CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS 75207
February 22, 1971

RESERVOIR FLUID ANALYSIS

Phillips Petroleum Company - Norway
P. O. Box 72
Stavanger, Norway

Attention: Mr. P. W. Reynolds

Subject: Reservoir Fluid Studies
2/4-4AX Well
DST Nos. 1 and 4
Ekofisk Field
North Sea, Norway
Our File Numbers: RFL 6653 and
RFL 6654

Gentlemen:

Samples of separator liquid and vapor collected during DST No. 1 and DST No. 4 were submitted to our laboratory in Dallas for use in reservoir fluid studies. Presented on the following pages are the results of these studies as requested by Phillips Petroleum Company - Norway.

After correction for the gas gravity and supercompressibility factors, the separator gas-liquid ratio during DST No. 1 was calculated to be 1222 standard cubic feet of separator gas per barrel of separator liquid at 570 psig and 74° F. This ratio was used in conjunction with the measured compositions of the separator products to calculate the composition of the well stream material. The separator products were then physically recombined in this producing gas-liquid ratio and the bubble point pressure of this resulting fluid was measured to be 5886 psig at the reservoir temperature of 266° F. The results of the tests that were performed using these separator products are presented on pages one through four of the report.

The producing gas-liquid ratio during DST No. 4 was calculated to be 1703 standard cubic feet of separator gas per barrel of separator liquid. After

physically recombining the separator products to this producing gas-liquid ratio the resulting fluid was determined to have a bubble point pressure of 6228 psig at 258° F. The results of the tests performed on these samples are presented on pages five through eight of the report.

A preliminary report issued November 4, 1970 contained the results of a hydrocarbon analyses of the separator products, the calculated well stream compositions and the bubble point pressure of each mixture at reservoir temperature. At that time we were requested to hold all remaining gas and liquid samples collected during these tests until these preliminary data had been fully analyzed by Phillips Petroleum Company - Norway. On February 12, 1971 we were instructed by telex that no further testing would be required using these samples, and that any remaining gas and liquid samples could be discarded at this time.

As always, it has been our pleasure to cooperate with Phillips Petroleum Company - Norway in performing these studies. If you have any questions regarding these data, please do not hesitate to contact us.

Very truly yours,

Core Laboratories, Inc.
Reservoir Fluid Analysis

P. L. Moses HS

P. L. Moses
Manager

PLM:HS:dl

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DALLAS, TEXAS

File RFL 6653

Company Phillips Petroleum Co. - Norway Date Sampled August 10, 1970

Well 2/4-4AX, DST No. 1 County

Field Ekofisk State North Sea, Norway

FORMATION CHARACTERISTICS

Formation Name	Danian
Date First Well Completed	August 10, 1970
Original Reservoir Pressure	7085 PSIG @ 10530 Ft.
Original Produced Gas-Liquid Ratio	SCF/Bbl
Production Rate	Bbls/Day
Separator Pressure and Temperature	PSIG ° F
Liquid Gravity at 60° F.	36.0 ° API
Datum	Ft. Subsea

WELL CHARACTERISTICS

Elevation	89 RKB Ft.
Total Depth	10848 Ft.
Producing Interval	10380-10510 Ft.
Tubing Size and Depth	2-1/2 In. to 10321 Ft.
Open Flow Potential	MMSCF/Day
Last Reservoir Pressure	PSIG @ Ft.
Date	, 19
Reservoir Temperature	266 ° F. @ 10445 Ft.
Status of Well	Flowing DST 1
Pressure Gauge	

SAMPLING CONDITIONS

Flowing Tubing Pressure		4120 PSIG
Flowing Bottom Hole Pressure		PSIG
Primary Separator Pressure		570 PSIG
Primary Separator Temperature		74 ° F.
Secondary Separator Pressure		PSIG
Secondary Separator Temperature		° F.
Field Stock Tank Liquid Gravity		° API @ 60° F.
Primary Separator Gas Production Rate		909.0 MSCF/Day
Pressure Base	14.696 PSIA	
Temperature Base	60 ° F.	
Compressibility Factor (F_{pv})	1.0576	
Gas Gravity (Laboratory)	0.663	
Gas Gravity Factor (F_g)	1.2281	
Separator Liquid Production Rate @ 74° F. & 570 psig		744 Bbls/Day
Primary Separator Gas/Separator Liquid Ratio		1222 SCF/Bbl
	or	Bbls/MMSCF
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REMARKS:

Hydrocarbon Analyses of Separator Products and Calculated Well Stream

Component	Separator Liquid Mol Per Cent	Separator Gas Mol Per Cent	Separator Gas GPM	Well Stream * Mol Per Cent
Hydrogen Sulfide				
Carbon Dioxide	0.43	1.51		1.11
Nitrogen	0.04	0.34		0.23
Methane	14.12	85.65		59.17
Ethane	6.83	8.27	2.083	7.74
Propane	6.86	2.76	0.758	4.28
iso-Butane	1.50	0.31	0.101	0.75
n-Butane	4.35	0.63	0.198	2.01
iso-Pentane	1.52	0.12	0.044	0.64
n-Pentane	2.07	0.15	0.054	0.86
Hexanes	5.92	0.11	0.045	2.26
Heptanes plus	56.36	0.15	0.068	20.95
	100.00	100.00	3.351	100.00

Properties of Heptanes plus

API gravity @ 60° F.	33.3			
Specific gravity @ 60/60° F.	0.8584			0.858
Molecular weight	228	103		227

Calculated separator gas gravity (air = 1.000) = 0.663
Calculated gross heating value for separator gas = 1136 BTU
per cubic foot of dry gas @ 14.696 psia and 60° F.

Primary separator gas collected @ 570 psig and 74 °F.
Primary separator liquid collected @ 570 psig and 74 °F.

Primary separator gas/separator liquid ratio 1222 SCF/Bbl @ 74° F.

* Bubble point pressure = 5886 psig at 266° F.

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File RFL 6653

Well 2/4-4AX, DST No. 1

VOLUMETRIC DATA OF Reservoir Fluid SAMPLE

1. Saturation pressure (bubble-point pressure) 5886 PSIG @ 266 °F.
2. Thermal expansion of saturated oil @ 7500 PSI $= \frac{V \text{ @ } 266\ ^\circ F}{V \text{ @ } 72\ ^\circ F} =$ 1.14249
3. Compressibility of saturated oil @ reservoir temperature: Vol/Vol/PSI:

From 7500 PSI to 6500 PSI = 20.40×10^{-6}

From 6500 PSI to 6200 PSI = 24.32×10^{-6}

From 6200 PSI to 5886 PSI = 25.62×10^{-6}

Pressure-Volume Relations of Reservoir Fluid at 266° F.

Pressure, PSIG	Relative Volume
7500	0.9646
7000	0.9742
6500	0.9847
6300	0.9790
6200	0.9920
6100	0.9943
6000	0.9968
5900	0.9996
5886	1.0000
5836	1.0025
5796	1.0045
5696	1.0095
5510	1.0194
5178	1.0396
4887	1.0600
4528	1.0907
4147	1.1321
3698	1.1947
3264	1.2789
2767	1.4162
2315	1.6073
1737	2.0140
1274	2.6539
888	3.7017

Company Phillips Petroleum Co. - Norway Date Sampled August 23, 1970
Well 2/4-4AX, DST No. 4 County
Field Ekofisk State North Sea, Norway

FORMATION CHARACTERISTICS

Formation Name	Danian
Date First Well Completed	August 23, 1970
Original Reservoir Pressure (2/4-2X Well)	7085 PSIG @ 10530 Ft.
Original Produced Gas-Liquid Ratio	SCF/Bbl
Production Rate	Bbls/Day
Separator Pressure and Temperature	PSIG ° F.
Liquid Gravity at 60° F.	37.5 ° API
Datum	Ft. Subsea

WELL CHARACTERISTICS

Elevation	89 RKB Ft.
Total Depth	10110 Ft.
Producing Interval	9980-10090 Ft.
Tubing Size and Depth	3-1/2 In. to 9922 Ft.
Open Flow Potential	MMSCF/Day
Last Reservoir Pressure	PSIG @ Ft.
Date	, 19
Reservoir Temperature	258 ° F. @ 10035 Ft.
Status of Well	Flowing DST 4
Pressure Gauge	

SAMPLING CONDITIONS

Flowing Tubing Pressure		560 PSIG
Flowing Bottom Hole Pressure		PSIG
Primary Separator Pressure		460 PSIG
Primary Separator Temperature		83 ° F.
Secondary Separator Pressure		PSIG
Secondary Separator Temperature		° F.
Field Stock Tank Liquid Gravity		37.5 ° API @ 60° F.
Primary Separator Gas Production Rate		643.6 MSCF/Day
Pressure Base	14.696 PSIA	
Temperature Base	60 ° F.	
Compressibility Factor (F_{pv})	1.0494	
Gas Gravity (Laboratory)	0.700	
Gas Gravity Factor (F_g)	1.1952	
Separator Liquid Production Rate @ 83° F. & 460 psig		378 Bbls/Day
Primary Separator Gas/Separator Liquid Ratio		1703 SCF/Bbl
or		Bbls/MMSCF
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REMARKS:

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Well 2/4-4AX, DST No. 4

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
Hydrogen Sulfide				
Carbon Dioxide	0.22	1.42		1.09
Nitrogen	0.07	0.47		0.36
Methane	9.58	82.12		61.90
Ethane	4.84	9.32	2.348	8.07
Propane	5.38	4.01	1.101	4.39
iso-Butane	1.35	0.51	0.166	0.74
n-Butane	4.09	1.17	0.368	1.98
iso-Pentane	1.65	0.27	0.099	0.65
n-Pentane	2.00	0.32	0.116	0.79
Hexanes	7.41	0.19	0.077	2.20
Heptanes plus	63.41	0.20	0.091	17.83
	100.00	100.00	4.366	100.00

Properties of Heptanes plus

API gravity @ 60° F.	35.5			
Specific gravity @ 60/60° F.	0.8475			0.847
Molecular weight	225	103		224

Calculated separator gas gravity (air = 1.000) = 0.700

Calculated gross heating value for separator gas = 1194 BTU per cubic foot of dry gas @ 14.696 psia and 60° F.

Primary separator gas collected @ 460 psig and 83 °F.

Primary separator liquid collected @ 460 psig and 83 °F.

Primary separator gas/separator liquid ratio 1703 SCF/Bbl @ 83° F.

* Bubble point pressure = 6228 psig at 258° F.

VOLUMETRIC DATA OF Reservoir Fluid SAMPLE

1. Saturation pressure (bubble-point pressure) 6228 PSIG @ 258 °F.
2. Thermal expansion of saturated oil @ 7500 PSI $= \frac{V \text{ @ } 258\ ^\circ F}{V \text{ @ } 70\ ^\circ F} =$ 1.15380
3. Compressibility of saturated oil @ reservoir temperature: Vol/Vol/PSI:

From 7500 PSI to 7000 PSI = 23.14×10^{-6}

From 7000 PSI to 6600 PSI = 26.16×10^{-6}

From 6600 PSI to 6228 PSI = 31.58×10^{-6}

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Well 2/4-4AX, DST No. 4

Pressure-Volume Relations of Reservoir Fluid at 258° F.

Pressure, PSIG	Relative Volume
7500	0.9666
7000	0.9779
6800	0.9827
6700	0.9854
6600	0.9883
6500	0.9912
6400	0.9942
6300	0.9974
6228	1.0000
6183	1.0020
6139	1.0040
6028	1.0090
5769	1.0227
5443	1.0428
5030	1.0732
4582	1.1143
4083	1.1763
3588	1.2597
3112	1.3752
2712	1.5122
2397	1.6601
1833	2.0641
1370	2.7006
970	3.7469

Core Laboratories, Inc.
Reservoir Fluid Analysis

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Manager

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