

Denne rapport  
tilhører



**L&U DOK. SENTER**

L. NR. 20088890020

KODE Well 31/2-3 nc27

Returneres etter bruk

Reservoir Fluid Analysis  
For  
Norske Shell Exploration & Production  
Well: 31/2-3  
North Sea, Norway

**CORE LABORATORIES UK LTD.**  
*Petroleum Reservoir Engineering*  
**ABERDEEN, SCOTLAND**

Reservoir Fluid Analysis  
For  
Norske Shell Exploration & Production  
Well: 31/2-3  
North Sea, Norway

**CORE LABORATORIES UK LTD.**  
*Petroleum Reservoir Engineering*  
**ABERDEEN, SCOTLAND**

6th January, 1981

Norske Shell Exploration & Production,  
Damsle Ferusuei 43,  
P.O. Box 10,  
40-33 Forus,  
Stavanger,  
Norway.

Attention: Mr. Dave Jolly

Subject: Reservoir Fluid Analysis  
Well: 31/2-3  
North Sea, Norway  
Our File Number: RFLA 80168

Gentlemen,

On 16th June, 1980, samples of separator gas and condensate were collected during testing of the subject well and forwarded to our Aberdeen laboratory for analysis. The results of these analyses as requested by a representative of Norske Shell Exploration & Production are presented in the following report.

The hydrocarbon composition of the separator gas was determined by routine gas chromatography. The hydrocarbon composition of the condensate liquid was determined by low temperature fractional distillation.

After correcting the quoted producing gas-condensate ratio for the factors shown on page one a corrected gas-condensate ratio of 1094 MSCF/BBL of separator condensate was calculated. Utilizing this gas-condensate ratio in conjunction with the experimentally determined hydrocarbon compositions of the separator products and the measured laboratory shrinkage of the condensate liquid, a wellstream composition was calculated. These compositions are to be found on page two. The laboratory shrinkage data may be found on page five.

The separator products were physically recombined at the above gas-condensate ratio and the resultant reservoir gas-condensate utilized for the remainder of the study.

A portion of the gas-condensate was placed in a high pressure visual cell and examined at the reservoir temperature of 154<sup>o</sup>F. At this temperature the system exhibited a retrograde dew point at 1842 psig. The pressure-volume relations are shown on page three.

Continued/...

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Norske Shell Exploration & Production

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Page Two

The wellstream composition was used to calculate the cumulative stock tank liquid and sales gas recovery using normal two stage separation. Also calculated are the plant liquid products on the primary and secondary stage separator gases. The total plant products in the wellstream are also shown. All recoveries are based on one MMSCF of original reservoir fluid. It must be remembered in applying these data that all recoveries are based on 100 percent plant efficiency. These data may be found on page four.

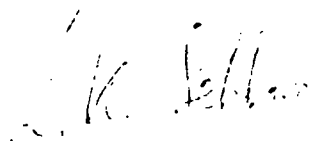
The extended hydrocarbon composition to eicosanes plus of the condensate fluid was determined by gas chromatography and this composition may be found on page six.

The extended composition to eicosanes plus of the reservoir fluid was calculated and this composition is presented on page seven.

In view of these results, the reservoir fluid would usually be considered a dry gas system, and consequently we would not normally perform a "step-wise" equilibrium (constant volume) depletion to simulate wellstream behaviour below the dew point. We will retain the samples in our laboratory pending further instructions from Norske Shell Exploration & production.

It has been a pleasure to be of service to Norske Shell Exploration & Production. Should any questions arise concerning the data presented in this report, please do not hesitate to contact us.

Very truly yours,  
Core Laboratories U.K. Ltd.,



LKS/HG  
15 cc addressee

L. K. Sebborn,  
Laboratory Manager - RFL

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Company .....Norske Shell Expl. & Prod..... Date Sampled .....16th June, 1980.....  
 Well .....31/2-3..... County .....North Sea.....  
 Field ..... State .....Norway.....

**FORMATION CHARACTERISTICS**

Formation Name .....Micaceous Sand.....  
 Date First Well Completed ..... , 19.....  
 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 .....1520-1535 m.....  
 Tubing Size and Depth .....5..... In. to 1491 m.....  
 Open Flow Potential .....MMSCF/Day  
 Last Reservoir Pressure .....2275..... PSIG @ .....Ft.  
     Date ..... , 19.....  
     Reservoir Temperature .....154..... ° F. @ ..... Ft.  
 Status of Well .....  
 Pressure Gauge .....

**SAMPLING CONDITIONS**

Flowing Tubing Pressure ..... PSIG  
 Flowing Bottom Hole Pressure ..... PSIG  
 Primary Separator Pressure .....390..... 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 .....5129..... MSCF/Day  
     Pressure Base .....14.696..... PSIA  
     Temperature Base .....60..... °F.  
     Compressibility Factor (F ) .....1.0260.....  
     Gas Gravity (Laboratory)<sup>PV</sup> .....0.597.....  
     Gas Gravity Factor (F ) .....1.2942.....  
 Primary sep. Liquid Production Rate @ 74°F .....4.69..... Bbls/Day  
 Primary Separator Gas/Primary sep. Liquid Ratio .....1094..... MSCF/Bbl  
     or .....0.914..... Bbls/MMSCF  
 Sampled by .....Flopetrol.....

REMARKS :

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Well 31/2-3

**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	NIL	NIL		NIL
Carbon Dioxide	0.21	0.57		0.57
Nitrogen	0.37	1.61		1.61
Methane	10.96	93.52		93.45
Ethane	2.39	3.40		3.40
Propane	0.84	0.36	0.099	0.36
iso-Butane	1.33	0.25	0.085	0.26
n-Butane	0.24	0.04	0.013	0.04
iso-Pentane	1.20	0.03	0.011	0.03
n-Pentane	0.42	0.01	0.004	0.01
Hexanes	3.71	0.05	0.020	0.05
Heptanes plus	<u>78.33</u>	<u>0.15</u>	<u>0.068</u>	<u>0.22</u>
	100.00	100.00	0.300	100.00

**Properties of Heptanes plus**

API gravity @ 60° F.	46.7		
Specific gravity @ 60/60° F.	0.7941		0.732
Molecular weight	121	103	109

Calculated separator gas gravity (air=1.000)= 0.597

Calculated gross heating value for separator gas= 1036 BTU

per cubic foot of dry gas @ 14.696 psia and 60° F.

Primary separator gas collected @ 390 psig and 74° F.

Primary separator liquid collected @ 390 psig and 74° F.

Primary separator gas/separator liquid ratio 1.094575 SCF/Bbl @ 390 psig and 74° F

Primary separator liquid/stock tank liquid ratio 1.0872 Bbls @ 390 psig and 74° F per Bbl at 0 psig and 60° F

+ Cylinder Number: 16251/69

\* Cylinder Number: A5113

These analyses, opinions or interpretations are based on observations and material supplied by the client to whom, and for whose exclusive and confidential use, this report is made. The interpretations or opinions expressed represent the best judgement of Core Laboratories, Inc. (all errors and omissions excepted); but Core Laboratories, Inc. and its officers and employees, assume no responsibility and make no warranty or representations as to the productivity, proper operation, or profitability of any oil, gas or other mineral well or sand in connection with which such report is used or relied upon.

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Well ..... 31/2-3 .....

Pressure-Volume Relations at ..... 154 ..... °F.

<u>Pressure PSIG</u>		<u>Relative Volume (1)</u>	<u>Compressibility Factor Z</u>
3000		0.6152	0.875
2500		0.7291	0.865
<u>2275</u>	Reservoir Pressure	0.8017	0.866
2200		0.8298	0.867
2100		0.8710	0.869
2000		0.9163	0.871
1900		0.9677	0.874
<u>1842</u>	Dew Point Pressure	1.0000	0.876
1800		1.0244	
1700		1.0890	
1600		1.1620	
1500		1.2442	
1400		1.3391	
1200		1.5788	
1000		1.9154	
800		2.4222	
600		3.2608	

(1) Relative Volume :  $V/V_{sat}$  is barrels at indicated pressure per barrel at saturation pressure.

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Well ..... 31/2-3 .....

CALCULATED RECOVERY PER MMSCF OF ORIGINAL FLUID

Wellstream MSCF ..... 1000

Normal Temperature Separation\*

Stock Tank liquid - Barrels	1.77
Primary Separator Gas - MSCF	996.98
Second Stage Gas - MSCF	0.90
Stock Tank Gas - MSCF	0.56

Total Plant Products in  
Primary Separator Gas - Gallons\*\*

Propane	98
Butanes (Total)	95
Pentanes Plus	59

Total Plant Products in  
Second Stage Gas - Gallons\*\*

Propane	0.11
Butanes (Total)	0.10
Pentanes Plus	0.04

Total Plant Products in  
Wellstream - Gallons\*\*

Propane	99
Butanes (Total)	98
Pentanes Plus	132

\* Recovery Bases: Primary separation at 1250 psig and 40<sup>o</sup>F  
Second Stage at 500 psig and 40<sup>o</sup>F  
Stock Tank at 0 psig and 27<sup>o</sup>F

\*\* Recovery assumes 100% plant efficiency



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SEPARATOR TESTS OF Separator Liquid SAMPLE

SEPARATOR PRESSURE PSI GAUGE	SEPARATOR TEMPERATURE °F	SEPARATOR GAS/OIL RATIO (1)	STOCK TANK GAS/OIL RATIO (1)	STOCK TANK GRAVITY API @ 60°F	SHRINKAGE FACTOR VR/VSAT (2)	FORMATION VOLUME FACTOR (3)	SPECIFIC GRAVITY OF FLASHED GAS
0	65		142	49.8	0.9198	1.0872	0.838

- (1) Separator and Stock Tank Gas/Oil Ratio in cubic feet of gas @ 60°F and 14.7 PSI absolute 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 @ 390 PSI gauge and 74 F.
- (3) Formation Volume Factor : Vsat/Vr is barrels of saturated oil @ 390 PSI gauge and 74 F per barrel of stock tank oil @ 60°F.

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Well 31/2-3

HYDROCARCON ANALYSIS OF SEPARATOR LIQUID SAMPLE

<u>Component:</u>	<u>Mol Percent:</u>	<u>Weight Percent:</u>
Hydrogen Sulphide	NIL	NIL
Carbon Dioxide	0.21	0.09
Nitrogen	0.37	0.10
Methane	10.96	1.71
Ethane	2.39	0.70
Propane	0.84	0.36
Iso-Butane	1.33	0.75
N-Butane	0.24	0.14
Iso-Pentane	1.20	0.85
N-Pentane	0.42	0.29
Hexanes	3.71	3.10
Methyl Cyclopentane	4.98	4.20
Benzene	NIL	NIL
Cyclohexane	7.31	6.17
Heptanes	5.57	5.61
Methyl Cyclohexane	14.29	14.07
Toluene	0.85	0.78
Octanes	9.34	10.70
Ethylbenzene	1.24	1.32
Meta and Para Xylene	4.43	4.72
Orthoxylene	0.89	0.95
Nonanes	7.05	9.07
1, 2, 4 Trimethylbenzene	1.83	2.20
Decanes	8.05	11.49
Undecanes	5.60	8.26
Dodecanes	2.98	4.80
Tridecanes	1.94	3.42
Tetradecanes	1.08	2.07
Pentadecanes	0.46	0.95
Hexadecanes	0.20	0.45
Heptadecanes	0.10	0.24
Octadecanes	0.07	0.17
Nonadecanes	0.03	0.11
Eicosanes plus	0.04	0.16
	<u>100.00</u>	<u>100.00</u>

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HYDROCARBON ANALYSIS OF WELLSTREAM SAMPLE

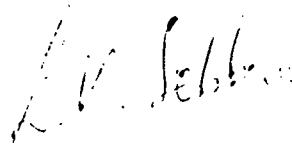
<u>Component:</u>	<u>Mol Percent:</u>
Hydrogen Sulphide	NIL
Carbon Dioxide	0.57
Nitrogen	1.61
Methane	93.45
Ethane	3.40
Propane	0.36
Iso-Butane	0.26
N-Butane	0.04
Iso-Pentane	0.03
N-Pentane	0.01
Hexanes	0.05
Methyl Cyclopentane	0.02
Benzene	NIL
Cyclohexane	0.04
Heptanes	0.03
Methyl Cyclohexane	0.03
Toluene	TRACE
Octanes	0.03
Ethylbenzene	TRACE
Meta and Para Xylene	<del>0.01</del>
Orthoxylene	TRACE
Nonanes	0.02
1, 2, 4 Trimethylbenzene	TRACE
Decanes	0.02
Undecanes	0.01
Dodecanes	0.01
Tridecanes	TRACE
Tetradecanes	TRACE
Pentadecanes	TRACE
Hexadecanes	TRACE
Heptadecanes	TRACE
Octadecanes	TRACE
Nonadecanes	TRACE
Eicosanes plus	TRACE
	<u>100.00</u>

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Norske Shell Exploration & Production  
RFLA 80168

Core Laboratories U.K. Ltd.,  
Reservoir Fluid Analysis,

A handwritten signature in black ink, appearing to read 'L. K. Sebborn', written in a cursive style.

L. K. Sebborn,  
Laboratory Manager - RFL