

OIL and GAS DIVISION

DEPT. NAT. RES & ENV



PE800674

OIL

HYDROCARBON REPORT

TUNYA - 1

GAS ANALYSES

OIL and GAS DIVISION

FOR

TUNA M-1 AND T-1 RESERVOIRS

RESERVOIR:	M-1	T-1*
SAMPLE	TUNA-2	TUNA-1
SOURCE:	4545 FT.KB	6608 FT.KB
REPORT:	EPR69.PS17 13853 MKB	EPR68.PS106

<u>COMPONENT</u>	<u>MOLE %</u>	<u>MOLE %</u>
Hydrogen Sulphide	-	-
Nitrogen	.75	3.0
Carbon Dioxide	2.74	12.0
Methane	82.15	74.3
Ethane	6.30	5.4
Propane	3.88	2.3
i-Butane	.81	.4
n-Butane	1.27	.7
i-Pentane	.44	.2
n-Pentane	.41	.2
Hexanes	.11	.4
Heptanes	.31	.4
Octanes	.31	.2
Nonanes	.24	.1
Decanes Plus	.28	.4
	-----	-----
Total	100.00	100.0
	-----	-----

* The gas analysis considered representative of gas from the T-1 gas cap is the calculated equilibrium vapour for the T-1 oil.

OIL and GAS DIVISION

ESSO PRODUCTION RESEARCH COMPANY

HYDROCARBON REPORT - SUBSURFACE OIL
ESSO STANDARD OIL (AUSTRALIA) LTD.
TUNA ~~1~~-1 (LOWER) WELL

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TUNA A-1 (LOWER) SUBSURFACE OIL SAMPLES

Source: Esso Standard Oil (Australia) Ltd., Tuna A-1 (Lower) Well

Date Taken: June 26, 1968

Sampling Data

Sampled in the one-half gallon isolation chamber of an FIT subsurface tool, and transferred into shipping containers on shore. Free gas was observed when excess water was drained from container number 32.

Sample Evaluation

The sample in container number 629 was used for the analyses reported.

<u>Container No.</u>	<u>Saturation Pressure</u>	
	<u>psig at 75° F</u>	<u>psig at 201° F</u>
32	3100	3670*
629	2320	2890
843	1655	2225*

Reservoir Data

Elevation RDB	31 ft
Depth, bdf	6608 ft
Original reservoir pressure	2890 psig
Reservoir temperature	201° F 93.9° C

Properties of Samples

Pressure-Volume Relations	Table I
Flash Liberation and Differential Liberation Results	Table II
Comparison of Experimental and Computed Flash Liberation Results	Table II-A
Hydrocarbon Analysis of Subsurface Oil Sample - Pour Point, Wax and Sulfur Content in Residual Crude Oil	Table III
Viscosity of Reservoir Oil at 201° F	Table IV

*Saturation pressure of sample in container number 32 was in excess of the reservoir pressure at reservoir temperature. Separator gas/stock-tank oil ratio of sample in container number 843 was less than the 600 cu ft/bbl ratio measured in the field.

TABLE I

Pressure-Volume Relations of Subsurface Oil Sample

Source: Esso Standard Oil (Australia) Ltd., Tuna A-1 (Lower) Well

Date Taken: June 26, 1968

Temperature: 201° F

<u>Pressure, psig</u>	<u>Relative Volume, V/V_{bp}</u>	<u>*Y = $\frac{P_s - P}{P(\frac{V_t}{V_{bp}} - 1)}$</u>
4000	0.9856	
3500	0.9919	
3300	0.9946	
3200	0.9961	
3100	0.9973	
3000	0.9987	
P _s = 2890	1.0000	
2760	1.0157	2.984
2563	1.0438	2.906
2327	1.0862	2.789
2085	1.1430	2.681
1898	1.2002	2.590
1715	1.2719	2.498
1567	1.3439	2.432
1377	1.4621	2.352
890	2.0410	2.123
630	2.7554	1.996
492	3.4534	1.928
403	4.1580	1.884
342	4.8311	1.863
292	5.6075	1.830

Specific Volume at Saturation Pressure = 0.02301 cu ft/lb

*Calculated data for use in correcting subsurface oil sample

P_s = Saturation pressure of sample at 201° F, psia

P = Pressure below saturation pressure, psia

V_t = Two-phase relative volume factor at 201° F and P

V_{bp} = Saturated oil relative volume at 201° F and 2905 psia (2890 psig)

TABLE II

Flash Liberation and Differential Liberation Results
Subsurface Oil Sample

Source: Esso Standard Oil (Australia) Ltd., Tuna A-1 (Lower) Well

Date Taken: June 26, 1968

Properties of Saturated Oil: Temperature, °F 201 Saturation Pressure, psig 2890

Gas Liberation and Shrinkage of Oil:
(Flash)

Pressure (p ₁), psig	Temperature, °F	P ₁	Flashed at P ₁	Gas-Oil Ratio: cu ft at 60° F and 14.7 psia/bbl Residual Oil Flashed from		Residual Oil Gravity, °API at 60° F	Specific Gravity Gas at 60° F (air = 1)	V _R /V _S *
				P ₁ to 0	2890 psig			
0	75	756	-	-	40.5	0.9101	0.7169	1.3949
20	75	708	20	20	41.0	-	0.7246	1.3801
150	75	628	70	70	41.5	-	0.7313	1.3474

(Differential at 201° F)

Properties of Liberated Gas at Gas-Oil Ratio: cu ft at 14.7 psia Residual Oil
and 60° F/bbl Reservoir Oil at
60° F and Indicated Pressure***
Compressibility, Z: Viscosity, cp

Pressure, psig	Compressibility, Z	Viscosity, cp	2890 psig, 201° F	°API at 60° F	V _R */V _S
2890	-	-	0	60R/bbl STOIL	1.0000
2770	0.821	0.0187	21	27.1	0.9909
2350	0.828	0.0170	99	127.7	0.9587
1955	0.842	0.0156	173	223.2	0.9290
1535	0.862	0.0141	242	312.2	0.9028
1170	0.885	0.0134	307	396.1	0.8755
730	0.919	0.0128	380	490.3	0.8465
400	0.946	0.0122	435	561.3	0.8198
200	0.964	0.0116	468	603.9	0.8046
0	-	-	519	669.7	0.7750
				41.1	

*V_R = Volume residual oil at 0 psig, 60° F

V_S = Volume saturated oil at 2890 psig, 201° F

**V = Volume saturated oil at indicated pressure, 201° F

*** = Determined from calculated composition of equilibrium gas

TABLE II-A

Comparison of Experimental and Computed Flash Liberation Results
Subsurface Oil Sample

Source: Esso Standard Oil (Australia) Ltd., Tuna A-1 (Lower) Well

Date Taken: June 26, 1968

(P ₁) Pressure psig	Temperature °F	Gas-Oil Ratio - cu ft/bbl Residual Oil Flashed from P ₁ to 0		Residual Oil Gravity °API at 60°F		V _R /S	
		Experimental	Computed	Experimental	Computed	Experimental	Computed
0	75	756	749	40.5	40.5	0.7169	0.7179
20	75	708	707	41.0	41.1	0.7246	0.7296
150	75	628	609	41.5	41.7	0.7313	0.7377

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Data Used in Flash Calculations

Subsurface Oil Sample		
Component	Mol %	gal/mol
Hydrogen Sulfide	0.00	
Carbon Dioxide	8.10	6.47
Nitrogen	0.60	
Methane	33.64	
Ethane	5.19	
Propane	3.33	
Iso-Butane	0.66	
N-Butane	1.47	
Iso-Pentane	0.53	
N-Pentane	0.80	
Hexanes	2.28	14.51
Heptanes	3.72	15.54
Octanes	3.59	16.62
Nonanes	2.39	18.08
Heavier Fraction	33.70	27.45
Total	100.00	

K-value Source: NGAA (1957)
Convergence Pressure: 10,000 psia

Unadjusted Flash Data*

Molecular weight of heavier fraction	191
Density of heavier fraction, gm/cc at 60°F	0.8336
Specific volume of reservoir fluid at bubble point and 201° F, cu. ft./lb.	0.02301
Mols per barrel	2.675

*Computed values reported were obtained using a + 1/2 percent C₁₀₊ density correction.

TABLE III

Hydrocarbon Analysis of Subsurface Oil Sample

Source: Esso Standard Oil (Australia) Ltd., Tuna A-1 (Lower) Well

Date Taken: June 26, 1968

<u>Component</u>	<u>Weight Percent</u>	<u>Density, g/cc at 60° F</u>	<u>Molecular Weight</u>
Hydrogen Sulfide	0.00		
Carbon Dioxide	3.91		
Nitrogen	0.18		
Methane	5.91		
Ethane	1.71		
Propane	1.60		
Iso-Butane	0.42		
N-Butane	0.94		
Iso-Pentane	0.42		
N-Pentane	0.63		
Hexanes	2.17	0.7186	87
Heptanes	4.08	0.7711	100
Octanes	4.33	0.7932	110
Nonanes	3.14	0.8019	121
Heavier Fraction	<u>70.53</u>	0.8336	191
Total	100.00		
Pentane-Free Fraction		0.8241	169

Orsat Analysis of Gas Liberated at 0 psig and 75° F

<u>Component</u>	<u>Volume Percent</u>
Hydrocarbons	84.90
Hydrogen Sulfide	0.00
Carbon Dioxide	<u>15.10</u>
Total	100.00

Residual Crude Oil

Wax Content	24.89 % by wt
Sulfur Content	0.04 % by wt
Pour Point	75° F

TABLE IV

Viscosity of Reservoir Oil at 201° F

Source: Esso Standard Oil (Australia) Ltd., Tuna A-1 (Lower) Well

Date Taken: June 26, 1968

<u>Pressure, psig</u>	<u>Viscosity, cp</u>	<u>Density, gm/cc</u>
4000	0.508	0.7061
3500	0.495	0.7015
3000	0.485	0.6968
P _s = 2890	0.484	0.6959
2380	0.505	0.7045
2000	0.532	0.7109
1720	0.545	0.7156
1505	0.565	0.7192
1230	0.591	0.7237
1010	0.608	0.7274
720	0.658	0.7321
510	0.686	0.7356
215	0.775	0.7406
0	0.962	0.7445

P_s of oil at 201° F = 2905 psia (2890 psig)