PRODUCTION TEST
NORWAY - WELL 31/2-2
SAMPLING AND ANALYSIS
OF GAS AND CONDENSATE

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SUMMARY

The Thornton well-head testing equipment has been used to determine the well-head fluid composition by split phase sampling during the production testing of Well 31/2-2 on the North West Venture.
This report details the liquid/gas ratios, compositional and equilibrium data obtained from these tests.

SAMPLING AND ANALYSIS OF GAS AND CONDENSATE

NORWAY - WELL 31/2-2

1. INTRODUCTION

In September 1980 Thornton carried out a series of gas tests using the Thornton well-head testing equipment on Well 31/2-2 (West Venture), during the production testing period.

The object of the Thornton tests was to obtain detailed gas/liquid equilibrium data for use in designing production streams.

2. EXPERIMENTAL AND RESULTS

The Thornton well-head testing equipment consists of two main pieces of equipment comprising a large heavy-duty sampling mainfold (ref. Figure 1) containing a mixing device to ensure that a fully representative sample of well-head fluid is obtained for testing. The latter sample is fed by means of a probe into the second piece of equipment, which is a miniature laboratory containing a series of separators controlled at selected conditions of temperature and pressure (ref. Figure 2).

The Thornton manifold is placed next to the well-head christmas tree, upstream of the Flopetrol choke manifold and test separator.

After preliminary evaluation of the gas, two stage separations were selected for treating the gas at specific times during the production test. The conditions chosen were:

	psig	°F
1st stage	1000	33 ⟶ 43*
2nd stage	500	4 ⟶ 12*

* Constant temperature between these limits.

Gases and condensates obtained from these tests were recombined to produce a well-head fluid composition. In addition condensate/gas ratios (CGRs) were determined for both separations at test conditions and also vented to atmosphere.

The series of gas tests carried out using the Thornton equipment on Well 31/2-2 during production testing are reported as follows:

Clean sand zone

Test No. NWT:	Approx. flow MMSCF/D	Results of phase compositions Table No.
1	23	1
2	23	2
3	23	3

The experimentally measured liquid/gas ratios at test conditions and also vented to atmosphere are reported in Table 4. Schematic separation diagrams together with condensate/gas ratios (CGR's) are shown in Figures 3-5. The schematic diagram is in effect, two diagrams in one. The upper figures in each box show the molar split of the reservoir fluid throughout the separation sequence, whilst the lower figures show the related quantities of liquids and gas involved in each separation resulting in an end volume of 1MMSCF. The two sets of figures are not equivalent.

A comparison of well-head fluid compositions from all tests is given in Table 5.

Table 1

Test NWT 1 - Tested 21.9.80

Compositions (mol %) - Experimentally determined

Component	Feed composition	Separation 1 1000 psig/33°F		Separation 2 500 psig/7°F	
		Liquid	Gas	Liquid	Gas
C1	92.257	27.912	92.702	20.382	92.821
2	3.920	5.637	3.908	6.421	3.904
3	0.461	2.148	0.449	2.967	0.445
i4	0.383	3.642	0.360	6.364	0.350
n4	0.044	0.860	0.039	1.000	0.037
i5	0.072	2.533	0.055	3.333	0.050
n5	0.005	0.671	-	0.025	0.001
6	0.161	11.999	0.079	19.662	0.047
7	0.199	20.814	0.056	28.531	0.009
8	0.060	7.312	0.010	6.125	-
9	0.039	5.113	0.004	2.466	
10	0.032	4.351	0.002	0.933	
11	0.013	1.846	-	0.115	
12	0.006	0.827			
13	0.004	0.565			
14	0.002	0.271			
15	-	0.129			
16		0.046			
17		0.028			
18		0.024			
19		0.009			
Benzene	-	0.068	-	0.036	-
Toluene	0.001	0.167	-	0.156	-
Xylene	0.019	2.532	0.002	1.095	-
N_2	1.761	0.073	1.772	0.096	1.775
CO_2	0.561	0.423	0.562	0.291	0.562
Mole ratio		0.0069		0.0016	
CGR bbl/MMSCF		5.74 (4.76)*		1.32 (1.19)*	

* Vented to atmos.

Table 2

Test NWT 2 - Tested 21.9.80

Compositions (mol %) - Experimentally determined

Component	Feed composition	Separation 1 1000 psig/38°F		Separation 2 500 psig/12°F	
		Liquid	Gas	Liquid	Gas
C1	92.425	27.316	92.810	20.405	92.926
2	3.731	4.978	3.726	6.118	3.720
3	0.450	1.949	0.441	2.913	0.437
i4	0.373	3.286	0.355	6.291	0.346
n4	0.051	0.763	0.047	1.216	0.045
i5	0.067	2.304	0.054	3.267	0.049
n5	0.004	0.596	-	0.025	0.0001
6	0.155	9.319	0.100	19.357	0.070
7	0.182	19.243	0.069	28.300	0.024
8	0.057	7.928	0.010	6.382	-
9	0.042	6.388	0.004	2.687	
10	0.038	6.129	0.002	1.073	
11	0.017	2.883	-	0.148	
12	0.009	1.547		-	
13	0.006	0.961			
14	0.003	0.567			
15	0.002	0.295			
16	-	0.070			
17		0.058			
18		0.052			
19		0.023			
Benzene	Less than 0.001	0.052	-	0.037	-
Toluene	0.001	0.145	-	0.163	-
Xylene	0.018	2.658	0.002	1.231	-
N_2	1.814	0.097	1.824	0.099	1.827
CO_2	0.555	0.393	0.556	0.288	0.556
Mole ratio		0.0059		0.0016	
CGR bbl/MMSCF		5.17 (4.38)*		1.27 (1.16)*	

* Vented to atmos.

Table 3

Test NWT 3 - Tested 21.9.80

Compositions (mol %) - Experimentally determined

Component	Feed composition	Separation 1 1000 psig/43°F		Separation 2 500 psig/4°F	
		Liquid	Gas	Liquid	Gas
C1	92.141	27.990	92.554	20.343	92.689
2	3.868	5.268	3.859	6.339	3.854
3	0.395	2.063	0.384	2.533	0.380
i4	0.362	3.384	0.343	6.036	0.332
n4	0.063	0.719	0.059	1.514	0.056
i5	0.081	2.432	0.066	3.933	0.059
n5	0.004	0.625	-	0.025	-
6	0.181	11.213	0.110	19.740	0.073
7	0.242	20.304	0.112	28.164	0.060
8	0.060	7.531	0.011	6.124	-
9	0.040	5.558	0.005	2.481	
10	0.034	4.949	0.002	0.924	
11	0.014	2.155	-	0.131	
12	0.007	1.072		-	
13	0.004	0.657			
14	0.002	0.313			
15	0.001	0.164			
16	-	0.056			
17		0.042			
18		0.013			
19		0.009			
Benzene	Less than 0.001	0.070	-	0.036	-
Toluene	0.001	0.172	-	0.156	-
Xylene	0.020	2.797	0.002	1.117	-
N_2	1.903	0.044	1.915	0.104	1.918
CO_2	0.577	0.400	0.578	0.300	0.579
Mole ratio		0.0064		0.0018	
CGR bbl/MMSCF		5.48 (4.55)*		1.50 (1.37)*	

* Vented to atmos.

Table 4

Liquid/gas ratios for well-head gas tests

Test no.	Well flow-rate (Approx.) MMSCF/D	Date and time	Separation conditions psig/°F	Measured liquid gas/ratio			
				At test conditions		At 1 atmosphere*	
				kg/10^6 Nm^3	bbl/MMSCF	kg/10^6 Nm^3	bbl/MMSCF
1	23	21-9-80 12-10	1. 1000/33 2. 500/7	23 010 5 271	5.74 1.32	19 765 4 790	4.76 1.19
2	23	21-9-80 15-00	1. 1000/38 2. 500/12	20 920 5 101	5.17 1.27	18 362 4 671	4.38 1.16
3	23	21-9-80 17-30	1. 1000/43 2. 500/4	21 869 18 945	5.48 1.50	6 000 5 492	4.55 1.37

* Refer to Figures 3-5 for flash temperatures.

Table 5

Composition of well-head fluid compositions (mol %)

Component	NWT 1	NWT 2	NWT 3
C1	92.257	92.425	92.141
2	3.920	3.731	3.868
3	0.461	0.450	0.395
i4	0.383	0.373	0.362
n4	0.044	0.051	0.063
i5	0.072	0.067	0.081
n5	0.005	0.004	0.004
6	0.161	0.155	0.181
7	0.199	0.182	0.242
8	0.060	0.057	0.060
9	0.039	0.042	0.040
10	0.032	0.038	0.034
11	0.013	0.017	0.014
12	0.006	0.009	0.007
13	0.004	0.006	0.004
14	0.002	0.003	0.002
15	-	0.002	0.001
. Benzene	-	Less than 0.001	Less than 0.001
Toluene	0.001	0.001	0.001
Xylene	0.019	0.018	0.020
N_2	1.761	1.814	1.903
CO_2	0.561	0.555	0.577

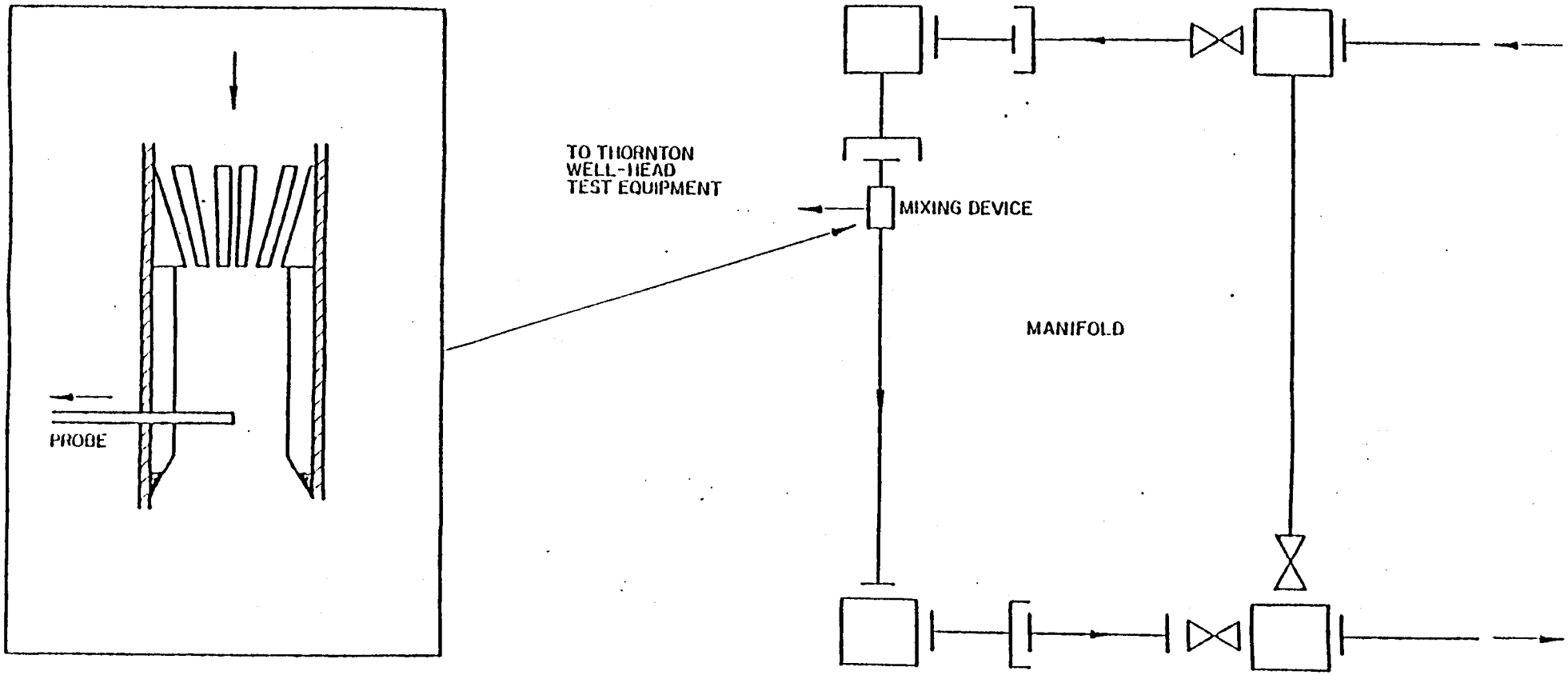

FIG. 1 – Thornton sample manifold and mixing device

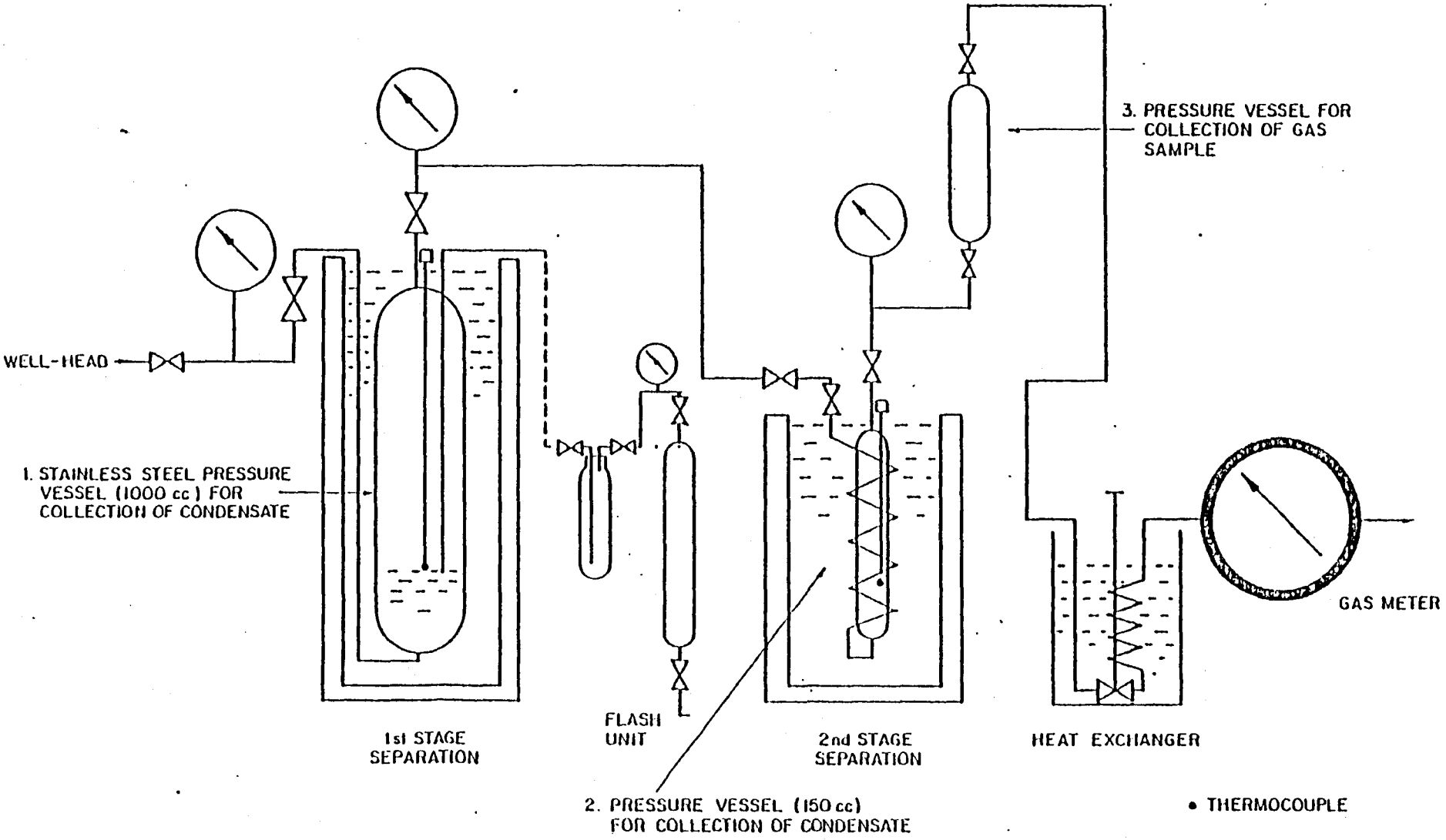

FIG.2—Well-head test equipment

FIG.3

TEST NWT1
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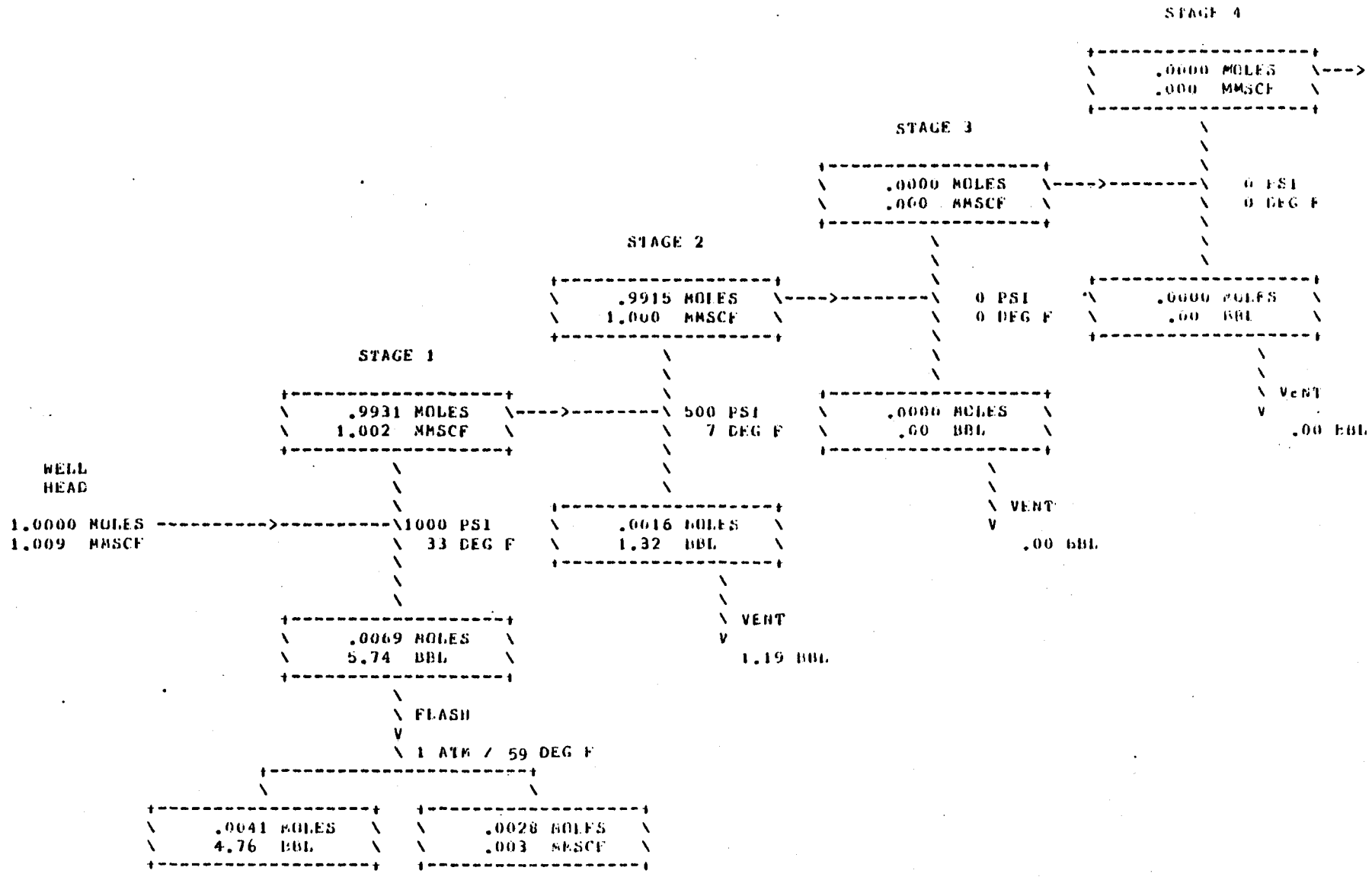

G.O.R. = 211139. SCF/BBL

FIG.4

TEST NWT2
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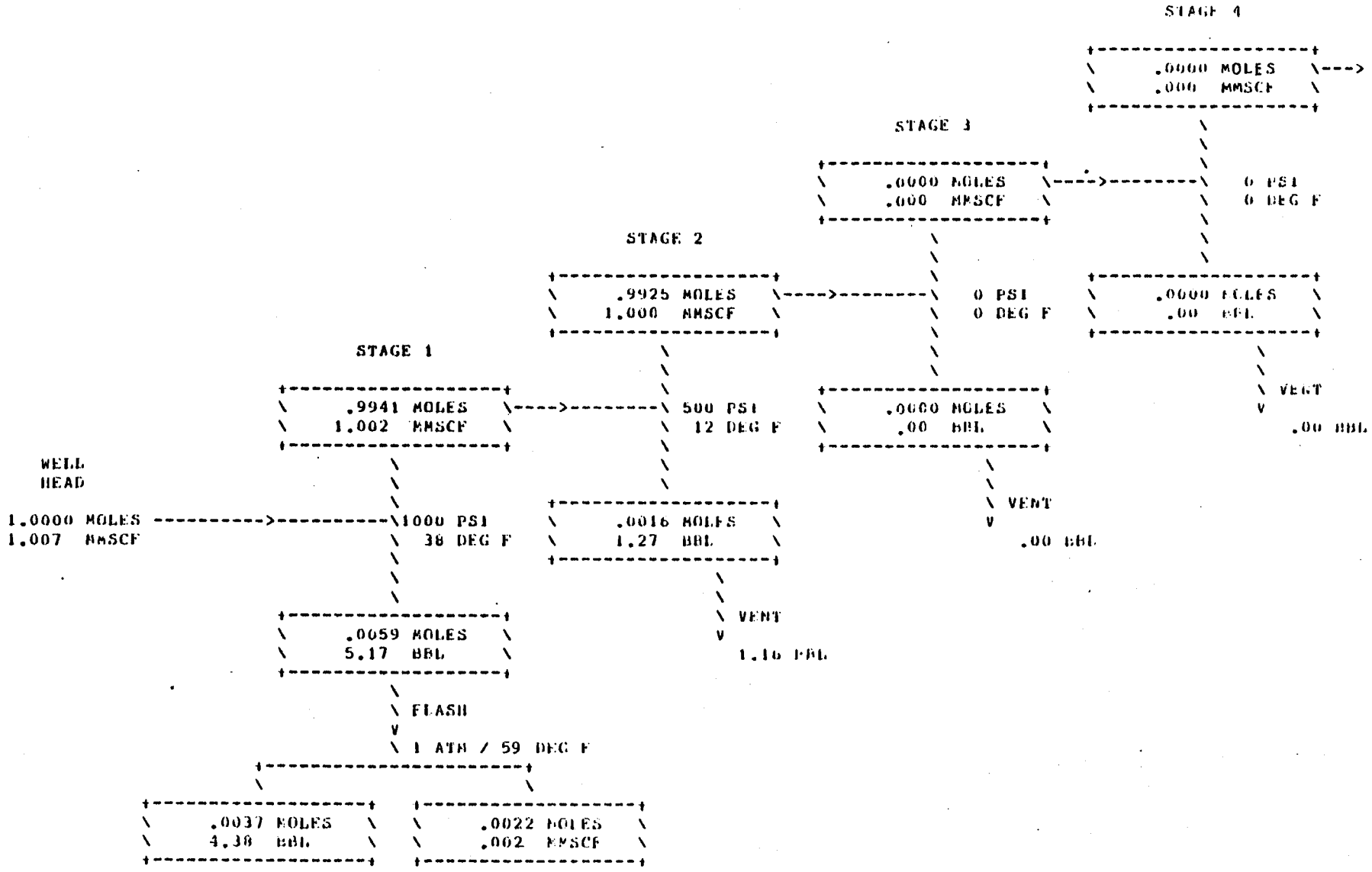

G.O.R. = 229090. SCF/BBL

FIG.5

TEST NWT3
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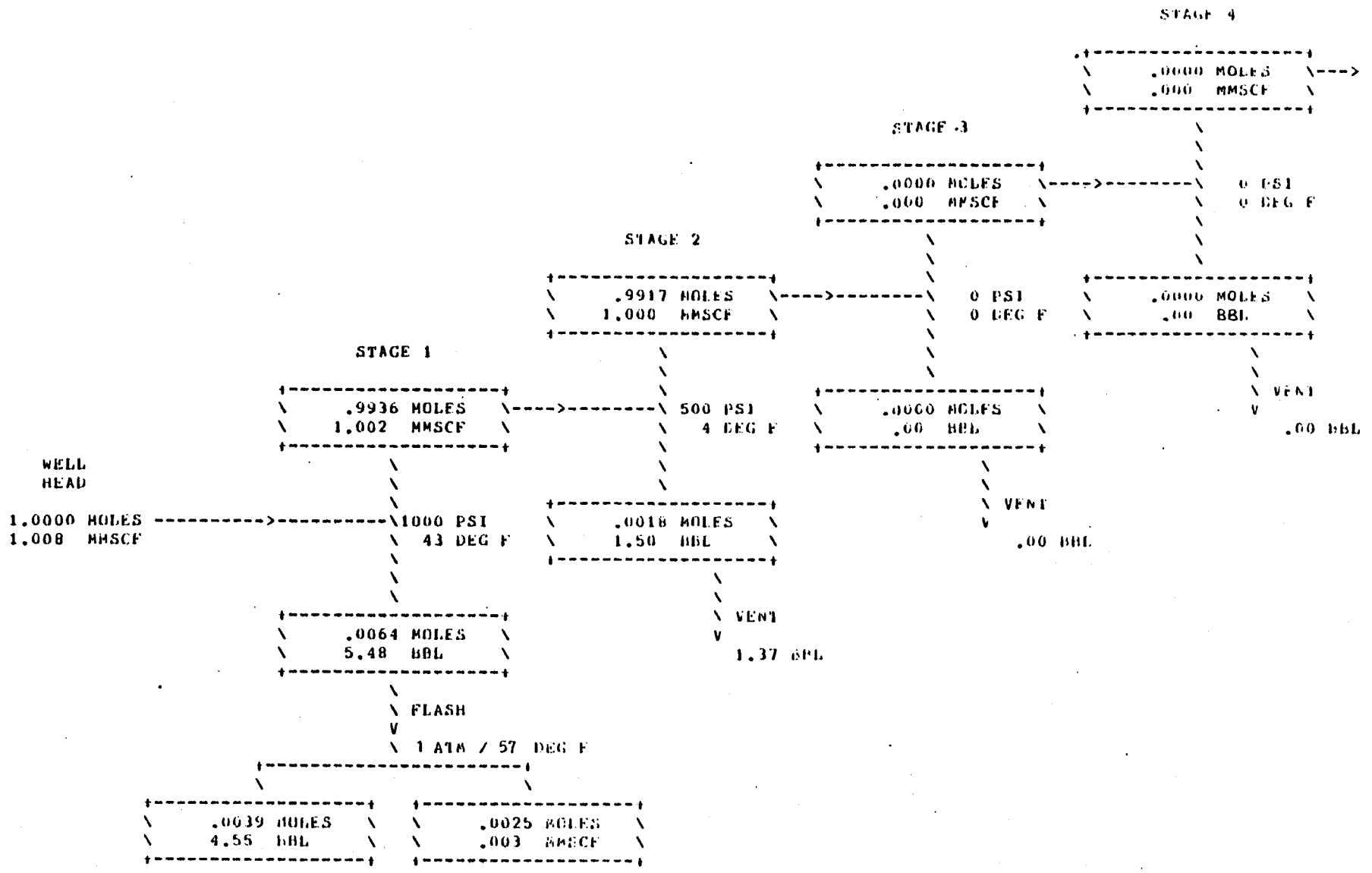

G.O.R. = 220911. SCF/BBL