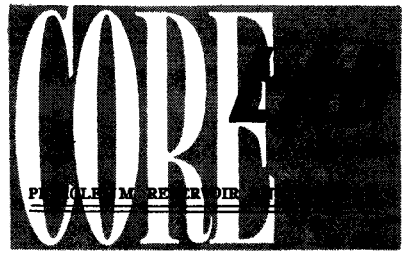


NR01626527

RESERVOIR FLUID STUDY
FOR
PHILLIPS PETROLEUM COMPANY - NORWAY

2/4-2X WELL
DST NO. 6B
EKOFISK FIELD
NORTH SEA, NORWAY

WA. 414-04. 0101



CORE LABORATORIES, INC.

Petroleum Reservoir Engineering

DALLAS, TEXAS 75207

August 3, 1970

RESERVOIR FLUID ANALYSIS

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

Attention: Mr. A. T. Crump

Subject: Reservoir Fluid Study
2/4-2X Well
DST No. 6B
Ekofisk Field
North Sea, Norway
Our File Number: RFL 6388

Gentlemen:

Samples of separator liquid and vapor collected from the subject well were used in the performance of a reservoir fluid study and the results of this study were mailed to you on June 25, 1970 under our file number RFL 6388. During an examination of the results that were reported to you in this study, it was found that an error was made in the measurements and calculations of the viscosity of this reservoir fluid material. The viscosity of the reservoir fluid was remeasured in our laboratory and the results of these corrected viscosity measurements are presented in this report.

For your convenience we are therefore reissuing the complete results of the reservoir fluid study. Would you please destroy all copies of our original reports that were dated June 25, 1970 and replace them with these corrected copies of the reservoir fluid study?

The well stream gas-liquid ratio was calculated to be 1165 standard cubic feet of primary separator gas per barrel of separator liquid at 70° F. The separator samples were then physically recombined to this gas-liquid ratio and the entire reservoir fluid study was performed using this recombined fluid. The well stream hydrocarbon composition was calculated on the basis

of the producing gas-liquid ratio using the measured compositions of the separator gas and liquid.

The saturation pressure of the fluid was measured to be 5990 psig at the reservoir temperature of 268° F. During differential pressure depletion at this temperature the fluid evolved 1971 standard cubic feet of gas per barrel of residual oil at 60° F. The accompanying formation volume factor was 2.148 barrels of saturated fluid per barrel of residual oil. The density of the liquid phase and the properties of the evolved gases were measured at several succeeding pressure levels during this depletion.

Under similar depletion conditions at 268° F. the viscosity of the fluid was measured from pressures exceeding reservoir pressure to atmospheric pressure. The viscosity of the liquid phase varied from a minimum of 0.209 centipoise at the saturation pressure to a maximum of 1.424 centipoises at atmospheric pressure.

A multi-stage separation test was performed on a sample of this fluid using the conditions specified by Phillips Petroleum Company - Norway. The results of this test are reported on page seven. The gas evolved from the primary stage of separation during this test was collected and analyzed as requested.

Again, may we thank Phillips Petroleum Company - Norway for the opportunity of performing this reservoir fluid study. Should you have any questions regarding these data or if we may assist you further, 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

7 cc. - Addressee

1 cc. - Mr. B. N. Boyce

Phillips Petroleum Company
Bartlesville, Oklahoma 74003

1 cc. - Phillips Petroleum Company
Bartlesville, Oklahoma 74003

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Petroleum Reservoir Engineering
DALLAS, TEXAS

Page 1 of 11

File RFL 6388

Company Phillips Petroleum
Company-Norway Date Sampled April 27, 1970
 Well 2/4-2X, DST No. 6B Province North Sea
 Field Ekofisk Country Norway

FORMATION CHARACTERISTICS

Formation Name Danian
 Date First Well Completed April 27, 19 70
 Original Reservoir Pressure _____ PSIG @ _____ Ft.
 Original Produced Gas-Liquid Ratio 1209 SCF/Bbl
 Production Rate 1046 Bbls/Day
 Separator Pressure and Temperature 530 PSIG 70 ° F.
 Liquid Gravity at 60° F. 35.3 ° API
 Datum 10441 Ft. Subsea

WELL CHARACTERISTICS

Elevation 89 RKB Ft.
 Total Depth 10592 Ft.
 Producing Interval 10480-10580 Ft.
 Tubing Size and Depth 2-1/2 In. to _____ Ft.
 Open Flow Potential _____ MMSCF/Day
 Last Reservoir Pressure _____ PSIG @ _____ Ft.
 Date April 27, 19 70
 Reservoir Temperature 268 ° F. @ 10530 Ft.
 Status of Well Initial Test
 Pressure Gauge _____

SAMPLING CONDITIONS

Flowing Tubing Pressure 3645 PSIG
 Flowing Bottom Hole Pressure 6677 PSIG
 Primary Separator Pressure 530 PSIG
 Primary Separator Temperature 70 ° F.
 Secondary Separator Pressure _____ PSIG
 Secondary Separator Temperature _____ ° F.
 Field Stock Tank Liquid Gravity 35.3 ° API @ 60° F.
 Primary Separator Gas Production Rate 1219 MSCF/Day
 Pressure Base 14.696 PSIA
 Temperature Base 60 ° F.
 Compressibility Factor (F_{pv}) 1.049
 Gas Gravity (Laboratory) 0.661
 Gas Gravity Factor (F_g) 1.2318
 Separator Liquid Production Rate @ 70° F. 1046 Bbls/Day
 Primary Separator Gas/Separator Liquid @ 70° F. Ratio 1165 SCF/Bbl
 or _____ Bbls/MMSCF

Core Laboratories, Inc., Engineer

REMARKS:

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Petroleum Reservoir Engineering
DALLAS, TEXAS

Page 2 of 11

File RFL 6388

Well 2/4-2X, DST No. 6B

Hydrocarbon Analyses of Separator Products and Calculated Well Stream

<u>Component</u>	<u>Separator Liquid Mol Per Cent</u>	<u>Separator Gas Mol Per Cent</u>	<u>GPM</u>	<u>Well Stream Mol Per Cent</u>
Hydrogen Sulfide				
Carbon Dioxide	0.08	1.93		1.25
Nitrogen	0.03	0.22		0.15
Methane	12.97	85.76		58.99
Ethane	6.55	8.08	2.035	7.52
Propane	6.45	2.70	0.741	4.08
iso-Butane	1.43	0.29	0.095	0.71
n-Butane	4.27	0.62	0.195	1.96
iso-Pentane	1.52	0.12	0.044	0.63
n-Pentane	2.66	0.14	0.051	1.07
Hexanes	5.07	0.09	0.037	1.92
Heptanes plus	58.97	0.05	0.023	21.72
	<u>100.00</u>	<u>100.00</u>	<u>3.221</u>	<u>100.00</u>

Properties of Heptanes plus

API gravity @ 60° F.	<u>31.9</u>		
Specific gravity @ 60/60° F.	<u>0.8659</u>		<u>0.866</u>
Molecular weight	<u>239</u>	<u>103</u>	<u>239</u>

Calculated separator gas gravity (air = 1.000) = 0.661
 Calculated gross heating value for separator gas = 1124 BTU
 per cubic foot of dry gas @ 14.696 psia and 60° F.

Primary separator gas collected @ 530 psig and 70 °F.
 Primary separator liquid collected @ 530 psig and 70 °F.

Primary separator gas/separator liquid ratio 1165 SCF/Bbl @ 70° F.

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Petroleum Reservoir Engineering
DALLAS, TEXAS

Page 3 of 11
File RFL 6388
Well 2/4-2X, DST No. 6B

VOLUMETRIC DATA OF Reservoir Fluid SAMPLE

1. Saturation pressure (bubble-point pressure) 5990 PSIG @ 268 °F.
2. Thermal expansion of saturated oil @ 7500 PSI = $\frac{V @ 268 \text{ } ^\circ\text{F}}{V @ 74 \text{ } ^\circ\text{F}}$ = 1.14106
3. Compressibility of saturated oil @ reservoir temperature: Vol/Vol/PSI:
From 7500 PSI to 7000 PSI = 18.44 x 10⁻⁶
From 7000 PSI to 6500 PSI = 19.58 x 10⁻⁶
From 6500 PSI to 5990 PSI = 23.03 x 10⁻⁶
4. Specific volume at saturation pressure: ft³/lb 0.02701 @ 268 °F.

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Petroleum Reservoir Engineering
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Page 4 of 11
 File RFL 6388
 Well 2/4-2X, DST No. 6B

Reservoir Fluid SAMPLE TABULAR DATA

PRESSURE PSI GAUGE	PRESSURE-VOLUME RELATION @ 268 °F., RELATIVE VOLUME OF OIL AND GAS, V/V _{SAT.}	VISCOSITY OF OIL @ 268 °F., CENTIPOISES	DIFFERENTIAL LIBERATION @ 268 °F.		
			GAS/OIL RATIO LIBERATED PER BARREL OF RESIDUAL OIL	GAS/OIL RATIO IN SOLUTION PER BARREL OF RESIDUAL OIL	RELATIVE OIL VOLUME, V/V _R
7500	0.9696	0.233			2.083
7200		0.229			
7000	0.9786				2.102
6900		0.224			
6600		0.219			
6500	0.9883				2.123
6400	0.9906				2.128
6300	0.9928				2.133
6200	0.9952	0.212			2.138
6100	0.9974				2.143
6000	0.9998				2.148
5990	1.0000	0.209	0	1971	2.148
5936	1.0025				
5892	1.0045				
5800		0.218	178	1793	2.040
5780	1.0095				
5600		0.232	332	1639	1.953
5498	1.0243				
5300		0.251	517	1454	1.852
5152	1.0447				
4900		0.275	707	1264	1.750
4728	1.0756				
4400		0.311	893	1078	1.655
4107	1.1382				
3900		0.347	1049	922	1.579
3525	1.2228				
3300		0.398	1210	761	1.501
2992	1.3397				
2700		0.468	1351	620	1.434
2588	1.4683				
2262	1.6161				
2100		0.548	1480	491	1.375
1682	2.0348				

v = Volume at given pressure

V_{SAT.} = Volume at saturation pressure and the specified temperature.

V_R = Residual oil volume at 14.7 PSI absolute and 60° F.

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Petroleum Reservoir Engineering
 DALLAS, TEXAS 75207

Page 5 of 11
 File RFL 6388
 Well 2/4-2X, DST No. 6B

Reservoir Fluid **SAMPLE TABULAR DATA**

PRESSURE PSI GAUGE	PRESSURE-VOLUME RELATION @ 268 °F.. RELATIVE VOLUME OF OIL AND GAS, V/V _{SAT.}	VISCOSITY OF OIL @ 268 °F.. CENTIPOISES	DIFFERENTIAL LIBERATION @ 268 °F.		
			GAS/OIL RATIO LIBERATED PER BARREL OF RESIDUAL OIL	GAS/OIL RATIO IN SOLUTION PER BARREL OF RESIDUAL OIL	RELATIVE OIL VOLUME, V/V _R
1500		0.638	1600	371	1.319
1227	2.6786				
900		0.767	1714	257	1.265
857	3.7388				
300			1837	134	1.196
0		1.424	1971	0	1.097
				@ 60° F. = 1.000	

Gravity of residual oil = 30.6° API @ 60° F.

v = Volume at given pressure
 V_{SAT.} = Volume at saturation pressure and the specified temperature.
 V_R = Residual oil volume at 14.7 PSI absolute and 60° F.

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CORE LABORATORIES, INC.*Petroleum Reservoir Engineering***DALLAS, TEXAS**Page 6 of 11File RFL 6388Well 2/4-2X, DST No. 6B**Differential Pressure Depletion at 268° F.**

<u>Pressure</u> <u>PSIG</u>	<u>Oil Density</u> <u>Gms/Cc</u>	<u>Gas</u> <u>Gravity</u>	<u>Deviation Factor</u> <u>Z</u>
5990	0.5931		
5800	0.6067	1.015	1.056
5600	0.6166	0.985	1.040
5300	0.6298	0.950	1.022
4900	0.6449	0.901	0.994
4400	0.6612	0.849	0.966
3900	0.6756	0.811	0.944
3300	0.6926	0.777	0.926
2700	0.7082	0.767	0.912
2100	0.7232	0.765	0.915
1500	0.7386	0.768	0.932
900	0.7540	0.806	0.956
300	0.7757	0.974	
0	0.7955	1.904	

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Petroleum Reservoir Engineering
DALLAS, TEXAS

Page 7 of 11

File RFL 6388

Well 2/4-2X, DST No. 6B

SEPARATOR TESTS OF Reservoir Fluid SAMPLE

SEPARATOR PRESSURE, PSI GAUGE	SEPARATOR TEMPERATURE, ° F.	GAS/OIL RATIO (1)	GAS/OIL RATIO (2)	STOCK TANK GRAVITY, ° API @ 60° F.	Formation Volume Factor (3)	Separator Volume Factor (4)	SPECIFIC GRAVITY OF FLASHED GAS
1000	150	1108	1278			1.153	0.700
to							
250	80	122	130			1.065	0.702
to							
0	60	116	116	35.6	1.834	1.000	1.021

- (1) Gas/Oil Ratio in cubic feet of gas @ 60° F. and 14.7 PSI absolute per barrel of oil @ indicated pressure and temperature.
- (2) Gas/Oil Ratio in cubic feet of gas @ 60° F. and 14.7 PSI absolute per barrel of stock tank oil @ 60° F.
- (3) Formation Volume Factor is barrels of saturated oil @ 5990 PSI gauge and 268° F. per barrel of stock tank oil @ 60° F.
- (4) Separator Volume Factor is barrels of oil @ indicated pressure and temperature per barrel of stock tank oil @ 60° F.

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CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

Page 8 of 11

File RFL 6388

Company Phillips Petroleum Company-Norway Formation Danian
 Well 2/4-2X, DST No. 6B Province North Sea
 Field Ekofisk Country Norway

HYDROCARBON ANALYSIS OF Separator **GAS SAMPLE**

COMPONENT	MOL PER CENT	G P M
Hydrogen Sulfide		
Carbon Dioxide	1.43	
Nitrogen	0.63	
Methane	84.65	
Ethane	8.00	2.015
Propane	3.06	0.840
iso-Butane	0.39	0.127
n-Butane	0.88	0.277
iso-Pentane	0.22	0.080
n-Pentane	0.27	0.098
Hexanes	0.18	0.073
Heptanes plus	0.29	0.131
	100.00	3.641

Calculated gas gravity (air = 1.000) = 0.680

Calculated gross heating value = 1159 BTU
 per cubic foot of dry gas at 14.696 psia at 60° F.

Collected at 1000 psig and 150° F.

Composition does not include 1.669 pounds of
 condensate per MSCF of gas.

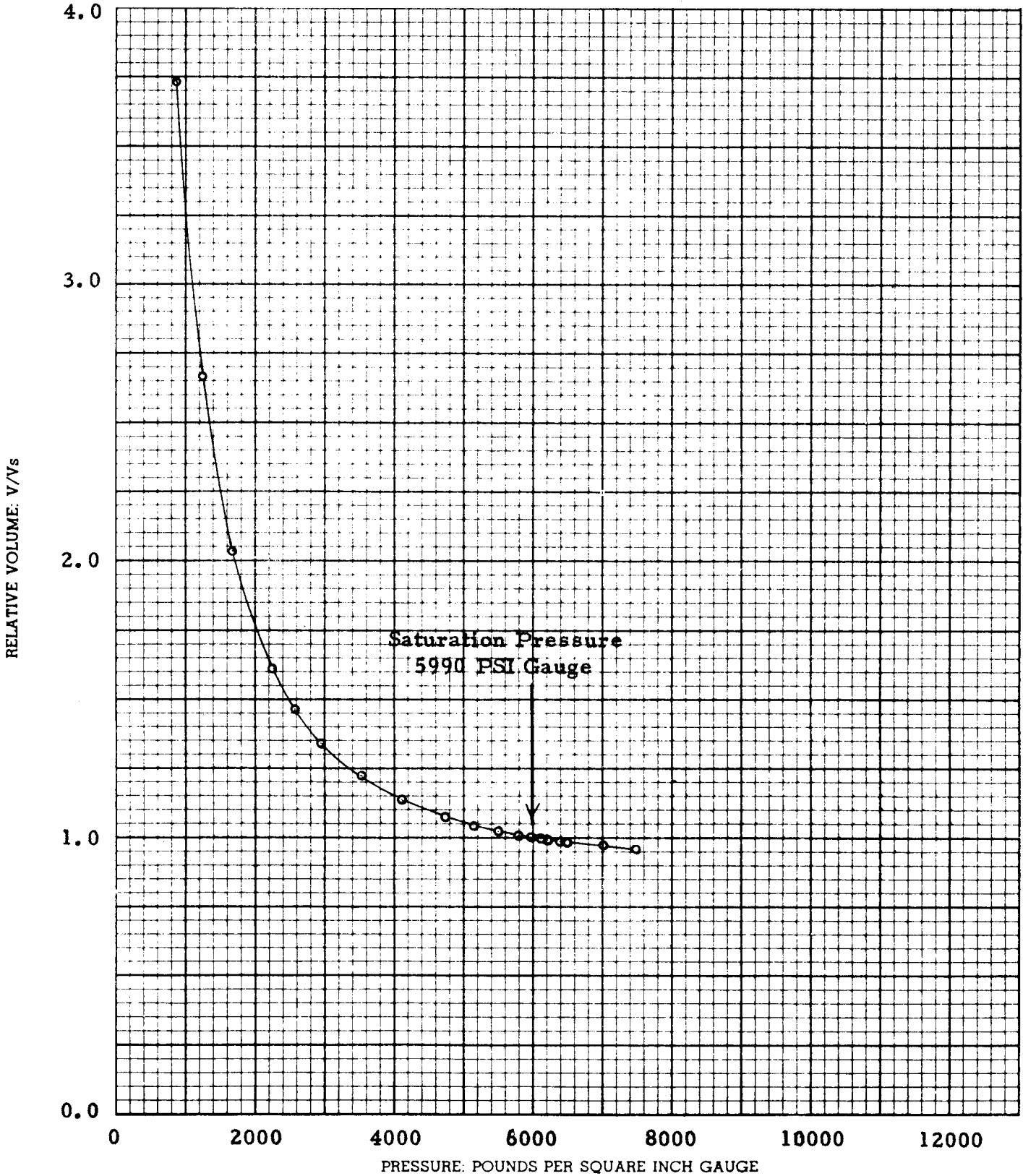
Core Laboratories, Inc.
 Reservoir Fluid Analysis

P. L. Moses _{MS}

P. L. Moses
 Manager

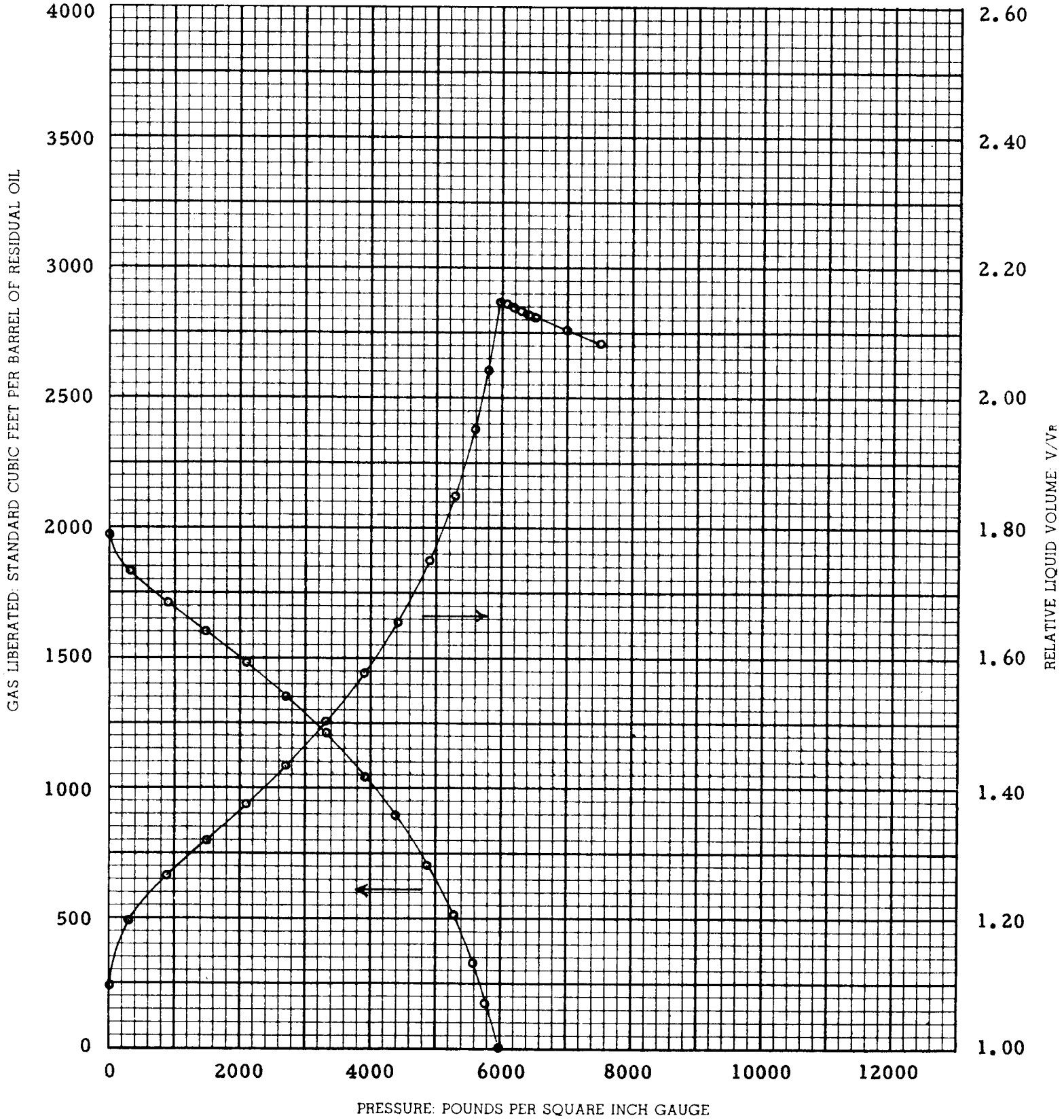
PRESSURE-VOLUME RELATIONS OF RESERVOIR FLUID

Company Phillips Petroleum Company-Norway Formation Danian
Well 2/4-2X, DST No. 6B Province North Sea
Field Ekofisk Country Norway



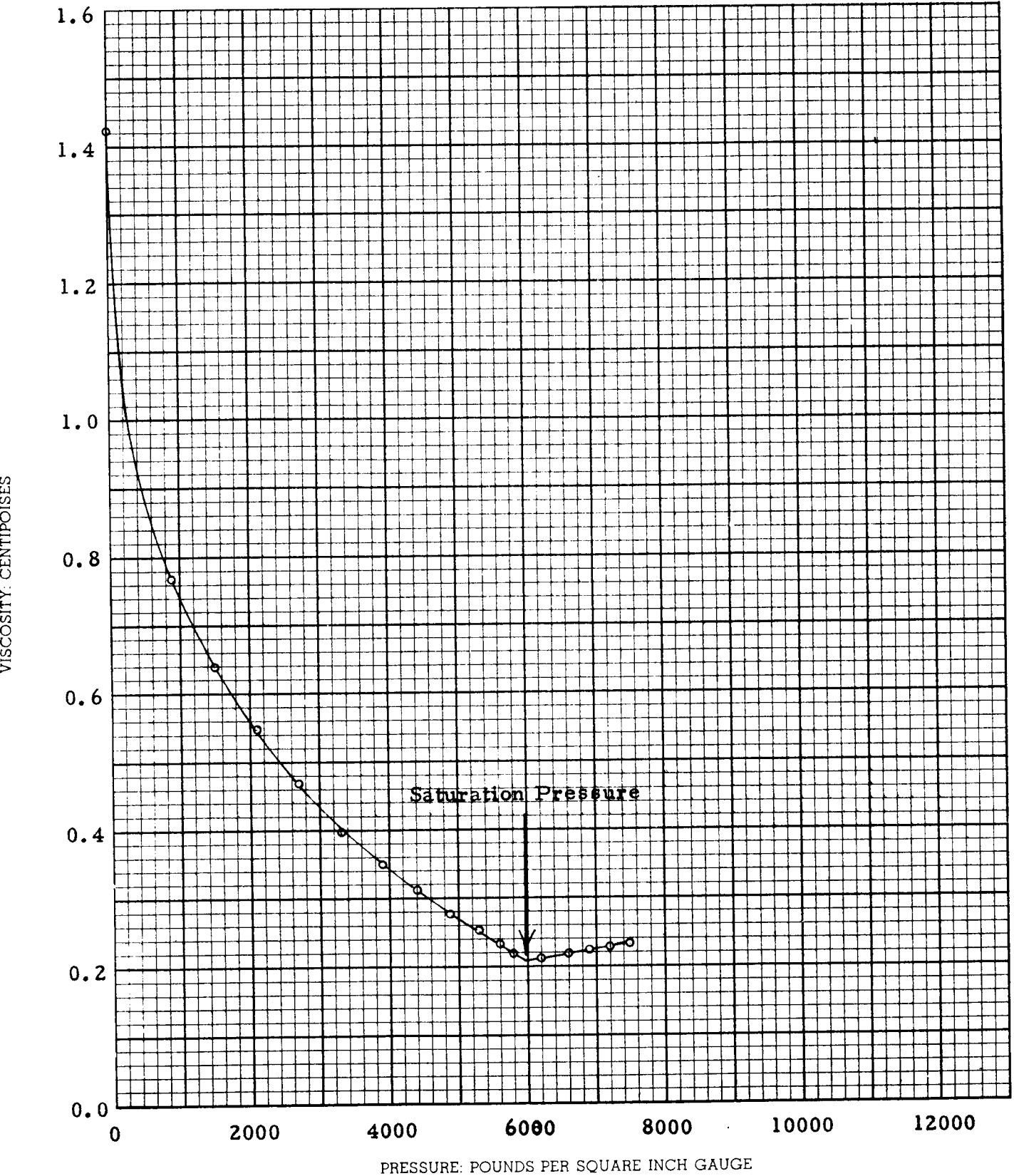
DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID

Company	Phillips Petroleum Company-Norway	Formation	Danian
Well	2/4-2X, DST No. 6B	Province	North Sea
Field	Ekofisk	Country	Norway



VISCOSITY OF RESERVOIR FLUID

Company Phillips Petroleum Company-Norway Formation Danian
Well 2/4-2X, DST No. 6B Province North Sea
Field Ekofisk Country Norway



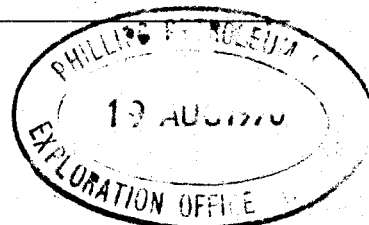


*J. Smith
Kamp HC*

PHILLIPS PETROLEUM COMPANY-NORWAY

UTENLANDSK AKSJESELSKAP

P.O. BOX 72 - STAVANGER, NORWAY - PHONE 41 340, 41 391 - CABLE: PHILLSTAV - TELEX: 33081



-/GJ-207/70

Stavanger, August 13, 1970

"Directione Europe"

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Paris XV - 75

FRANCE

Petrofina S.A.

33 Rue de la Loi

Brussel 4

BELGIUM

Agip S.P.A.

C.P. 4174

Milano

ITALY

Dear Sirs:

File

Transmitted herewith please find one copy of Core Lab's study on DST No. 6B of Well 2/4-2X.

Yours very truly,

P.W. Reynolds

P.W. Reynolds
Area Superintendent
Drilling & Production

Encl.

cc.: Mr. J.T. Jobin - London Office w/attachment ✓
Mr. L.H. Hoelscher - London Office w/attachment