quality check, the opening pressures of the separator gases and the ambient bubble point pressure of the separator liquid was determined in our laboratory. The gases had opening pressures of 670 psig and 740 psig and the separator liquid indicated a bubble point pressure of 720 psig at 73°F.

The producing gas/liquid ratio was 10270 cubic feet of gas at 14.696 psia and 60°F. per barrel of primary separator liquid at 905 psig and 133°F. This ratio was corrected with the factors shown on page one. The separator samples were recombined to this ratio and the resulting fluid was used for the study. The separator liquid was analyzed through eicosanes plus by low temperature distillation and temperature-programmed chromatography. The extended composition of the separator products was used in conjunction with the producing gas/liquid ratio to calculate the well stream composition.

The heptanes plus fraction of the separator liquid was analyzed through eicosanes plus by high temperature distillation. The density and the molecular weight were determined on the heptanes and heavier fractions. The separator liquid was also subjected to an atmospheric flash at 70°F.

A small portion of the reservoir fluid was charged to a high pressure visual cell and thermally expanded to the reservoir temperature of 300°F. During the constant composition expansion at this temperature, the fluid exhibited a retrograde dew point at 7871 psig. The results of the pressure-volume relations at 300°F. are presented on page six.

A large portion of the reservoir fluid was charged to a high pressure visual cell and the volume was determined at the dew point pressure. The constant volume depletion consisted of a series of expansions and constant pressure displacements terminating at the original saturated volume. The produced gas phase was charged to the low temperature distillation equipment for analysis and volume measurements. The results of the depletion are presented on page seven.

Published equilibrium ratios were used with the smooth well stream compositions to calculate the cumulative and instantaneous surface recoveries that may be expected during the pressure depletion of the reservoir. These recoveries are based upon one MMSCF of original fluid and these results are presented on page eight.

Measurements of the retrograde condensate were performed at several points during the constant volume depletion at the reservoir temperature. The maximum observed volume of retrograde condensate was 8.6 percent of the hydrocarbon pore space. These results are shown on page ten.

We appreciate the opportunity to be of service to Unionoil Norge S/A. 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:bt
15 cc: Addressee

CORE LABORATORIES, INC.
Reservoir Fluid Analysis

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Company Unionoil Norge A/S Date Sampled September 30, 1982
Well 30/2-1, DST No. 2 State _____
Field Wildcat Country Norway

FORMATION CHARACTERISTICS

Formation Name	<u>Etive</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	<u>13451</u> Ft.
Producing Interval	<u>12339-12372</u> Ft.
Tubing Size and Depth	<u>3-1/2</u> In. to _____ Ft.
Open Flow Potential	_____ MMSCF/Day
Last Reservoir Pressure	<u>9807</u> PSIG @ _____ Ft.
Date	_____
Reservoir Temperature	<u>300</u> °F. @ _____ Ft.
Status of Well	_____
Pressure Gauge	_____

SAMPLING CONDITIONS

Flowing Tubing Pressure	_____ PSIG
Flowing Bottom Hole Pressure	_____ PSIG
Primary Separator Pressure	<u>905</u> PSIG
Primary Separator Temperature	<u>133</u> °F.
Secondary Separator Pressure	_____ PSIG
Secondary Separator Temperature	_____ °F.
Field Stock Tank Liquid Gravity	_____ °API @ 60°F.
Primary Separator Gas Production Rate	<u>25617.3</u> MSCF/Day
Pressure Base	<u>14.696</u> PSIA
Temperature Base	<u>60</u> °F.
Compressibility Factor (F _{PV})	<u>1.048</u>
Gas Gravity (Laboratory)	<u>0.682</u>
Gas Gravity Factor (F _G)	<u>1.2109</u>
Separator Liquid Production Rate @ 60°F.	<u>2494.5</u> Bbls/Day
Primary Separator Gas/Separator Liquid Ratio	<u>10270</u> SCF/Bbl
	or <u>97.37</u> Bbls/MMSCF
Sampled by	<u>Flop petrol</u>

REMARKS:

Gas cylinders: A-14072, A-14055
Liquid cylinder: 8207521

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Reservoir Fluid Analysis

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Well 30/2-1, DST No. 2

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	1.52		3.63		3.47	
Nitrogen	0.03		0.42		0.39	
Methane	18.78		85.12		80.19	
Ethane	5.25		6.36	1.697	6.28	1.675
Propane	5.12		2.56	0.703	2.75	0.755
iso-Butane	1.28		0.36	0.118	0.43	0.140
n-Butane	3.20		0.69	0.217	0.88	0.277
iso-Pentane	1.63		0.20	0.073	0.31	0.113
n-Pentane	2.08		0.21	0.076	0.35	0.126
Hexanes	5.00		0.17	0.069	0.53	0.216
Heptanes	7.88		0.17	0.127*	0.74	2.935*
Octanes	11.14		0.08		0.90	
Nonanes	7.17		0.02		0.55	
Decanes	4.85		0.01		0.37	
Undecanes	3.37		Trace		0.25	
Dodecanes	2.71				0.20	
Tridecanes	2.76				0.20	
Tetradecanes	2.31				0.17	
Pentadecanes	2.05				0.15	
Hexadecanes	1.59				0.12	
Heptadecanes	1.36				0.10	
Octadecanes	1.30				0.10	
Nonadecanes	1.08				0.08	
Eicosanes plus	6.54				0.49	
	<u>100.00</u>		<u>100.00</u>	<u>3.080</u>	<u>100.00</u>	<u>6.234</u>

Properties of Heptanes plus

API gravity @ 60°F.	41.3		
Density, Gm/Cc @ 60°F.	0.8180		0.813
Molecular weight	176	96	171

Calculated separator gas gravity (air=1.000) = 0.682
 Calculated gross heating value for separator gas = 1111 BTU
 per cubic foot of dry gas @ 14.696 psia and 60°F.

Primary separator gas collected @ 905 psig and 133°F.
 Primary separator liquid collected @ 905 psig and 133°F.

Primary separator gas/separator liquid ratio = 10270 SCF/Bbl @ 133°F. (1829 Sm³/m³)
 Primary separator gas/well stream ratio = 925.91 MSCF/MMSCF.

*Heptanes plus

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Well 30/2-1, DST No. 2

HYDROCARBON ANALYSIS OF HEPTANES PLUS FRACTION OF SEPARATOR LIQUID SAMPLE*

<u>Component</u>	<u>Weight Percent</u>	<u>Mol Percent</u>
Methyl-Cyclopentane	0.52	1.08
Benzene	0.65	1.47
Cyclohexane	1.72	3.60
Heptanes	4.49	7.90
Methyl-Cyclohexane	3.21	5.76
Toluene	2.79	5.34
Octanes	5.68	8.76
Ethylbenzene	0.45	0.74
Meta & Para Xylenes	2.29	3.81
Orthoxylene	0.60	1.00
Nonanes	5.26	7.23
iso-Propyl Benzene	0.16	0.23
n-Propyl Benzene	0.15	0.21
1,2,4 Trimethylbenzene	0.63	0.93
Decanes	5.86	7.27
Undecanes	5.32	6.01
Dodecanes	4.66	4.83
Tridecanes	5.13	4.91
Tetradecanes	4.62	4.11
Pentadecanes	4.41	3.66
Hexadecanes	3.65	2.84
Heptadecanes	3.32	2.42
Octadecanes	3.34	2.32
Nonadecanes	2.95	1.93
Eicosanes plus	28.14	11.64
	<u>100.00</u>	<u>100.00</u>

*Temperature-programmed chromatography.

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Well 30/2-1, DST No. 2

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	14.98	8.31	0.7387	96
Octanes	16.25	9.48	0.7601	101
Nonanes	12.11	7.91	0.7760	113
Decanes	9.02	6.67	0.7789	128
Undecanes	6.14	5.11	0.7832	144
Dodecanes	5.37	4.87	0.7959	157
Tridecanes	6.38	6.38	0.8149	173
Tetradecanes	3.96	4.28	0.8330	187
Pentadecanes	3.12	3.67	0.8348	204
Hexadecanes	3.63	4.64	0.8370	221
Heptadecanes	2.28	3.21	0.8388	244
Octadecanes	2.09	3.02	0.8413	250
Nonadecanes	1.91	2.91	0.8503	264
Eicosanes plus	<u>12.76</u>	<u>29.55</u>	0.8791	401
	100.00	100.00		

<u>Properties of Heptanes plus</u>	<u>Measured</u>	<u>Calculated</u>
Density @ 60°F. Gm/Cc	0.8180	0.8165
Gravity °API @ 60°F.	41.3	41.6
Molecular weight	176	173

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Well 30/2-1, DST No. 2

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	70	344		45.0	0.8210	1.218	1.044

- (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 @ 905 psig and 133°F.
- (3) Formation Volume Factor is barrels of saturated oil at 905 psig and 133°F. per barrel of stock tank oil at 60°F.

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Well 30/2-1, DST No. 2

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

<u>Pressure,</u> <u>PSIG</u>	<u>Relative</u> <u>Volume</u>	<u>Deviation Factor,</u> <u>Z</u>
10000	0.9062	1.470
9807 Reservoir Pressure	0.9134	1.453*
9500	0.9241	1.424
9000	0.9438	1.378
8500	0.9660	1.332
8300	0.9758	1.314
8100	0.9873	1.297
7950	0.9940	1.282
7871 Dew Point	1.0000	1.277**
7800	1.0038	
7650	1.0128	
7450	1.0251	
7200	1.0419	
6900	1.0644	
6600	1.0892	
6300	1.1166	
6000	1.1480	
5700	1.1836	
5400	1.2232	
5100	1.2701	
4800	1.3224	
4500	1.3851	
4200	1.4576	
3900	1.5443	
3600	1.6477	
3300	1.7739	
3000	1.9293	
2700	2.1236	
2400	2.3703	
2100	2.6986	
1800	3.1336	
1538	3.6663	
1302	4.3386	
1082	5.2307	
867	6.5535	

*Gas Expansion Factor = 1.767 MCF/Bbl.

**Gas Expansion Factor = 1.614 MCF/Bbl.

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Well 30/2-1, DST No. 2

DEPLETION STUDY AT 300°F.

Hydrocarbon Analyses of Produced Well Stream - Mol Percent

Component	Reservoir Pressure - PSIG							
	7871	6800	5400	4000	2500	1200	700	700*
Hydrogen Sulfide	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Carbon Dioxide	3.47	3.46	3.45	3.44	3.49	3.61	3.70	0.69
Nitrogen	0.39	0.39	0.40	0.40	0.41	0.40	0.37	0.04
Methane	80.19	80.73	81.35	82.07	82.57	82.24	81.45	13.24
Ethane	6.28	6.22	6.20	6.18	6.38	6.48	6.59	2.46
Propane	2.75	2.71	2.67	2.63	2.69	2.85	2.98	2.01
iso-Butane	0.43	0.42	0.41	0.40	0.40	0.45	0.47	0.49
n-Butane	0.88	0.86	0.83	0.82	0.81	0.91	0.98	1.18
iso-Pentane	0.31	0.30	0.29	0.28	0.28	0.31	0.34	0.63
n-Pentane	0.35	0.33	0.32	0.31	0.30	0.35	0.39	0.81
Hexanes	0.53	0.51	0.49	0.47	0.45	0.49	0.55	2.06
Heptanes plus	4.42	4.07	3.59	3.00	2.22	1.91	2.18	76.39
	<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>	<u>100.00</u>
Molecular weight of heptanes plus	171	156	141	131	121	114	111	227
Density of heptanes plus	0.813	0.803	0.789	0.779	0.769	0.762	0.759	0.851
Deviation Factor - Z								
Equilibrium gas	1.277	1.180	1.061	0.978	0.938	0.954	0.970	
Two-phase	1.277	1.182	1.076	0.990	0.936	0.922	0.911	
Well Stream produced-								
Cumulative percent of initial	0.000	6.623	18.479	34.336	56.485	78.657	87.296	

*Experimental composition of equilibrium liquid phase.

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Well 30/2-1, DST No. 2

CALCULATED CUMULATIVE RECOVERY DURING DEPLETION

Cumulative Recovery per MMSCF of Original Fluid	Initial in Place	Reservoir Pressure - PSIG						
		7871	6800	5400	4000	2500	1200	700
<u>Well Stream - MSCF</u>	1000	0	66.23	184.79	343.36	564.85	786.57	872.96
<u>Normal Temperature Separation*</u>								
Stock Tank Liquid - Barrels	70.35	0	3.96	9.69	15.64	21.23	25.84	
Primary Separator Gas-MSCF	926.13	0	61.77	173.38	324.31	538.12	753.07	
Stock Tank Gas - MSCF	25.82	0	1.55	3.97	6.63	9.34	11.80	
<u>Total "Plant Products" in Primary Separator Gas - Gallons</u>								
Ethane	1565	0	103	289	540	905	1278	
Propane	652	0	43	120	225	377	541	
Butanes (total)	315	0	21	58	109	184	269	
Pentanes plus	389	0	26	73	139	235	339	
<u>Total "Plant Products" in Stock Tank Gas - Gallons</u>								
Ethane	103	0	6	16	26	37	47	
Propane	82	0	5	13	21	30	38	
Butanes (total)	56	0	3	9	14	20	26	
Pentanes plus	43	0	3	7	11	16	21	
<u>Total "Plant Products" in Well Stream - Gallons</u>								
Ethane	1675	0	110	306	567	944	1327	1479
Propane	755	0	49	136	251	414	588	658
Butanes (total)	417	0	27	74	135	221	317	356
Pentanes plus	3390	0	194	484	801	1132	1430	1559

*Primary separator at 910 psig and 135°F., stock tank at 70°F.

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Well 30/2-1, DST No. 2

CALCULATED INSTANTANEOUS RECOVERY DURING DEPLETION

	Reservoir Pressure - PSIG						
	7871	6800	5400	4000	2500	1200	700
<u>Normal Temperature Separation*</u>							
Stock Tank Liquid Gravity, °API at 60°F.	46.2	48.6	51.9	54.4	57.2	59.6	
Separator Gas/Well Stream Ratio, MSCF/MMSCF	926.13	932.68	941.35	951.81	965.33	969.48	
Primary Separator Gas Only	951.95	956.14	961.75	968.59	977.57	980.56	
Primary Separator and Stock Tank Gases							
Separator Gas/Stock Tank Liquid Ratio, SCF/STB	13165	15606	19481	25354	38276	46578	
Primary Separator Gas Only	13533	15998	19903	25800	38761	47110	
Primary Separator and Stock Tank Gases							

GPM from Smooth Well Stream Compositions

Ethane plus	6.237	5.742	5.227	4.756	4.322	4.284	4.532
Propane plus	4.562	4.083	3.573	3.108	2.620	2.556	2.774
Butanes plus	3.807	3.340	2.841	2.386	1.881	1.774	1.957
Pentanes plus	3.390	2.932	2.446	1.998	1.496	1.341	1.495

*Primary separator at 910 psig and 135°F., stock tank at 70°F.

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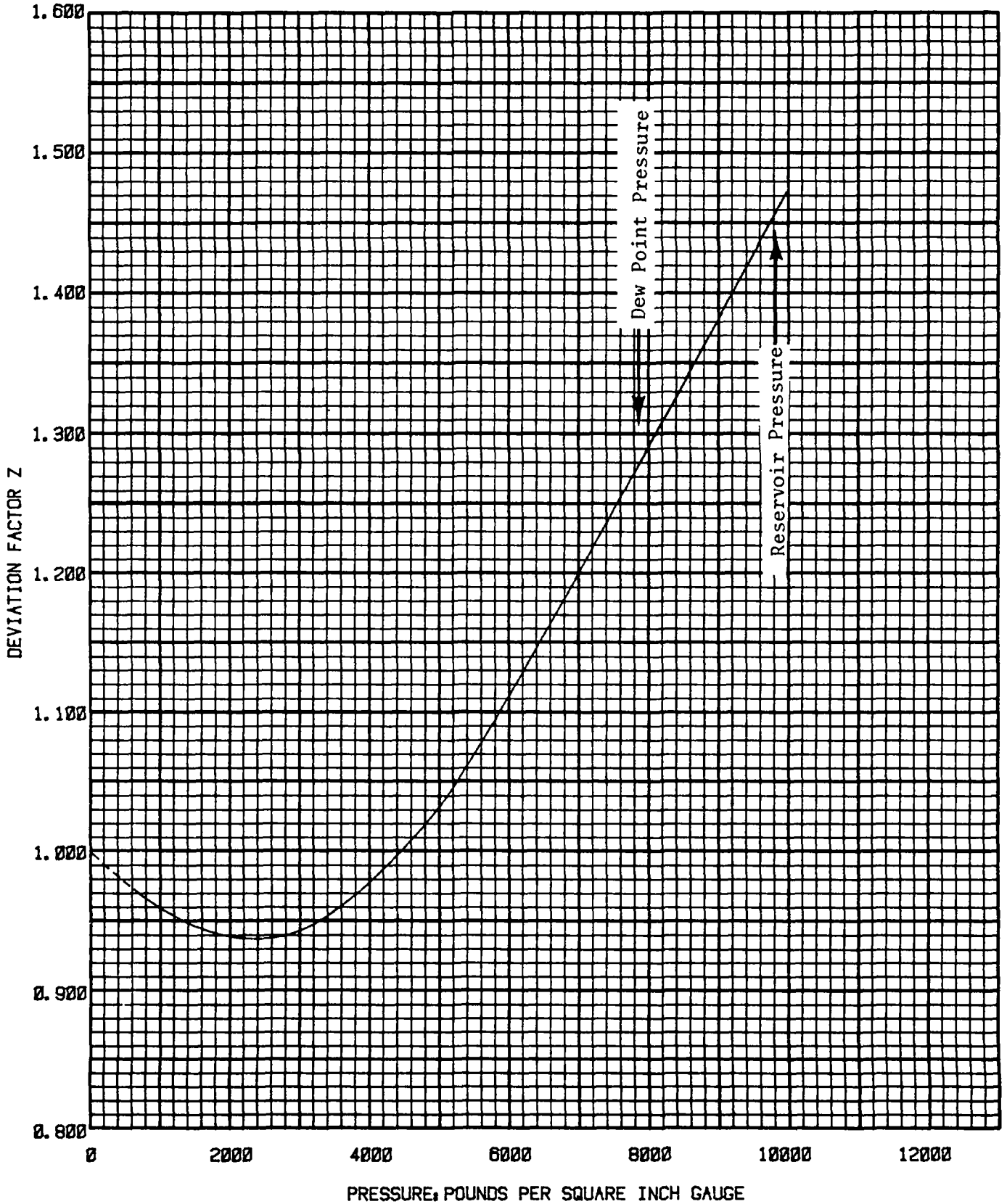
Well 30/2-1, DST No. 2

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>
7871 Dew Point	0.0
7800	0.1
7650	0.2
7450	0.4
7200	0.6
6900	1.0
6800 First Depletion Pressure	1.2
5400	4.8
4000	7.0
2500	8.5
1200	8.6
700	8.3
0	7.6

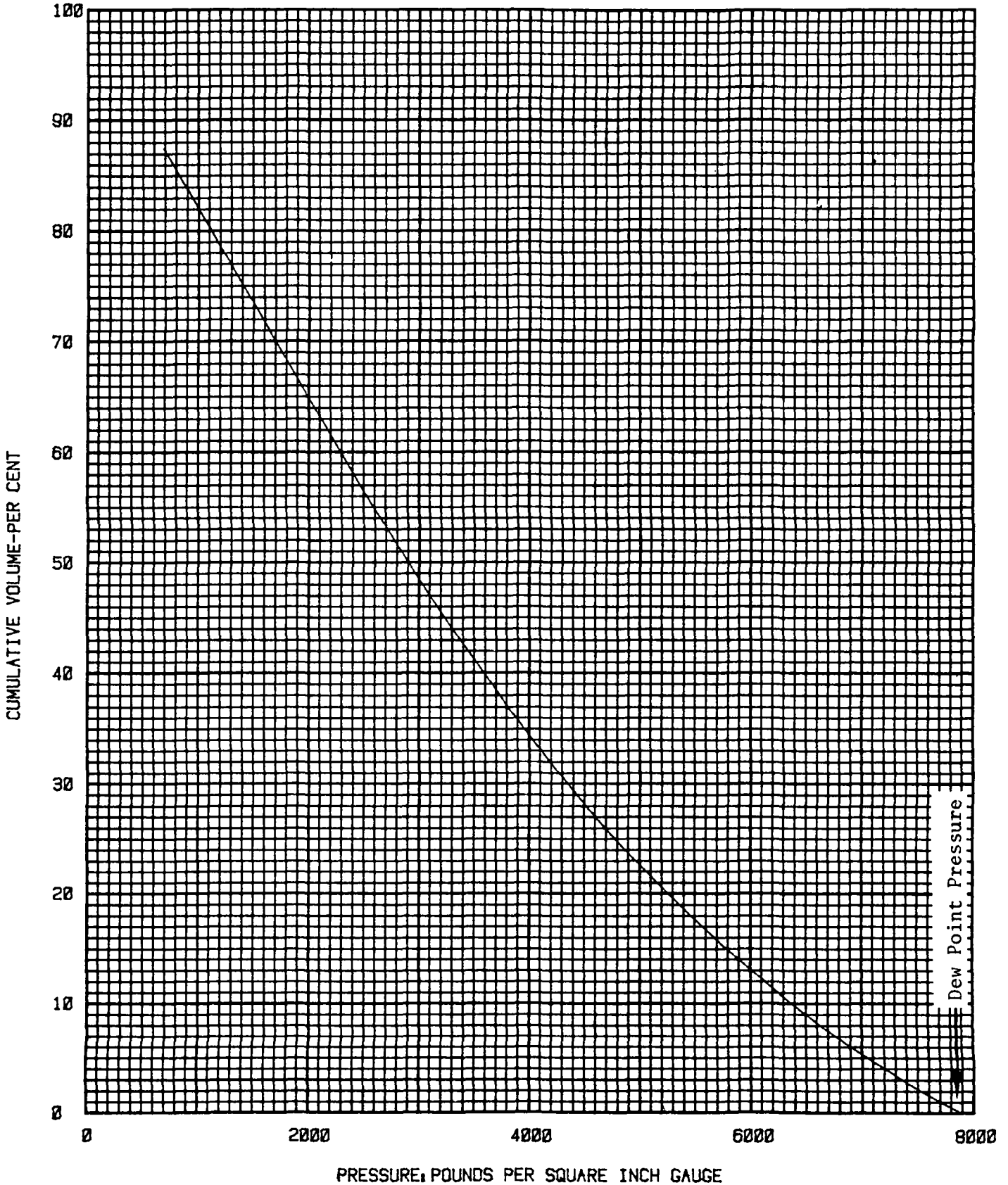
DEVIATION FACTOR Z OF WELL STREAM DURING DEPLETION AT 300°F.

Company	<u>UNIONOIL NORGE A/S</u>	Formation	<u>ETIVE</u>
Well	<u>30/2-1, DST NO. 2</u>	State	<u></u>
Field	<u>WILDCAT</u>	Country	<u>NORWAY</u>



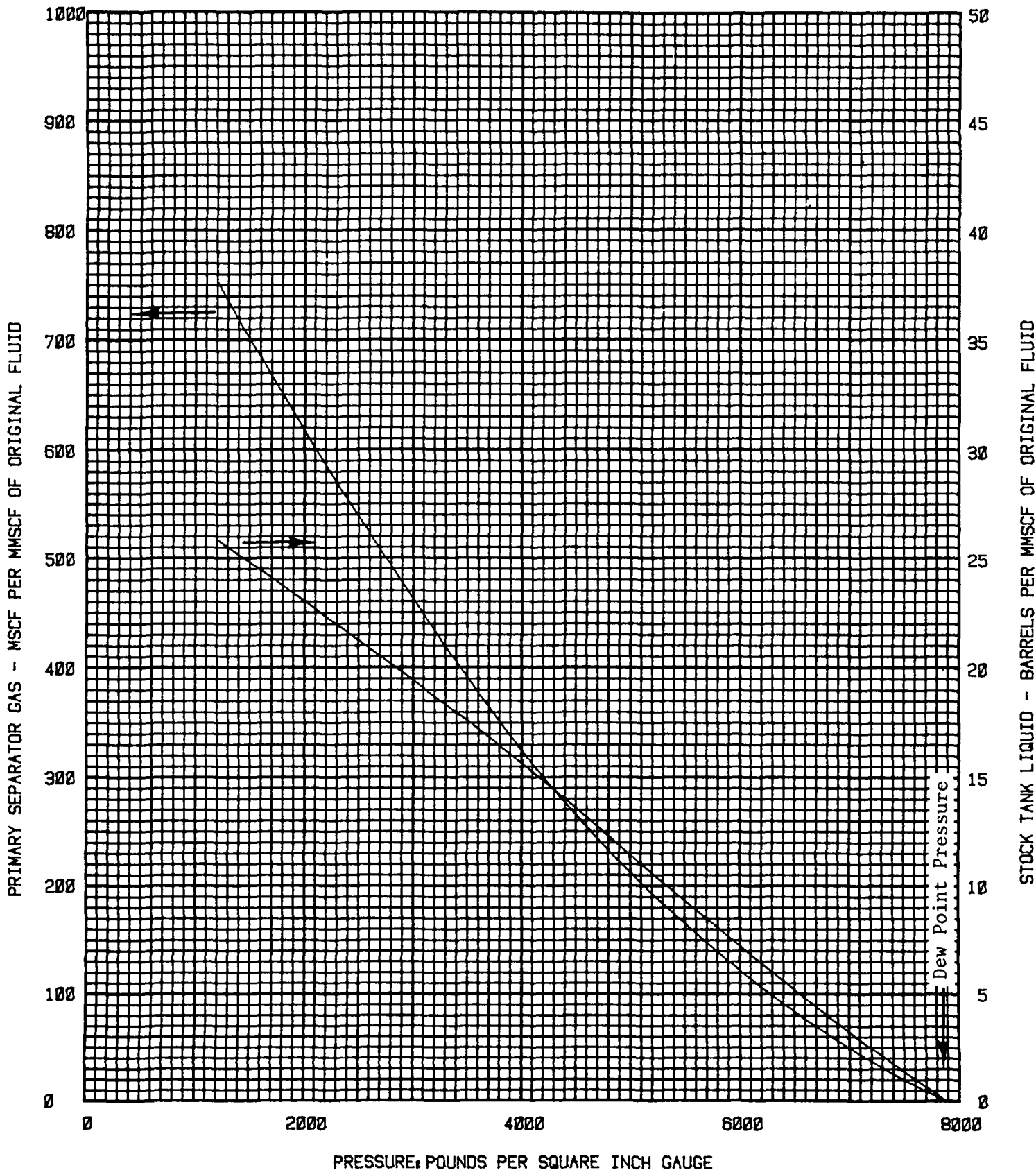
VOLUME OF WELL STREAM PRODUCED DURING DEPLETION

Company	<u>UNIONOIL NORGE A/S</u>	Formation	<u>ETIVE</u>
Well	<u>30/2-1, DST NO. 2</u>	State	<u></u>
Field	<u>WILDCAT</u>	Country	<u>NORWAY</u>



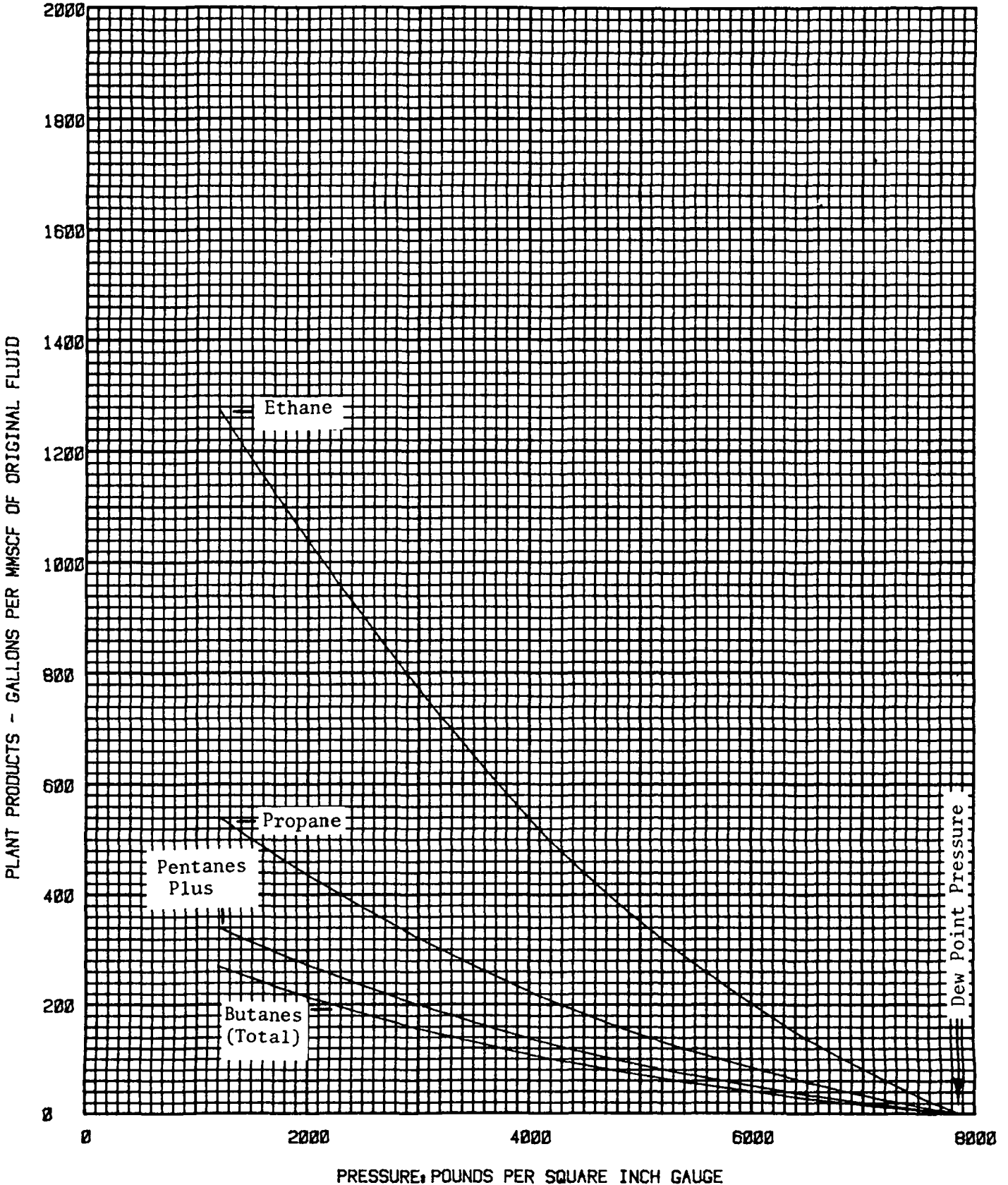
CUMULATIVE RECOVERY DURING DEPLETION

Company	UNIONOIL NORGE A/S	Formation	ETIVE
Well	30/2-1, DST NO. 2	State	
Field	WILDCAT	Country	NORWAY



CUMULATIVE RECOVERY-PLANT PRODUCTS IN PRIMARY SEPARATOR GAS

Company	UNIONOIL NORGE A/S	Formation	ETIVE
Well	30/2-1, DST NO. 2	State	
Field	WILDCAT	Country	NORWAY



RETROGRADE CONDENSATION DURING DEPLETION

Company	UNIONOIL NORGE A/S	Formation	ETIVE
Well	30/2-1, DST NO. 2	State	
Field	WILDCAT	Country	NORWAY

