

WELL TEST REPORT

PL 050

WELL NO. 34/10-9

NOVEMBER 1980

Leif Magne Meling

WELL DATA

Operator : Den norske stats oljeselskap a.s

Well : 34/10-9

Location : 61°12'55.30" N
02°15'00.50" E

Classification : Exploration well

Rig : Ross Rig 24.3. - 9.5.80
Deep Sea Saga 29.5. - 3.7.80
(testing)

Spudded : 24 March 1980

Completed : 3 July 1980

RKB elevation : 25 m

Water depth : 203 m

Total depth : 2421 m RKB

Objective : Sandstone of middle jurassic age

Status : Plugged and abandoned

WELL TEST REPORT 34/10-9

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1. INTRODUCTION

Well 34/10-9 is the eighth well drilled on the Delta structure on Block 34/10. The well penetrated Brent, Dunlin and Statfjord formation, and reached a total depth of 2421 m RKB. Brent formation and Cook member of the Dunlin formation contained hydrocarbons. Statfjord formation contained water.

2. OBJECTIVES

The objectives of testing 34/10-9 were:

1. To test the Brent formation and the Cook member of the Dunlin formation for productivity, pressure and temperature.
2. To find the pressure profile in the Brent and Dunlin formation.
3. To obtain representative samples of the reservoir fluid.
4. To get an estimate of the fracture pressure in the Brent formation.
5. To estimate the OWC in the Cook member of the Dunlin formation.

3. CONCLUSIONS

1. RFT and DST data indicate that the Brent formation in well 34/10-9 represent the same pressure system as in previous drilled wells in the Brent formation. The gradient is 0.076 bar/m.
2. The data indicate that the Cook member of the Dunlin formation represent the same pressure system as in well 34/10-7 in the Cook member of the Dunlin formation. The gradient in the oil zone is 0.074 bar/m and 0.105 bar/m in the water zone.
3. The OWC in the Cook member of the Dunlin formation must be below - 2084 m MSL (below the tested interval during DST no. 1).
4. The permeability thickness of the tested part of the Brent formation is estimated to 100463 md*ft and the permeability to 362 md.
5. The DST no. 2 in the Cook formation indicate a high permeable zone at top of the formation. The permeability thickness is estimated to 85227 md*ft and the permeability to 2221 md.
6. The DST no. 1 was performed in a more shaly part of the Cook formation. The permeability thickness is estimated to 403 md*ft and the permeability to 17.6 md.
7. The fracture test indicate a fracturing pressure of 5562 psia at - 1857 m MSL (ie. equivalent mudweight 2.06 g/cc).
8. The fluid samples taken in the Brent and the Dunlin formation do not compare with samples from previous drilled wells on Delta.

9. The maximum temperatures recorded during the drill stem tests were:

84.4°C	at - 2081 m MSL	DST no. 1
83.3°C	at - 2962 m MSL	DST no. 2A
76.8°C	at - 1882 m MSL	DST no. 3

10. No water was produced during DST no. 2A and 3. During DST no. 1 very small amounts of water was observed in some samples.
11. The well did not produce sand, but small sand slugs was observed after choke changes during DST no. 2A and DST no. 3.

4. DISCUSSION

4.1 DST no. 1

The well was perforated in the Cook 2 member of the Dunlin formation from 2103 m RKB to 2109 m RKB. The tested part of the formation is shaly and a relative low permeability was expected. The log evaluation indicate a high water saturation (approx. 60%) in tested part of the formation. One of the objectives of the DST was therefore to examine the water production. But during the test only very small amounts of water was produced (0.2 - 0.3%). This could indicate a lower water saturation than estimated from logs.

The initial PBU was performed without problems, but during the final PBU the APR-N valve failed to close. The final PBU was therefore heavily influenced by wellbore storage.

4.1.1 Analysis of DST no. 1

Because of the influence of the wellbore storage during the final build-up the test was too short to reach the Horner straight-line. The maximum slope method suggested by Raghavan and Rivery was used to analyse the PBU. The method is empirical and the results from the analysis must be considered as approximate values. The analysis indicate a permeability thickness of 403 md*ft and a permeability of 17.6 md.

The skin value is estimated to 33. The reservoir pressure calculated by this method is too low, the reservoir pressure estimated from the initial PBU, however, is close to the reservoir pressure calculated from the RFT data. The initial PBU indicate a reservoir pressure of 4820 psia at - 2062 m MSL.

A thickness of 7 m, an average porosity of 19% and a water saturation of 60% was used in the analysis. PVT properties were taken from the Core lab. report RFLA 80147 based on a sample taken during DST no. 2A.

The analysis of the DST can be found in appendix A1.

4.2 DST no. 2 and 2A

The well was perforated in the Cook 3 member of the Dunlin formation from 2084 RKB to 2090 RKB. The interval tested is clean compared with the interval tested during DST no. 1. Therefore a higher permeability was expected.

The DST no. 2 was aborted due to plugging of the sandscreen. The test was renamed to DST no. 2A. The same interval was tested.

4.2.1 Analysis of DST no. 2A

The test was analysed by using the Horner method. The analysis indicate a permeability thickness of 85227 md·ft, a permeability of 2221 md, and a skin factor of + 11.4. Because of the large perforated interval compared with the net pay, the total skin factor calculated is close to the formation skin factor.

The DST indicate a reservoir pressure of 4792 psia at - 2031.5 m MSL. This pressure is lower than indicated by the RFT data by within the accuracy of the tools.

A thickness of 11.7 m, an average porosity of 29% and a water saturation of 34% was used in the analysis. These data are estimated from the CPI log in appendix A8. PVT properties were taken from the Core lab. report RFLA 80147 based on a sample taken during the DST.

The analysis of the DST can be found in appendix A2.

4.3 DST no. 3

The well was perforated in the Rannoch member of the Brent formation from 1904 m RKB to 1910 m RKB.

4.3.1 Analysis of DST no. 3 -----

The Horner method was used to analyse the DST. The analysis indicate a permeability thickness of 100464 md·ft, a permeability of 362 and a total skin factor of + 10.6. The net pay thickness between 1854 m RKB and 1945 m RKB was used in the calculation of the permeability. The net pay thickness include the Rannoch memeber and the lower part of the Etive member of the Brent formation. The permeability of 362 md calculated from the DST data compare excellent with the permeability of 385 md estimated by log/core analysis. The calculated skin factors support the net pay thickness used in the analysis. The partial penetration skin factor is estimated to + 46, the total skin factor calculated from the DST data is + 10.6. This indicate a larger effective completion interval than perforated. The reason is probably poor cemenť bond and fluid flow in the annulus between the casing and the borehole.

The DST indicate a reservoir pressure of 4509 psia at - 1857 m MSL. This pressure compare excellent with the RFT data.

A thickness of 84.5 m, an average porosity of 30% and a water saturation of 17% was used in the analysis. These data are taken from the CPI log in appendix A8. PVT properties were taken from the Core lab. report RFLA 80146 based on a sample taken during the DST.

The analysis of the DST can be found in appendix A3.

4.4 RFT analysis

The repeat formation tester was run and data were obtained from 1838 m RKB to 1875 m RKB in the Brent formation and from 2086 m RKB to 2131 m RKB in the Dunlin formation. Besides the repeat formation tests, two formation interval tests (FIT) were run in well 34/10-9. One test was performed in the Brent formation at 1840 m RKB. The sample contained hydrocarbones. The other test was performed in teh Cook member of the Dunlin formation at 2132 m RKB. The objective of this test was to examine the interval with regard to a later drill stem test. But the sample contained water and the DST no. 1 was performed above this interval.

From the RFT data, a gradient pf 0.074 bar/m is estimated in the Brent formation. The data compare well with data from the Brent formation in previous drilled wells on the Delta structure.

In the Cook member of the Dunlin formation the data collected compare well with the data from well 34/10-7 in the Dunlin and Statfjord formation. The data from 34/10-9 are scattered, but comparèd with the data from well 34/10-7 a gradient of 0.076 bar/m is estimated in the oil zone and a gradient of 0.105 bar/m is estimated in the water zone. Because of the scattered data the OWC is a subject to discussion. The data indicate an OWC between - 2080 m MSL and - 2100 m MSL.

4.5 Reservoir temperature

The maximum recorded temperatures recorded during the drill stem tests were:

84.4°C	at - 2081 m MSL	DST no. 1
83.3°C	at - 2062 m MSL	DST no. 2A
76.8°C	at - 1882 m MSL	DST no. 3

These temperatures are compared with data from previous drilled wells on the Delta structure in appendix A5.

The data indicate a temperature of approx. 74°C at - 1900 m MSL and a temperature gradient of 3.5°C/100 m in the Brent formation. In the Cook member of the Dunlin formation the data indicate a temperature of approx. 81°C at - 2000 m MSL and a temperature gradient of 3.2°C/100 m.

4.6 Sampling

The surface sampling and bottom hole samples taken in well 34/10-9 are listed in appendix A6.

The analysis of the samples do not compare with data from previous drilled wells. The analysis done by Statoil Production Laboratory are listed in appendix A6.

4.7 Fracture test

After finishing bottom hole sampling on DST no. 3 a fracture test was performed. During the bullheading with water, after 45 barrels had been pumped, the BHP reached 5562 psia. This pressure was higher than the expected fracturing pressure of the formation. During the injection test the BHP steadily decreased. It is therefore believed that the formation was fractured during the bullheading at a pressure of 5562 psia. This pressure corresponds to a equivalent mudweight of 2.06 g/cc.

The data collected during the fracture test can be found in appendix A7.

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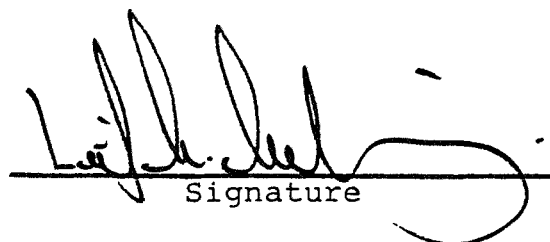
BOTTOM HOLE PRESSURE REPORTWell 34/10-9Test no. DST no. 1Test Date 14.6.80Date of analysis 18.11.80Gauge no. MRPG 0022

SUMMARY OF THE RESULTS

	PBU no.2	Initial PBU
	Max. slope method	Horner analysis
Kh md·ft	403	
K md	17.6	
S	+ 33	
\bar{P} (psig) at <u>-2062m</u> ss	4633	4820

Max recorded Temp. 84.4°CRemarks

The PBU no. 2 is analysed by using the maximum slope method. The initial pressure calculation is very sensitive to changes in production time and PVT data. No attempt was done to match the pressure obtained from the initial PBU by changing this data in PBU no. 2. The pressure estimated from the initial PBU is assumed to be more realistic.


Signature

Well 34110-9, DST no. 1

Test date 16.6.80

Reservoir Parameters

Perforations 2103-2109 m

Zone(s) COOK

RKB _____

Wellbore radius 0.11 m

RKB Elev 0.25 m

Midpoint Production 2081 m ss Bomb at 2087 m RKB 2062 m ss

Pressure Functions Evaluated at _____ ss Datum Depth _____ ss

Delta P required to correct to datum _____ psig Gradient _____ psi/ft

Estimated Average Pressure _____ psig

Formation Volume Factor 1.309 vol/vol Viscosity 0.80 cp

Thickness 7 m Porosity 19 % Drainage Area _____ acres

Oil Saturation 40 % Oil Compressibility 9.3 10^{-6} psi⁻¹

Water Saturation 60 % Water Compressibility 3.0x 10^{-6} psi⁻¹

Gas Saturation - % Gas Compressibility - 10^{-6} psi⁻¹

Formation Compressibility 3.0x 10^{-6} psi⁻¹

System Compressibility $C_t = S_o C_o + S_w C_w + S_g C_g + C_f$

$$C_t = .4 \times 9.3 \times 10^{-6} + .6 \times 3.0x \times 10^{-6} + - \times - \times 10^{-6} + 3.0 \times 10^{-6}$$

$$C_t = 8.5x \times 10^{-6} \text{ psi}^{-1}$$

Rates Reported on Test.

Choke 20/64 inches Oil Rate 264 STBPD Gas Rate 0.104 MMSCFD

FTP _____ psig Water Rate 0.2-0.37 BWD GOR 390 SCF/STB

ϕ API 34.2 Gas Spec. Grav. 0.675

Cumulative Production Oil 150 STB. Gas _____

Water _____

Well 34/10-9, DSTno.1
Initial PBV

Test Date 15.6.80

Horner Analysis

Effective-Production Time t_p = Cumulative Production / Rate Reported on Test.

$$t_p = \frac{\text{Cumulative Production}}{\text{Rate}} = \underline{15 \text{ mins.}}$$

Straight line starts at _____ hrs

Slope = 1033.9 psi/cycle

$P_{wf's}$ = 3208.7 psig

P_{1hr} = 4719.4 psig

P^* = 4819.6 psig

Calculated Values

$$K h = \frac{162.6 \text{ Q Bu}}{M} = \underline{162.6} \text{ md.ft}$$

$$K = Kh/h = \frac{\text{_____}}{\text{_____}} = \text{_____ md.}$$

$$S = 1.1513 \left[\frac{P_{1hr} - P_{wf's}}{M} + \text{Log} \left[\frac{t_p - 1}{t_p} \right] - \text{Log} \left[\frac{K}{\phi \mu C_t r_w^2} \right] + 3.2275 \right]$$

$$S = 1.1513 \left[\left[\text{_____} \right] + \text{Log} \left[\text{_____} \right] - \text{Log} \left[\text{_____} \right] + 3.2275 \right]$$

$$S = \underline{\hspace{2cm}}$$

$$t_{DA} = \frac{0.000264 K t}{\phi \mu C_t A} = \underline{0.000264}$$

$$P_{DMBH} = \underline{\hspace{2cm}}$$

$$\bar{P} = P^* - P_{DMBH} \left[\frac{M}{2.303} \right] = \underline{4820} \text{ psig @ } \underline{2062 \text{ m}} \text{ ss}$$

$$= \underline{\hspace{2cm}} \text{ psig @ } \underline{\hspace{2cm}} \text{ ss Datum}$$

Well 34/10-9, DST no. 1Test Date 16.6.80Test no. PBU no. 2MAXIMUM SLOPE METHODE

$$m_a = \underline{3100} \text{ psi/cycle}$$

$$T_p = \underline{150} / \underline{264} = \underline{13.67 \text{ hrs}}$$

$$C = \underline{1.58 \times 10^{-2}} \text{ RB/psi}$$

$$P_{1 \text{ hr}}^* = \underline{2980} \text{ psig}$$

$$C_D = \frac{5.615 C}{2 \pi \phi C_t r_w^2 h} = \frac{(5.615)(1.58 \times 10^{-2})}{2 \pi (.19)(8.5 \times 10^{-4})(35^2)(23)} = \underline{3108}$$

$$\frac{m_{(\text{apparent})}}{m_{(\text{true})}} = 0.834 \log C_D + 0.7322 S + 0.7462$$

$$C_D = (0.05859 - 0.004259 S + 0.000111 S^2) \Delta t_D^{*0.97}$$

$$K = \frac{162.6 Q B \mu}{m_t h}$$

$$t_D^* = \frac{0.000264 K t^*}{\phi C_t \mu r_w^2} \quad , \quad \dots \quad \frac{T + \Delta t^*}{\Delta t^*}$$

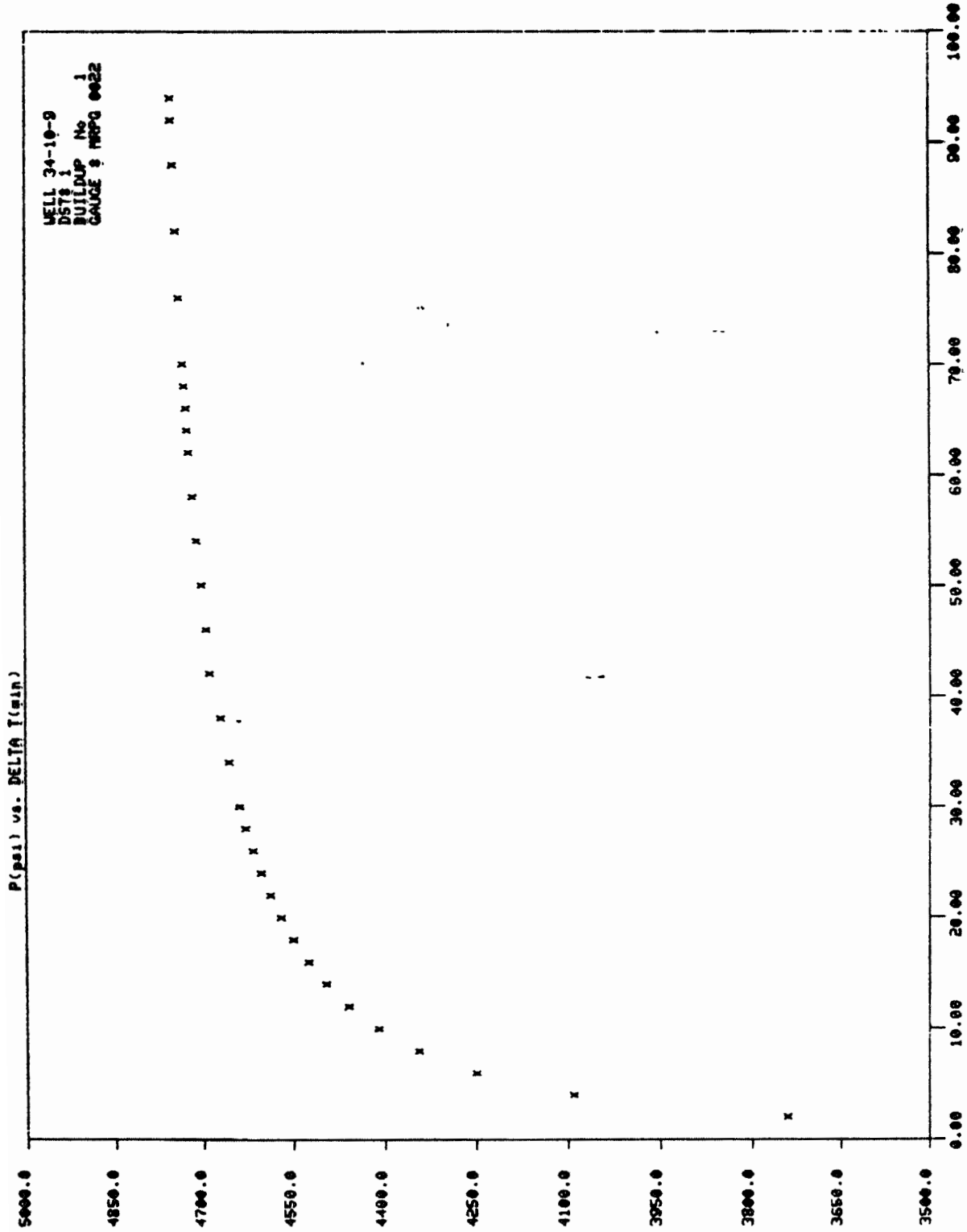
$$P^* = m_t \left(\log \left(\frac{T + \Delta t^*}{\Delta t^*} \right) \right) + m_a \left(\log (T + 1) - \log \left(\frac{T + \Delta t^*}{\Delta t^*} \right) \right) + P_{1 \text{ hr}}^*$$

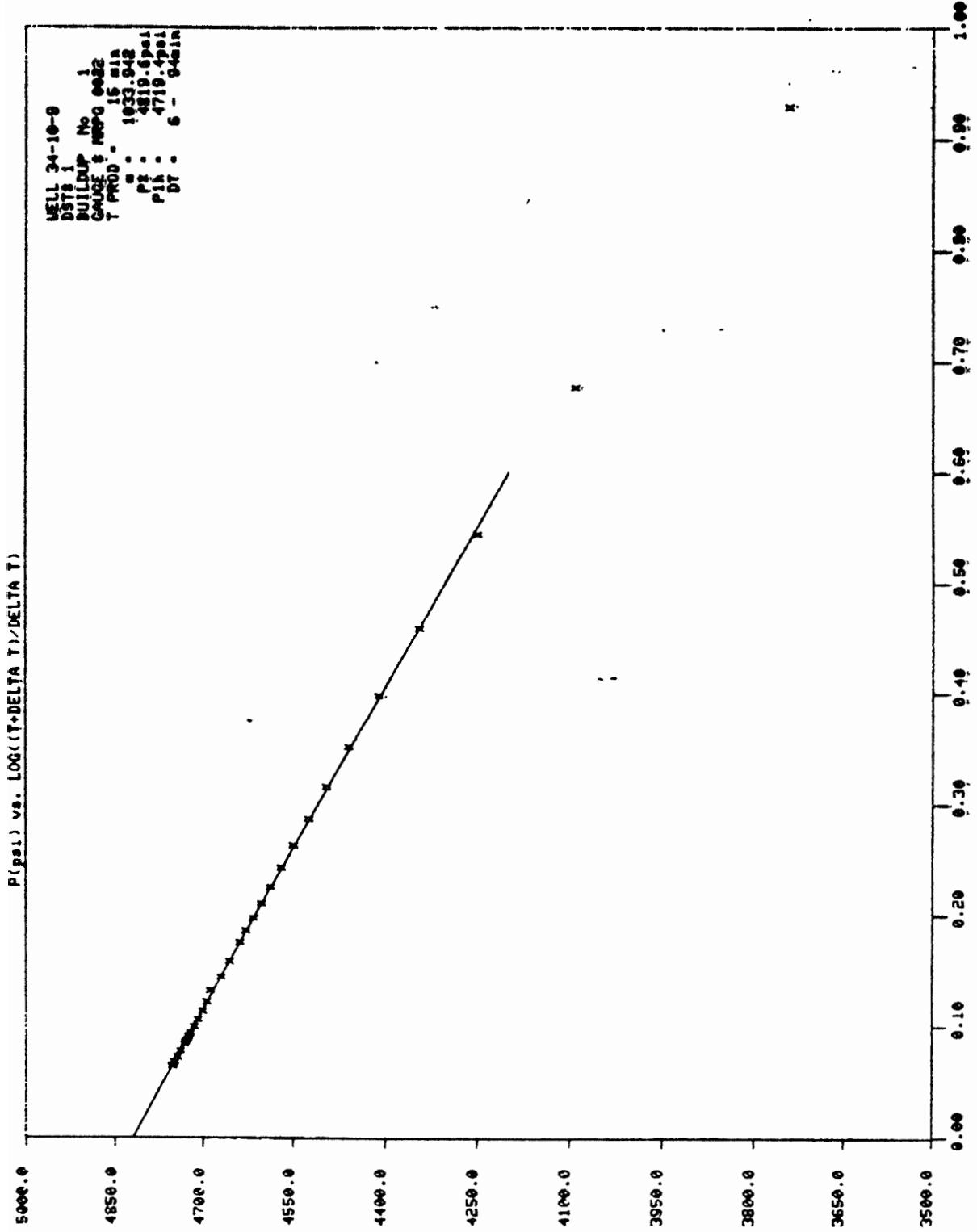
SKIN	K (md)	P^*	m_t	Δt^*	$\frac{T + \Delta t^*}{\Delta t^*}$
32	17.1	4743	114.4	4.30	4.18
33	17.6	4633	111.4	3.86	4.54
34	18.0	4521	108.5	3.47	4.94

26 12.10 4725.700
 27 12.12 4729.100
 28 12.14 4731.500
 29 12.50 4737.800
 30 12.56 4743.600
 31 13.02 4748.900
 32 13.06 4751.800
 33 13.08 4752.700

BRØNN 34-10-9 DST# 1
 BUILDUP NUMBER 1
 GAUGE MRPG 0022

NR.	TID	TRYKK (psig)
1	11.34	3208.700
2	11.36	3741.200
3	11.38	4090.700
4	11.40	4250.100
5	11.42	4344.900
6	11.44	4410.100
7	11.46	4458.900
8	11.48	4495.600
9	11.50	4524.200
10	11.52	4549.300
11	11.54	4569.100
12	11.56	4587.000
13	11.58	4602.000
14	12.00	4615.500
15	12.02	4627.600
16	12.04	4637.700
17	12.08	4655.100
18	12.12	4668.700
19	12.16	4687.200
20	12.20	4692.800
21	12.24	4700.500
22	12.28	4708.800
23	12.32	4715.000
24	12.36	4721.300
25	12.38	4724.200



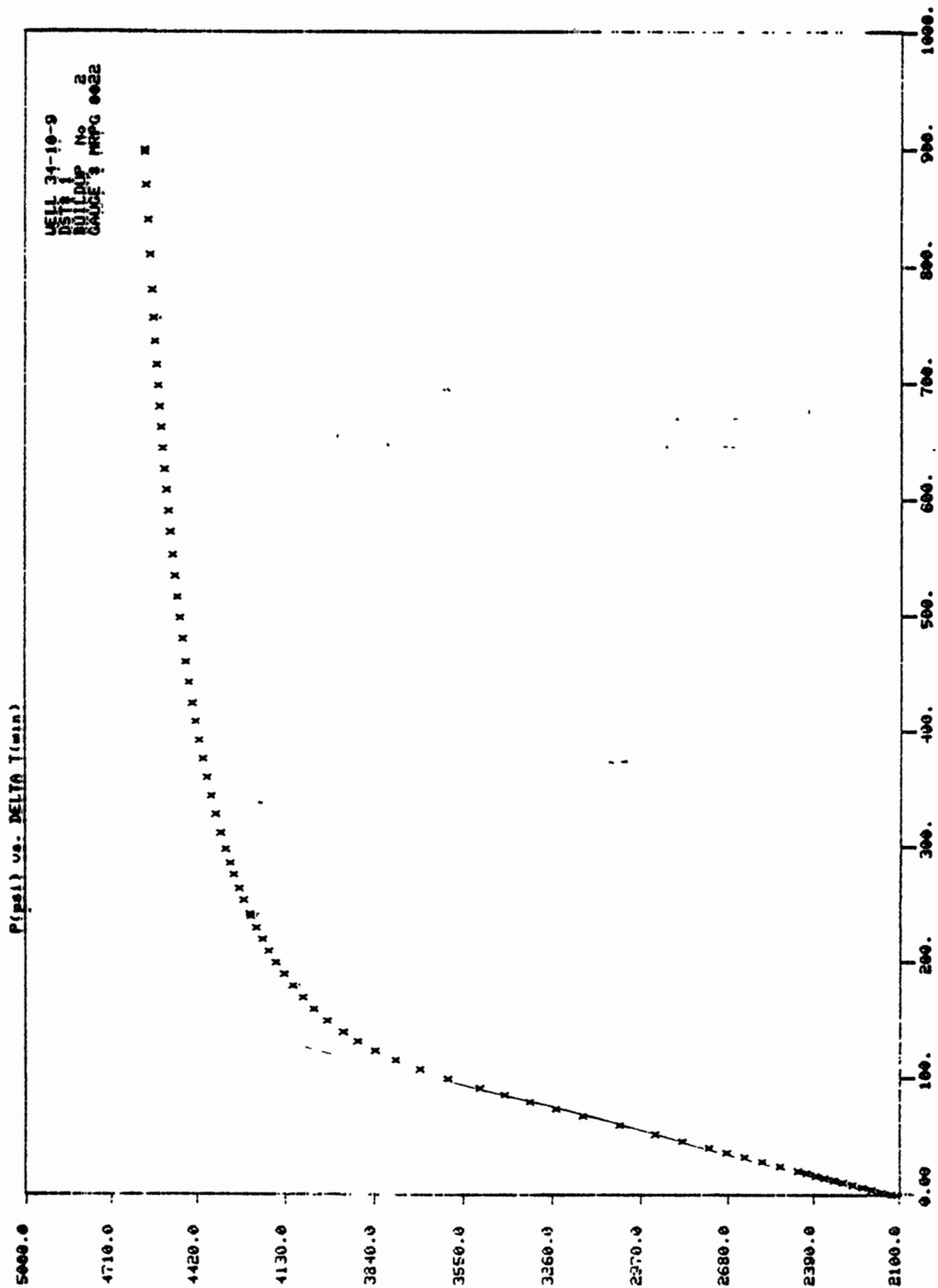


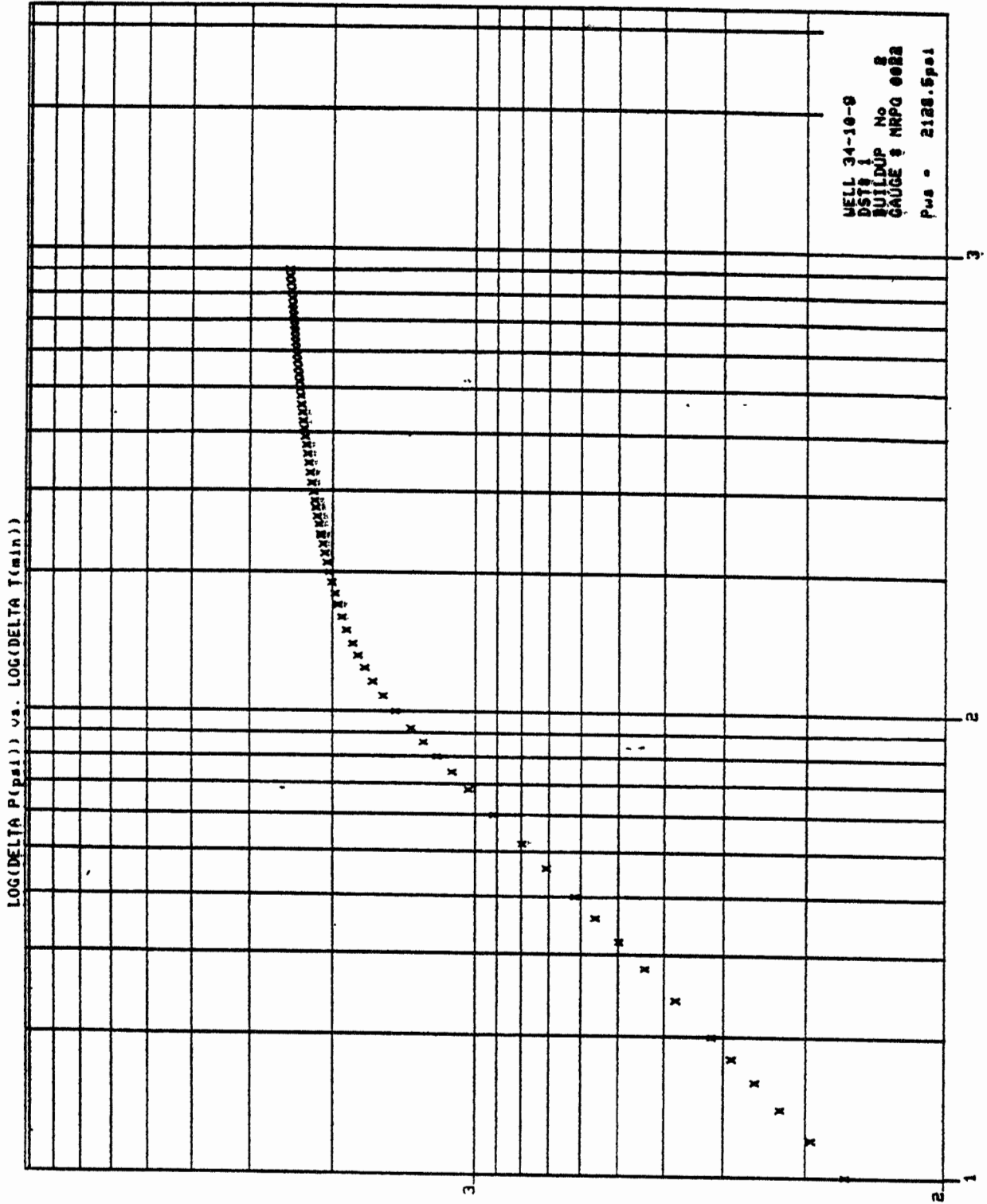
46	7.58	1323.100
47	8.12	1339.100
48	8.28	1355.500
49	8.44	1370.000
50	9.00	1385.000
51	9.16	1398.500
52	9.32	1411.100
53	9.48	1422.200
54	10.04	1433.800
55	10.22	1444.400
56	10.40	1455.000
57	11.00	1465.200
58	11.18	1475.300
59	11.36	1483.600
60	11.54	1491.800
61	12.12	1499.000
62	12.32	1506.800
63	12.50	1513.500
64	13.08	1519.300
65	13.26	1526.600
66	13.44	1532.400
67	14.02	1538.200
68	14.20	1543.000
69	14.38	1548.800
70	14.56	1553.100
71	15.16	1558.900
72	15.36	1563.800
73	16.00	1569.100
74	16.30	1575.300
75	17.00	1583.600
76	17.30	1590.400
77	17.58	1594.700
78	18.00	1595.200

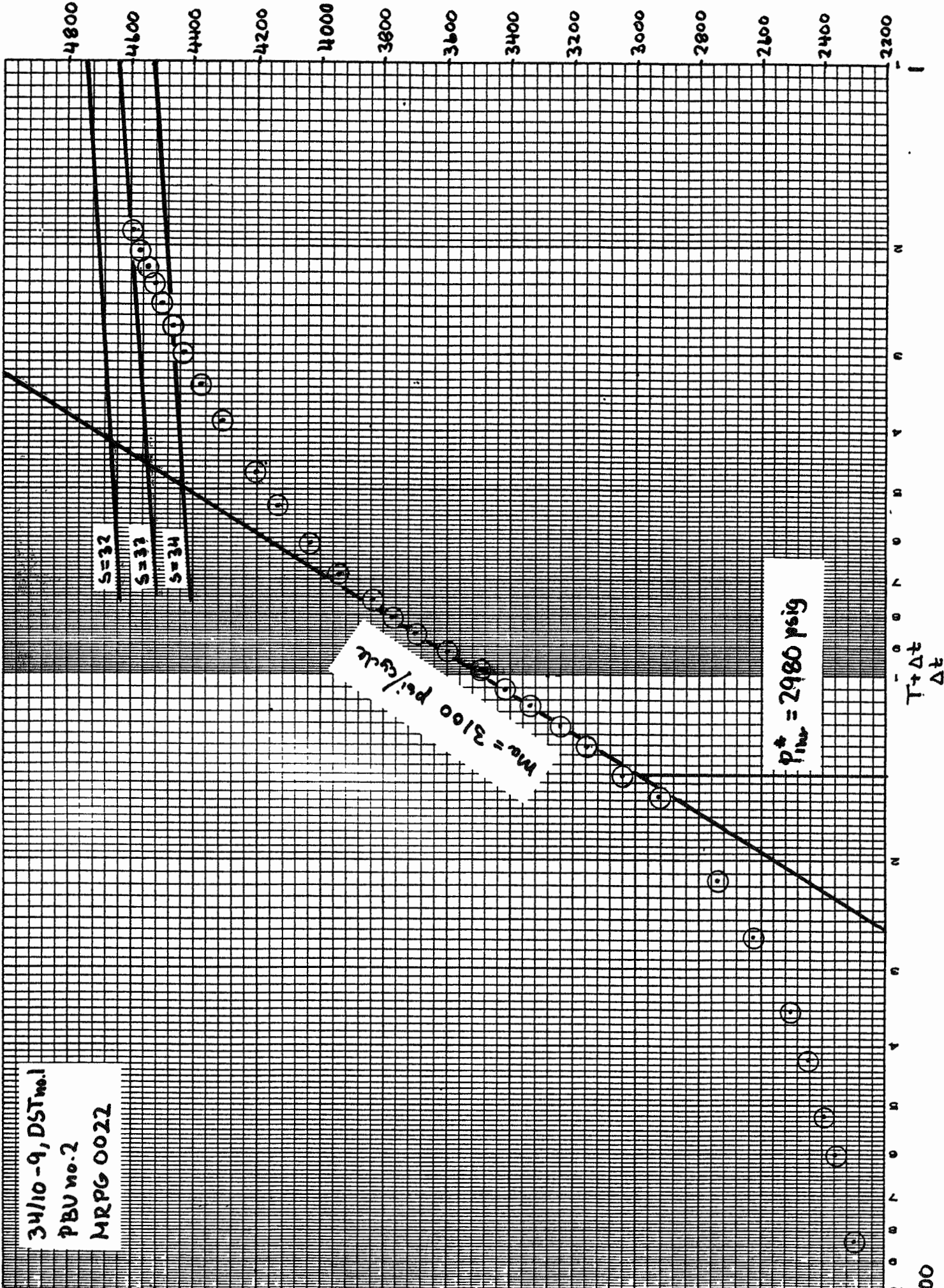
46	2128.500
47	2162.400
48	2193.800
49	2225.200
50	2258.100
51	2291.900
52	2322.800
53	2355.200
54	2385.200
55	2416.100
56	2446.100
57	2506.500
58	2567.400
59	2625.800
60	2686.200
61	2745.700
62	2835.100
63	2925.000
64	3041.900
65	3160.800
66	3248.800
67	3334.800
68	3416.500
69	3496.200
70	3600.100
71	3690.500
72	3770.700
73	3837.400
74	3893.000
75	3930.900
76	3991.100
77	4035.600
78	4070.800

46	7.58
47	8.12
48	8.28
49	8.44
50	9.00
51	9.16
52	9.32
53	9.48
54	10.04
55	10.22
56	10.40
57	11.00
58	11.18
59	11.36
60	11.54
61	12.12
62	12.32
63	12.50
64	13.08
65	13.26
66	13.44
67	14.02
68	14.20
69	14.38
70	14.56
71	15.16
72	15.36
73	16.00
74	16.30
75	17.00
76	17.30
77	17.58
78	18.00

BRNN 34-10-9		DST# 1	
BUILDUP NUMBER		2	
GAUGE MRPG 0022			
NR.	TID	TRYK (psia)	
1	3.00	2128.500	
2	3.02	2162.400	
3	3.04	2193.800	
4	3.06	2225.200	
5	3.08	2258.100	
6	3.10	2291.900	
7	3.12	2322.800	
8	3.14	2355.200	
9	3.16	2385.200	
10	3.18	2416.100	
11	3.20	2446.100	
12	3.24	2506.500	
13	3.28	2567.400	
14	3.32	2625.800	
15	3.36	2686.200	
16	3.40	2745.700	
17	3.46	2835.100	
18	3.52	2925.000	
19	4.00	3041.900	
20	4.08	3160.800	
21	4.14	3248.800	
22	4.20	3334.800	
23	4.26	3416.500	
24	4.32	3496.200	
25	4.40	3600.100	
26	4.48	3690.500	
27	4.56	3770.700	
28	5.04	3837.400	
29	5.12	3893.000	
30	5.20	3930.900	
31	5.30	3991.100	
32	5.40	4035.600	
33	5.50	4070.800	
34	6.00	4103.700	
35	6.10	4132.200	
36	6.20	4158.300	
37	6.30	4182.500	
38	6.40	4202.800	
39	6.50	4222.600	
40	7.00	4241.000	
41	7.02	4243.200	
42	7.14	4263.700	
43	7.24	4278.600	
44	7.36	4296.000	
45	7.46	4308.600	

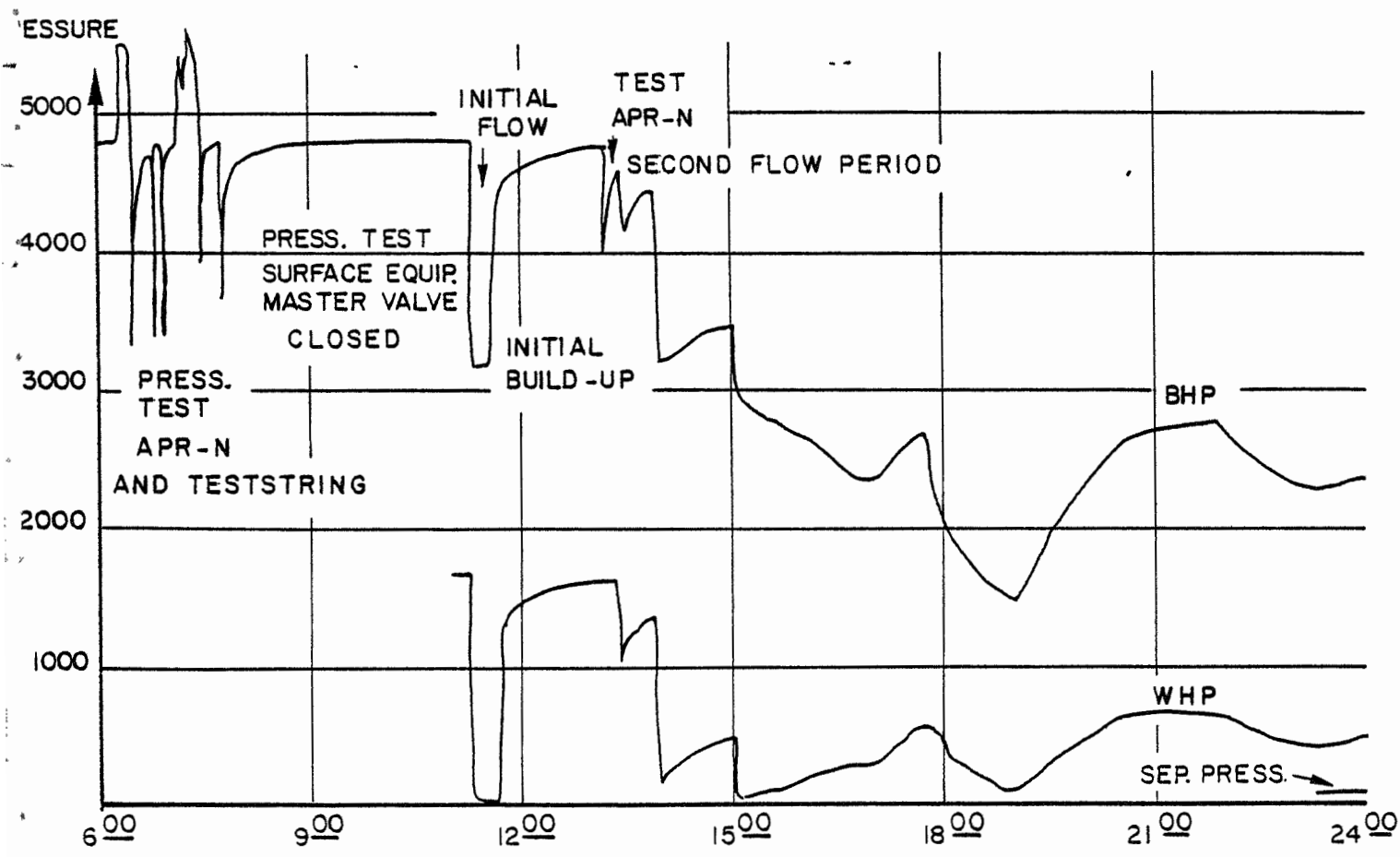
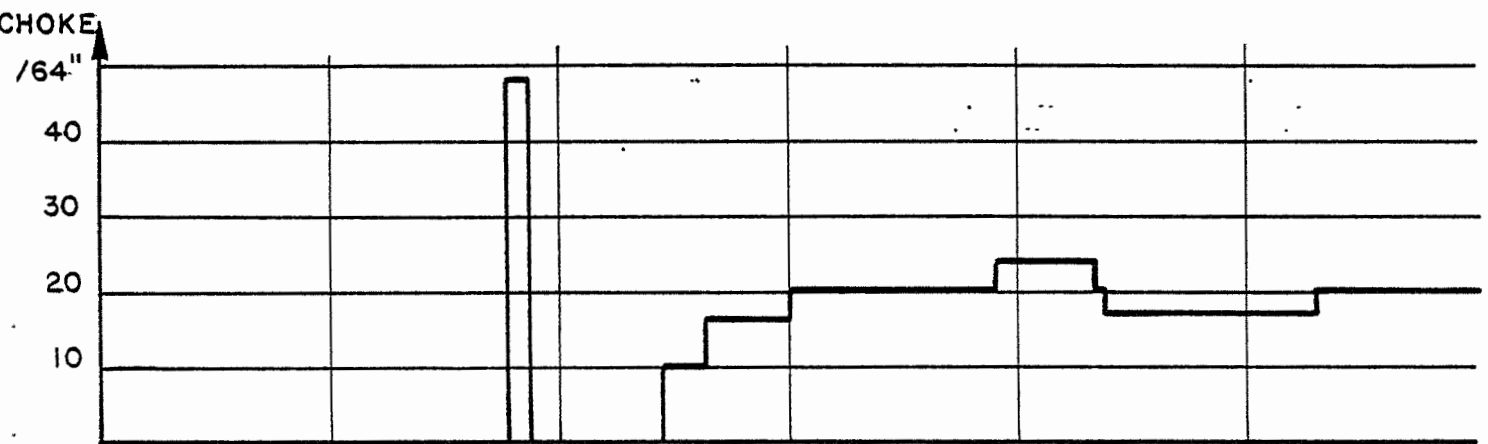
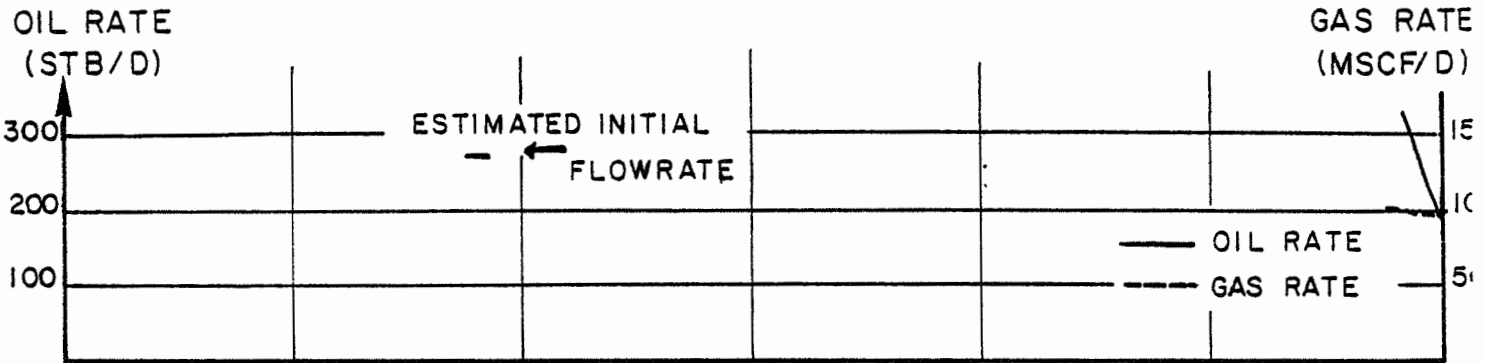






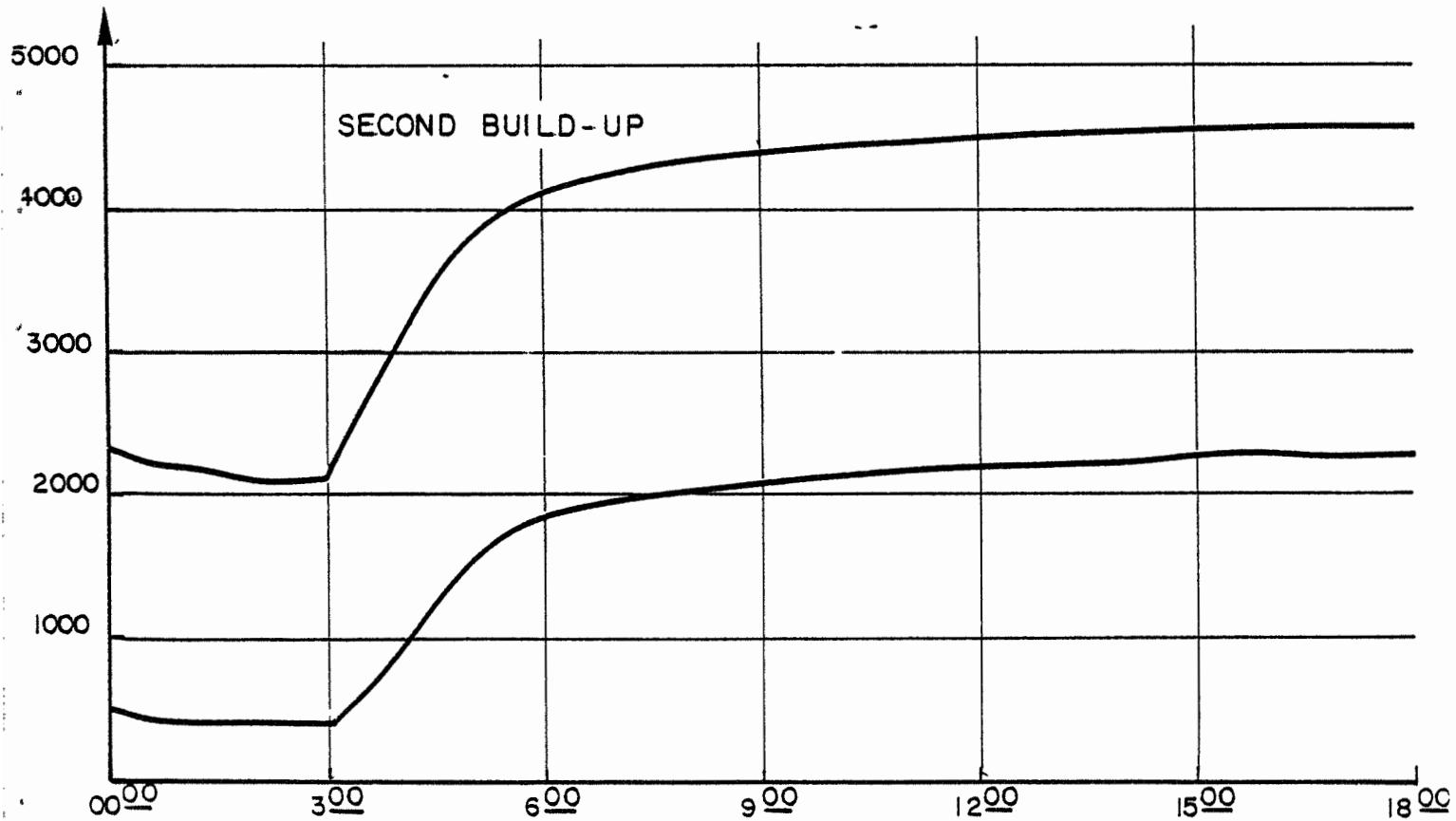
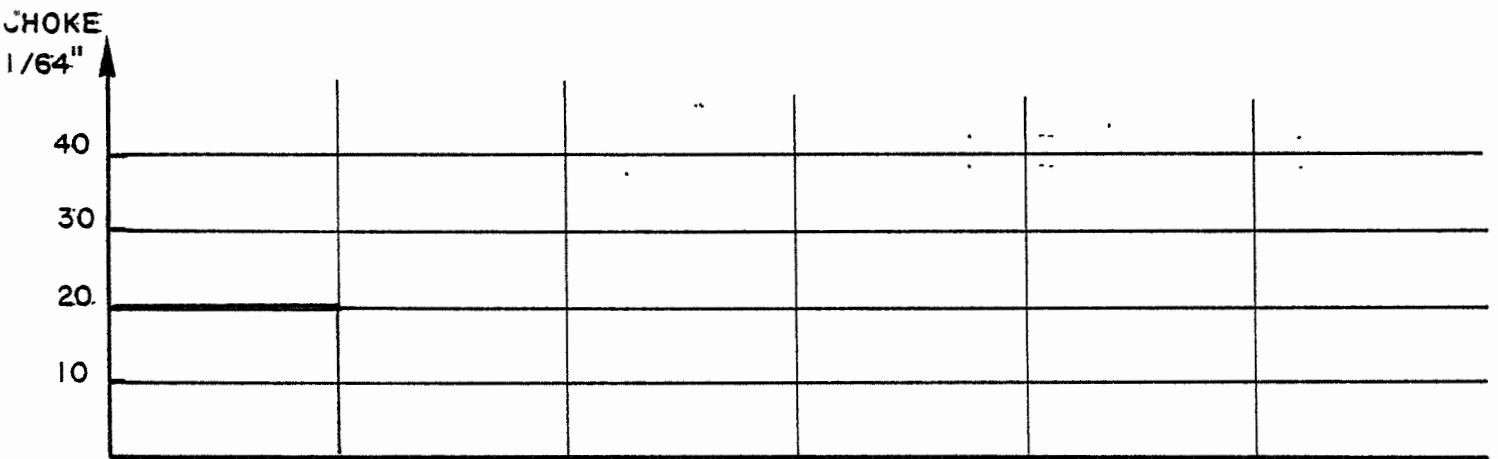
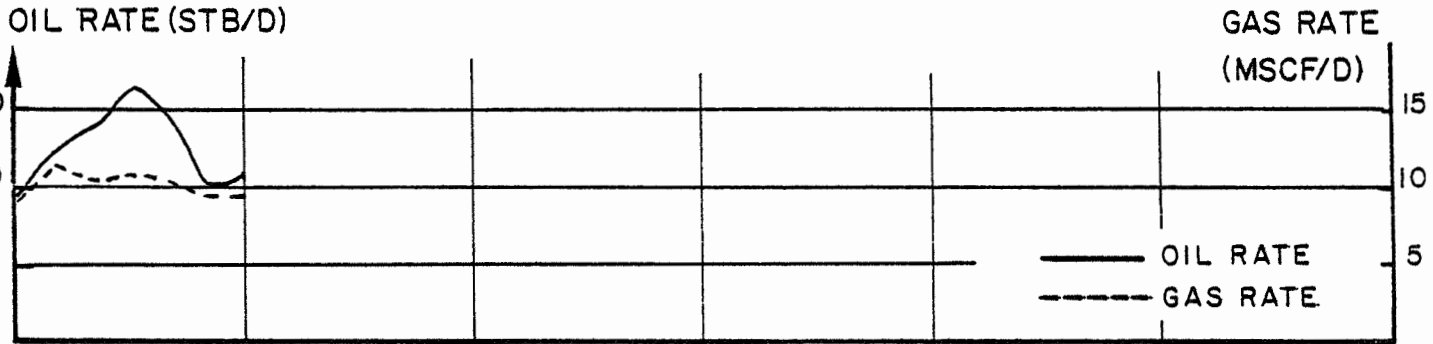
FLOWRATE, CHOKE AND PRESSURE DIAGRAM

34/10-9 DST NO.1



FLOWRATE, CHOKE AND PRESSURE DIAGRAM

34/10-9 DST NO. 1



FLOW DATA

WHP from Lynes surface probe and BHP from Sperry Sun recorder

Date/Time	Bottom hole		Well head		Chokes		Separator data Flopetrol						Liq. and gas analysis at goos neck								
	Press. Psig	Temp. OF	Press. Psig	Temp. OF	Manifold	Heater 64. inc.	Press. Psig	Temp. OF	Gas rat. lmscf/d	Oil rate stb/d	GOR scf/stb	Oil S.G.	Gas S.G.	Water %	PH	Sedim. %	Oil API	Co2	H2S		
15.6-80																					
20:55								Flowed through separator and stock tank													
23:15	2322	187	439	52	20/64		80	60	104				0.675								
23:30	2310	187	426	"	"		90	60	100	337		0.850	"								
24:00	2358	187	483	"	"		90	60	96	184.6		0.850	"								
00:30	2241	187	407	"	"		90	60	117	254	Average	0.854	"								
01:00	2214	187	398	"	"		90	60	107	286	390	"	"								
01:20	2156	187	385	"	"		90	60	112	330		"	"								
02:00	2120	187	376	"	"		90	60	105	298.5		"	"								
02:30	2125	187	375	"	"		90	60	96	203		"	"								
03:00	2129	188	376	"	"		90	60	96	222		"	"								
03:00			Bypassed separator and stock tank																		
									Average rates:												
									104	264											

B.S.W.WELL 34/10-9 TEST No 1 DATE 15/6-80SAMPLE POINT Goose Neck

TIME SAMPLED	% Oil	% Water	% Sediments	Sp. grav. oil 20°C	H ₂ S	CO ₂
18:00				0.867	0	0
18:15	99	0	1			
18:45	99	TRACES	1			
19:15	GAS ONLY AT SURFACE				0	0.1
19:45	50	5	45			
20:15	97	0.5	2.5	0.849	0	0.1
20:30	99.5	0.4	0.1	0.851		
20:45	99.6	0.3	0.1			
21:05	99.7	0.25	0.05			
21:15	99.6	0.3	0.1			
21:30	99.7	0.2	0.1	0.854	0	0.1
22:00	99.5	0.4	0.1		0	0.1
22:15	99.6	0.3	0.1			
22:30	99.7	0.2	0.1	0.853		
22:45	99.6	0.3	0.1		0	0.1
23:15	99.5	0.2	0.3			
23:30	99.6	0.3	0.1	0.843		
24:00	99.6	0.2	0.2		0	0.15
00:30	99.5	0.3	0.2	0.857		
01:30	99.5	0.2	0.3	0.856		
02:30	99.5	0.25	0.25		0	0.2

A1-17

WELL 34/10-9

DST 1 2103 - 09 m RKB

I.D.	O.D.	Description	Length (m)	Depth (
		Surface Test Tree (SST)	Above RKB	+ 4.37
		2 jt TDS tubing	18.08	13.71
		Lubricator valve	2.40	16.11
		2 pup jt, 1.25 m + 2.40 m	3.65	19.76
		7 stands TDS tubing + 1 single	198.10	217.86
		EZ-tree	7.78	225.64
		X-overs	0.45	226.09
		60 stand TDS tubing	1615.03	1841.12
		X-over 3½" TDS box x 3½ IF pin	0.29	1841.41
2.25	5.00	5" x 2 1/4" slip jt (open)	5.54	1846.95
2.25	5.00	5" x 2 1/4" slip jt (closed)	4.01	1850.96
2.25	4.75	4 3/4" DC, 5 stand	142.00	1992.96
2.43	4.75	X-over 3½" IF box 2 7/8" pin	0.24	1993.20
2.44	4.87	7" RTTS circulating valve	0.84	1994.04
2.25	5.00	X-over 2 7/8" EUE box x 3½ IF pin	0.21	1994.25
2.25	4.75	4 3/4" DC, 1 stand	28.40	2022.65
2.25	5.00	5" 2 1/4" slip joint (closed), 2 ea.	8.02	2030.67
2.25	4.75	4 3/4" DC, 1 stand	28.40	2059.07
2.25	5.00	5" APR-A reversing valve	0.91	2059.98
2.25	5.00	5" APR-N tester valve	3.90	2063.88
2.37	4.63	4 5/8" Hydraulic Bypass	1.93	2065.81
2.37	4.63	4 5/8" Big John Jars	1.52	2067.33
2.44	5.00	RTTS Safety Joint	1.00	2068.33
2.55	5.75	7" Packer, above set point	0.52	2068.85
2.36	5.65	7" Packer, below set point	0.81	2069.66
	2.875	X-over, 2 7/8" EUE pin x 2 7/8" 10 RND box down	0.22	2069.88
	2.875	Perforated tubing 2 7/8" 10 RND pin up x 2 7/8" EUE box	3.30	2073.18

Cont.

A1-18

WELL 34/10-9

DST 1 2103 - 09 m RKB

I.D.	O.D.	Description	Length (m)	Depth (m)
2.00	2.875	X-over, 2 7/8" EUE pin x 2 3/8" EUE pin down	0.25	2073.43
1.81	2.375	Baker F-nipple X-over, 2 7/8" EUE pin down x	0.24	2073.67
2.00	2.875	2 3/8" EUE box up	0.30	2073.97
-	2.875	2 7/8" EUE-tubing	9.80	2083.77
-	2.875	2 7/8" EUE-tubing	9.25	2093.02
-	2.875	X-over 2 7/8" EUE box x 2 7/8" DP pin	0.10	2093.12
-	3.875	Halliburton pressure recorder carrier X-Over 2 7/8" DP box x 2 7/8" EUE pin 2 7/8" Bullplug w/cross	1.67 0.20	2094.79

WELL NO.: 34/10-9 DST NO.: 1 DATE: 14/6-80

WIRELINE NIPPLE at 2073.84 m RKB

GAUGE TYPE AND NUMBER: LYNES DMR 314 no. 1206
 DEPTH, PRESSURE ELEMENT: 2075.59 m RKB RANGE: 0 - 5000 psi
 MODE: 2 min DELAY: 7 hours
 ACTUATED: time 13:59 date: 14/6/80
 WILL RUN OUT: time 07:07 date: 16/6/80

GAUGE TYPE AND NUMBER: LYNES DMR 312 no. 1136
 DEPTH, PRESSURE ELEMENT: 2077.17 RANGE: 0 - 10 000 psi
 MODE: 2 min DELAY: 7 hours
 ACTUATED: time: 14:00 date: 14/6/80
 WILL RUN OUT: time: 07:08 date: 16/6/80

D.S.T. HANGER 2083.94 m RKB

GAUGE TYPE AND NUMBER: SPERRY SUN - MRPG no. 0022
 DEPTH, PRESSURE ELEMENT: 2086.30 m RKB RANGE: 10 000 psi
 MODE: 2 minutes (56 hrs) DELAY: 512 minutes (8.53 hrs)
 ACTUATED: time: 14:05 on date: 14/6/80
 WILL RUN OUT: time: 06:37 hrs on date: 17/6/80

GAUGE TYPE AND NUMBER: SPERRY SUN - MRPG no. 0043
 DEPTH, PRESSURE ELEMENT: 2089.44 m RKB RANGE: 10 000 psi
 MODE: 4 minutes (112 hrs) DELAY: 0
 ACTUATED: time: 14:09 hrs on date: 14/6/80
 WILL RUN OUT: time: 06:09 hrs on date: 19/6/80

GAUGE TYPE AND NUMBER: HALLIBURTON APBT
 DEPTH, PRESSURE ELEMENT: 2094 m RKB RANGE: 0 - 10 000 psi
 MODE: 120 hrs DELAY: 0
 ACTUATED: time: 14:00 date: 14/6/80
 WILL RUN OUT: time: 14:00 date: 19/6/80

DIARY OF EVENTS		WELL No. <u>34/10-9</u>	DST No. <u>1</u>
		ZONE TESTED <u>Cook</u>	PERFS. <u>2103 - 09 m RKB</u>
DATE	TIME	OPERATIONS	
14.6	09:30	<u>PERFORATING</u>	
	10:00	Rigged up Schlumberger	
		Ran in hole w/CBL-VDL-GR	
		Logged from 2127 m RKB (top retainer loggerdepth) to 2075 m RKB w/repeat section	
		Good isolation squeeze from 2097 m RKB to 2118	
	11:00	Out of hole w/logging tool	
	12:15	Ran in hole w/perf. gun, 4 shots pr. foot 82 shots	
	13:00	Perforated 2103 - 2109 m RKB	
13:30	Out of hole, all shots fired		
15.6		<u>RAN TEST STRING</u>	
	14:00	Started to run in hole	
	02:30	Sat packer at 2070 m RKB	
	03:00	Started pressure testing	
		Chicksan leaked on kill side	
		APR-valve leaked	
		Halliburton choke manifold leaked, Changed w/Flopetrol choke manifold	
		Chicksans behind Flopetrol choke manifold leaked	
11:00	Finised pressure testing, ran test without functioning APR-n valve		
11:15		<u>INITIAL FLOW</u>	
		Opened master valve, WHP = 1675 psi	
	11:19	Opened Flopetrol choke manifold on 48/64" adjustable choke.	
		Flowed back 4.2 bbls included the compression of water in tubing. Estimated flow rate to 280 bbls/D.	
COMMENTS :			
PE:			

DIARY OF EVENTS		WELL No. <u>34/10-9</u>	DST No. <u>1</u>
		ZONE TESTED <u>Cook</u>	PERFS. <u>2103 - 09 m RKB</u>
DATE	TIME	OPERATIONS	
15.6		<u>INITIAL BUILD UP</u>	
	11:34	Closed Flopetrol choke manifold for initial build-up.	
		<u>SECOND FLOW</u>	
	13:08	Opened kill valve with backpressure on BJ-unit (1700 psi)	
	13:10	Bled of annulus pressure (tried to close APR-n valve)	
	13:11	Bled of tubing pressure to zero on BJ-unit	
	13:12	WHP increased, APR-n valve leaked.	
	13:16	Closed kill valve	
	13:20	Opened well on 10/64" adjustable choke to stock tank	
	13:52	Increased to 16/64" adjustable choke to stock tank	
	15:00	Increased to 20/64" adjustable choke to stock tank	
	15:10	Oil and gas slugs to surface (stock tank)	
	17:00	Mud to surface	
	17:00	Bypassed stock tank, flow directed to burners	
	17:05	Injected diesel in flow stream	
	17:39	Increased to 24/64" adjustable choke	
	17:43	Changed to 24/64" fixed choke, WHP decreased from 500 to 100 psi, mainly gas flowed to burners.	
	19:01	Changed to 24/64" adjustable choke	
	19:02	Choked back to 20/64"	
	19:06	Choked back to 16/64"	
		BSW increased to 45% sediments, VERY fine grained *	
	20:55	Flowed through seaprator no measurements due to low flow rates.	
	21:52	Increased to 20/64" adjustable choke.	
		Impossible to get oil rates at separator (unstable flow conditions).	
COMMENTS :		* The increase of BSW barely shows on the original chart, probably because it lasted just for an instant.	
		PE:	

DIARY OF EVENTS		WELL No. <u>34/10-9</u>	DST No. <u>1</u>
		ZONE TESTED <u>Cook</u>	PERFS. <u>2103 - 09 m RKB</u>
DATE	TIME	OPERATIONS	
15.6	22:30	Flowed to stock tank.	
	23:45	Estimated oil rate 337 STB/D and gas rate equal to 100 MSCF/D	
16.6	02:59	Bypassed separator and stock tank.	
		<u>SECOND BUILD-UP</u>	
	03:00	Closed choke manifold for surface shut-in.	
	18:00	Finished build-up period. Flushed surface lines and bullheaded w/mud. POOH w/teststring	
	11:00	Gauges to surface All recorder worked OK, But Lynes 314 (0 - 5000 psi) overpressured (max. BHP = 6200 psi) during pressure test of APR-n valve.	
		Test ended.	
COMMENTS :			
PE:			

APPENDIX A2, DST no. 2 and 2A	Page
DST analysis	A2-2
Pressure, choke and flowdiagram	A2-9
Rate data	A2-10
Layout of teststring	A2-11
Gauge arrangement	A2-13
Diary of events DST no. 2	A2-14
Diary of events DST no. 2A	A2-16

BOTTOM HOLE PRESSURE REPORTWell 34/10-9Test no. DST no. 2ATest Date 21.-22.6.80Date of analysis 19.11.80Gauge no. Lynes DMR 312, 1136

SUMMARY OF THE RESULTS . . .

	Semilog Analysis	Type Curve Analysis
Kh md·ft	85227	
K md	2221	
S	+ 11.4	
\bar{P} psia at <u>2031,5mss</u>	4793	

Max recorded Temp. 83.3°CRemarks

Signature

Well 34/10-9, DST no.2A

Test date 21-22.6.80

Reservoir Parameters

Perforations 2084-2090

Zone(s) COOK

RKB _____

Wellbore radius 0.11m

RKB Elev 25m

Midpoint Production -2062m ss Bomb at 2056.5m RKB -2031.5m ss

Pressure Functions Evaluated at -2031.5m ss Datum Depth - ss

Delta P required to correct to datum _____ psig Gradient _____ psi/ft

Estimated Average Pressure _____ psig

Formation Volume Factor 1.309 vol/vol Viscosity 0.80 cp

Thickness 11.7 Porosity 29 % Drainage Area _____ acres

Oil Saturation 66 % Oil Compressibility 9.3 x 10⁻⁶ psi⁻¹

Water Saturation 34 % Water Compressibility 3.0 x 10⁻⁶ psi⁻¹

Gas Saturation - % Gas Compressibility - 10⁻⁶ psi⁻¹

Formation Compressibility 3.0 x 10⁻⁶ psi⁻¹

System Compressibility $C_t = S_o C_o + S_w C_w + S_g C_g + C_f$

$$C_t = .66 \times 9.3 \times 10^{-6} + .34 \times 3.0 \times 10^{-6} + - \times - \times 10^{-6} + - \times 10^{-6}$$

$$C_t = 10.2 \times 10^{-6} \text{ psi}^{-1}$$

Rates Reported on Test.

Choke 32/64 inches Oil Rate 4755 STBPD Gas Rate 1.724 MMSCFD

FTP _____ psig Water Rate 0 BWD GOR 363 SCF/STB

oAPI 35.6 Gas Spec. Grav. 0.771

Cumulative Production Oil 1708 BBL Gas _____

Water _____

Well 34/10-9, DST no. 2ATest Date 21-22.6.80Horner AnalysisEffective Production Time t_p = Cumulative Production / Rate Reported on Test.

$$t_p = \frac{1708}{4755} = 518 \text{ mins}$$

Straight line starts at _____ hrs

Slope = 9.5 psi/cycle

$$P_{wf's} = \underline{4625.0} \text{ psia}$$

$$P_{1hr} = \underline{4782.3} \text{ psia}$$

$$P^* = \underline{4793.1} \text{ psia}$$

Calculated Values

$$Kh = \frac{162.6}{M} \frac{Q B u}{M} = \frac{162.6 (4755)(1.309)(0.80)}{9.5} = \underline{85227} \text{ md.ft}$$

$$K = Kh/h = \frac{85227}{((11.7)(3.28))} = \underline{2221} \text{ md.}$$

$$S = 1.1513 \left[\frac{P_{1hr} - P_{wf's}}{M} + \text{Log} \left[\frac{t_p + 1}{t_p} \right] - \text{Log} \left[\frac{K}{\phi \mu C_t r_w^2} \right] + 3.2275 \right]$$

$$S = 1.1513 \left[\frac{4782 - 4625}{9.5} + \text{Log} \left[\frac{518 + 60}{518} \right] - \text{Log} \left[\frac{2221}{(.29)(.8)(10^{-2} \times 10^{-6})(.35)^2} \right] + 3.2275 \right]$$

$$s = \underline{+11.4} \quad \Delta P_s = 0.87 \text{ ms} = (0.87)(9.5)(11.4) = 94 \text{ psi}$$

$$t_{DA} = \frac{0.000264 K t}{\phi \mu C_t A} = \underline{0.000264}$$

$$P_{DMBH} = \underline{\hspace{2cm}}$$

$$\bar{P} = P^* - P_{DMBH} \left[\frac{M}{2.303} \right] = \underline{4792} \text{ psia} \quad @ \quad \underline{2031.5} \text{ ss}$$

$$= \underline{\hspace{2cm}} \quad @ \quad \underline{\hspace{2cm}} \text{ ss Datum}$$

$$PI_a = \frac{Q}{P^* - P_{wf's}} = \underline{28.3} \text{ STBPD/psi} = \underline{65.3} \text{ M}^3\text{PD/Bar}$$

$$PI_{s=0} = \frac{Q}{P^* - P_{wf's} - \Delta P_s} = \underline{64.3} \text{ STBPD/psi} = \underline{148} \text{ M}^3\text{PD/Bar}$$

BRØNN 34-10-9 DST# 2A
 BUILDUP NUMMER 1
 GAUGE LYNES 1136

NR.	TID	TRYKK
---	---	-----
1	17.28	4625.000
2	17.32	4767.500
3	17.34	4772.500
4	17.36	4775.000
5	17.40	4775.000
6	17.42	4777.500
7	17.54	4777.500
8	18.00	4780.000
9	18.04	4780.000
10	18.06	4782.500
11	18.20	4782.500
12	18.32	4782.500
13	18.48	4782.500
14	19.08	4785.000
15	19.24	4782.500
16	19.40	4785.000
17	19.50	4787.500
18	20.12	4787.500
19	20.36	4787.500
20	20.56	4785.000
21	21.32	4787.500
22	22.04	4787.500
23	22.36	4787.500
24	23.08	4787.500
25	23.28	4787.500
26	23.30	4790.000
27	0.12	4787.500
28	0.44	4790.000
29	1.06	4792.500
30	1.16	4790.000
31	1.36	4792.500
32	1.42	4790.000
33	1.44	4792.500

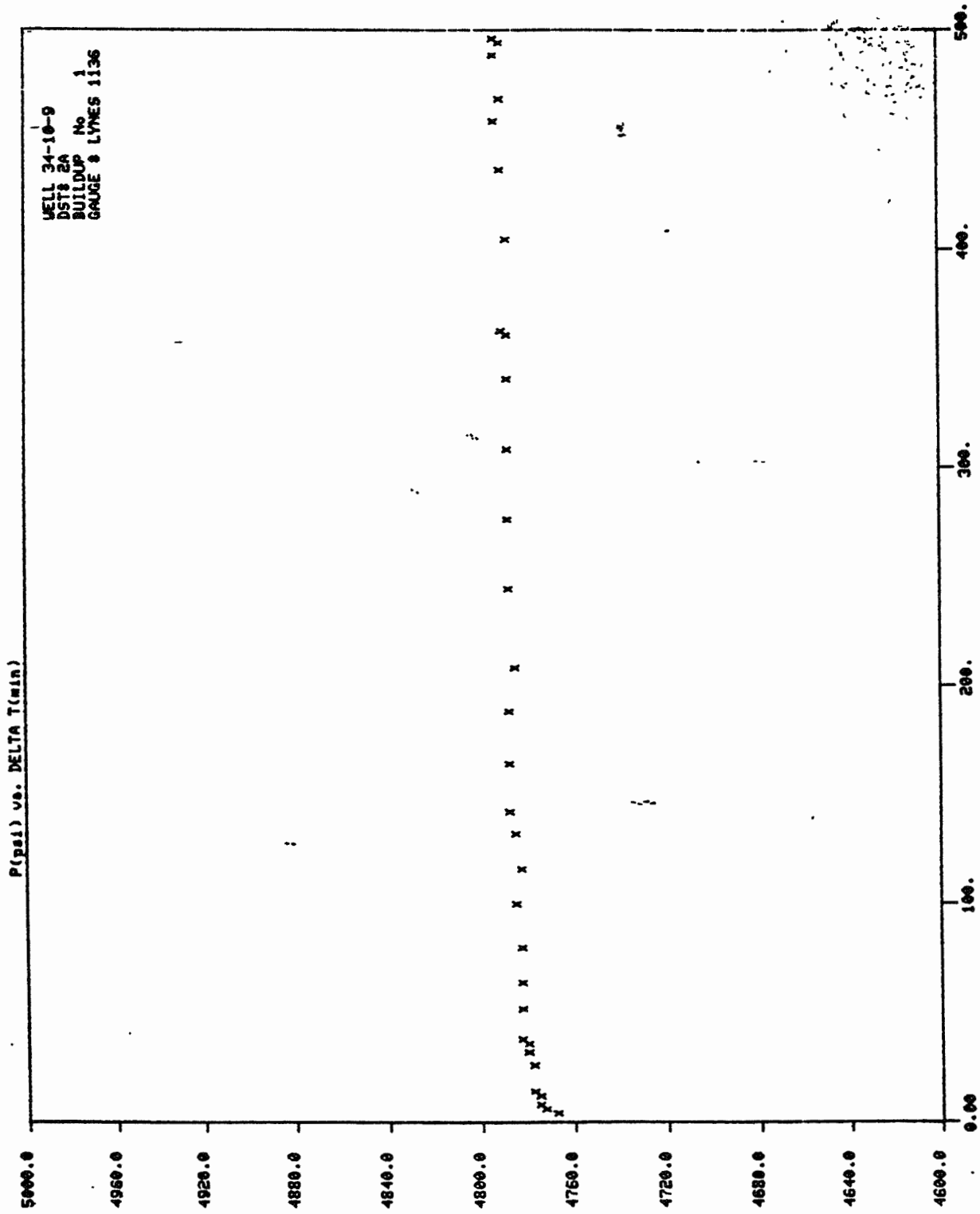
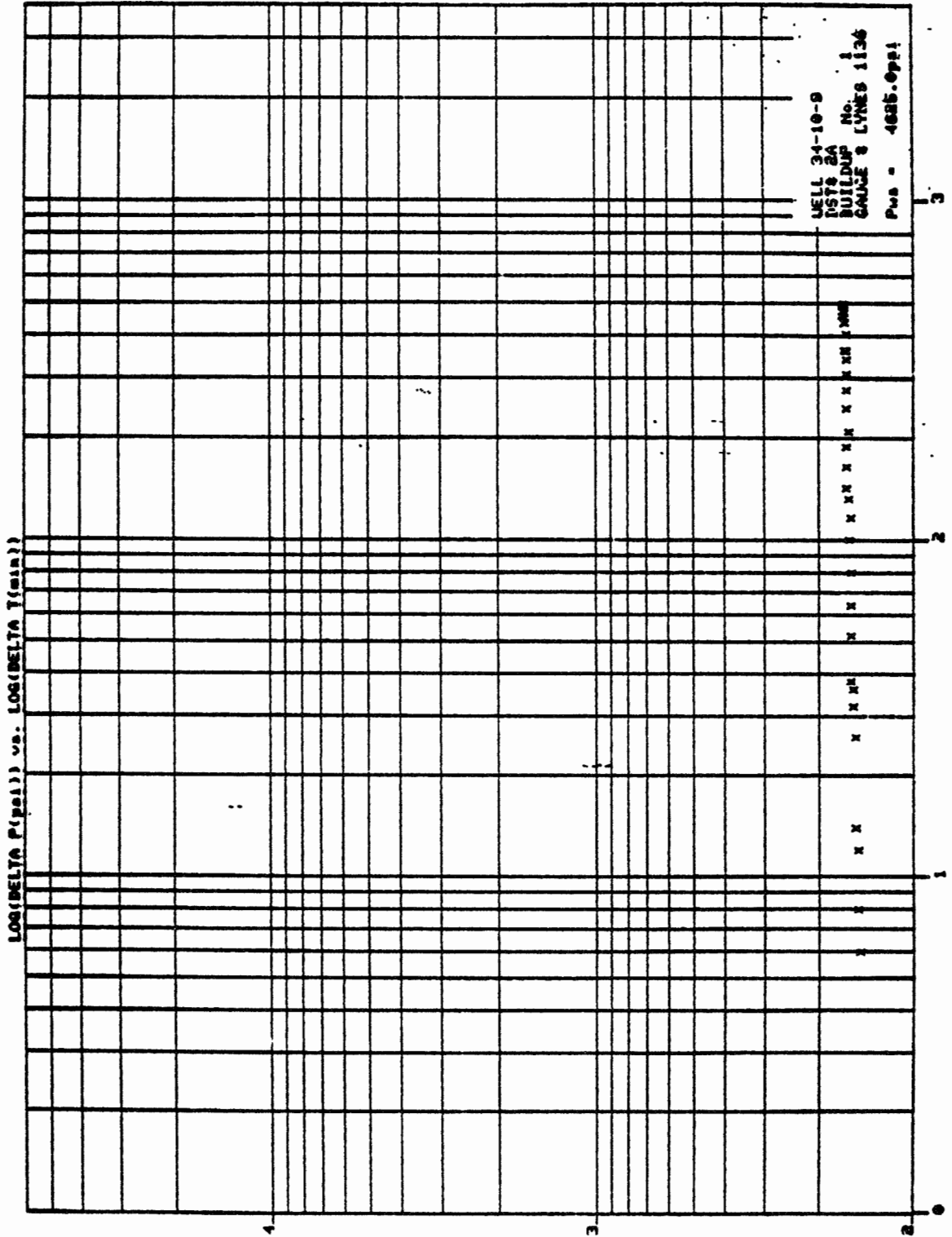
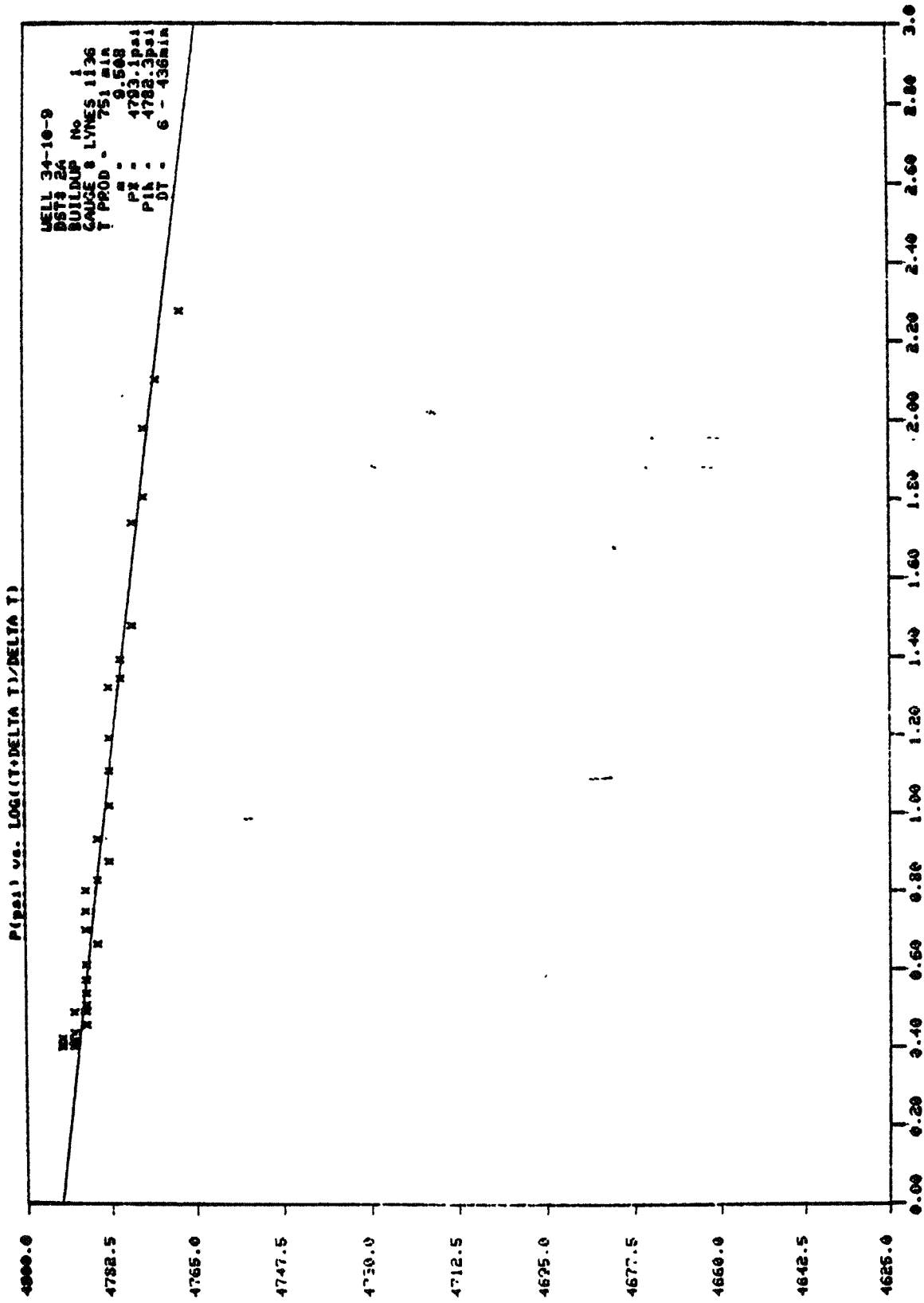


Fig. no. 6

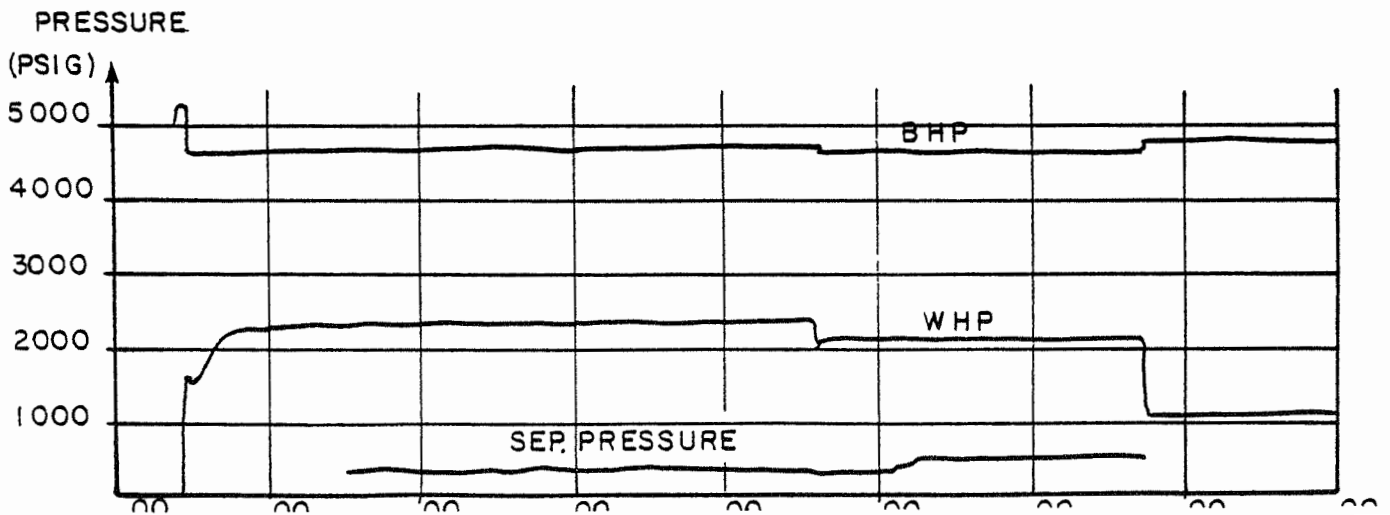
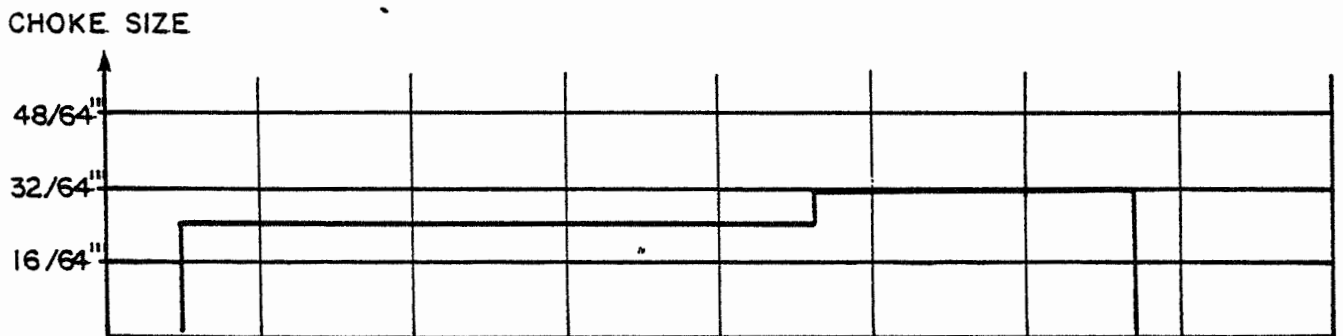
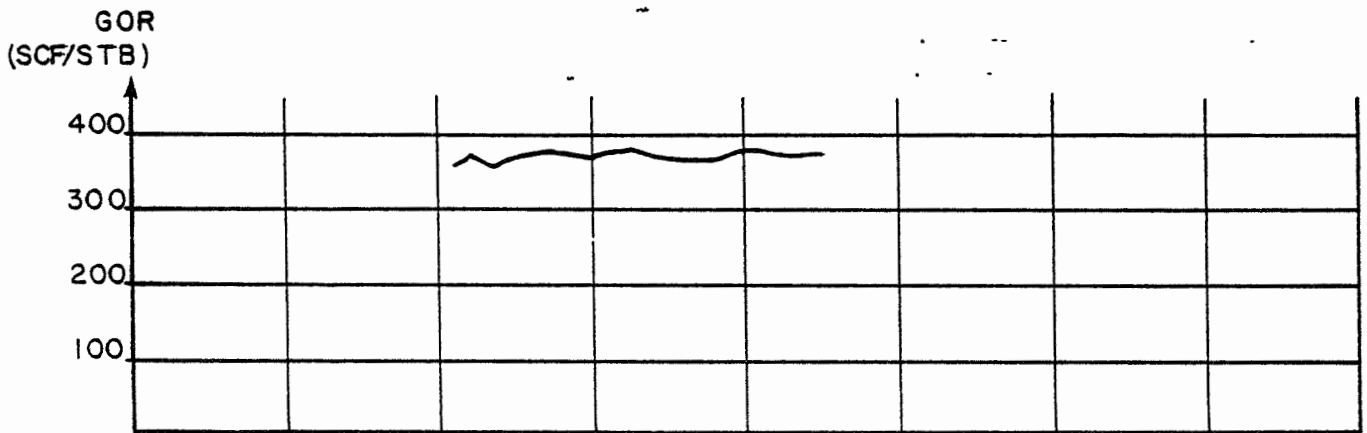
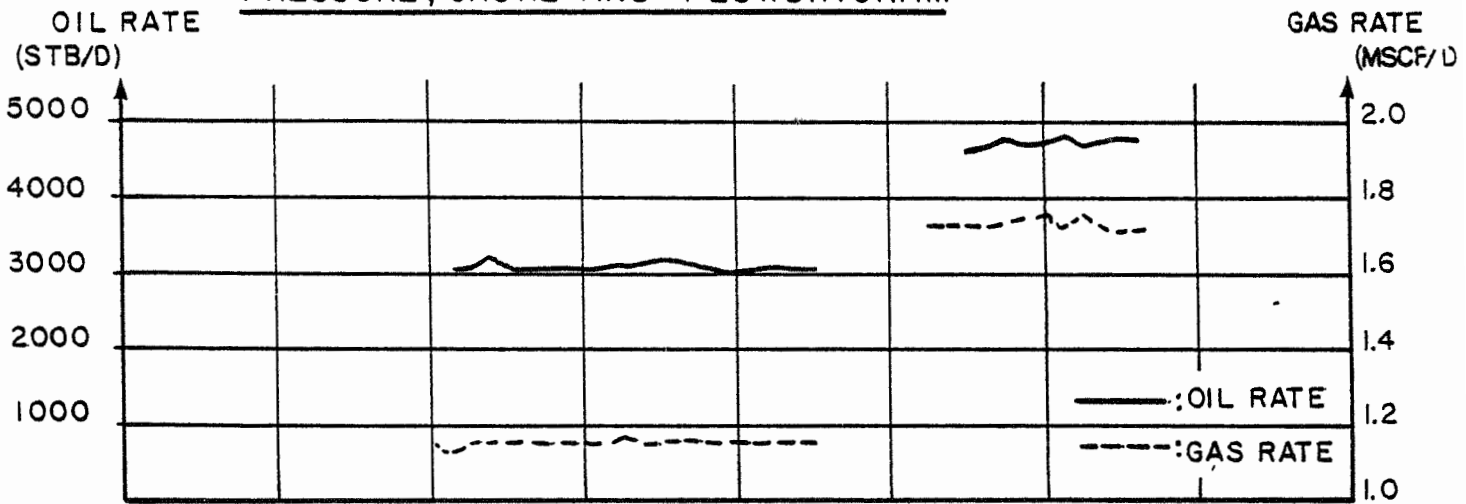




A2-9

34/10-9, DST # 2 A

PRESSURE, CHOKE AND FLOWDIAGRAM



WELL 34/I0-9

DST 2 A 2084 - 2090 m RKB

I.D.	O.D.	Description	Length (m)	Depth (m)
		Surface Test TREE		+4.37
		3 I/2" TDS tubing, 2 jts.	18.08	13.7
		Lubricator valve	2.40	16.14
		2 pup jts, 1.25 m 2.40 m	3.65	19.79
		7 stand TDS + 1 single	198.10	217.8
		EZ-tree + X-overs	8.23	226.09
		59 stand TDS + 3 m pupjt	1590.00	1816.0
		X-over 3-I/2 TDS box x 3-I/2 if pin	0.46	1816.55
2.25	5.00	5' x 2-I/4' slip joint (open)	5.54	1822.0
2.25	5.00	5' x 2-I/4' slip joint (closed)	4.01	1826.10
2.25	4.75	4-3/4 drill collars, 5 stands	142.00	1968.1
2.43	4.75	X-over, 3-I/2 if box x 2-7/8 pin	0.24	1968.34
2.44	4.87	7' rtts circulating valve	0.84	1969.18
2.25	5.00	X-over, 2-7/8 eue box x 3-I/2 if pin	0.21	1969.39
2.25	4.75	4-3/4 drill collars, 1 stand	28.40	1997.7
2.25	5.00	5' x 2-I/4' slip joint (closed)	4.01	2001.80
2.25	5.00	5' x 2-I/4' slip joint (closed)	4.01	2005.8
2.25	4.75	4-3/4 drill collars, 1 stand	28.40	2034.21
2.25	5.00	5' apr-a reversing valve	0.91	2035.1
2.25	5.00	5' apr-n test valve	3.90	2039.04
2.25		4-5/8" hydraulic by-pass	1.93	2040.97
2.37	4.63	4-5/8" big john jars	1.52	2042.4
2.44	5.00	rtts safety joint	1.00	2043.47
2.55	5.75	7' rtts packer, above set point	0.52	2043.9
2.36	5.65	7' rtts packer, below set point	0.81	2044.80
		2 7/8 EUE pupjt. pin up x box down	1.83	2046.6
		perforated pupjt, 2 7/8"		
		pin up x box down	2.97	2049.6
		Blindsub ^w /2 7/8" EUE box up x pin down	0.26	2049.86
		Perforated pupjt, 2 7/8" EUE		
		box up x pin down	3.38	2053.2
		DST hanger		
		1 2 7/8" EUE tubing	9.25	2062.5

Cont.

I.D.	O.D.	Description	Length (m)	Depth (m)
		I DST hanger		
		I 2 7/8" EUE tubing	9.27	2071.76
		x-over 2 7/8" EUE box up x 2 7/8" EUE pin down	0.10	2071.86
		I Halliburton pressure recorder	1.67	2073.53
		I x-over 2 7/8" box x 2 7/8" EUE pin down	0.10	2073.6
		X-over 2 7/8" EUE box up x 2 3/8" EUE pin down	0.72	2074.35
		I safetyjt. 40.000 lbs. (OTIS) 2 3/8" EUE box/pin		
		X-over 2 3/8" EUE box x 2 7/8" EUE pin down		
		X-over 2 7/8" EUE box x 3 1/2" TDS pin		
		I jt 3 1/2" TDS tubing, painted red w/bullplug w/cross	9.26	2083.85

WELL NO.: 34/10-9 DST NO.: 2A DATE: 20.6.80UPPER DST hanger at 2053.24
WIRELINE NIPPLE

GAUGE TYPE AND NUMBER: Lynes DMR 312 no. 1100
 DEPTH, PRESSURE ELEMENT: 2055.19 RANGE: 10000 psi
 MODE: 4 min DELAY: 7 hrs.
 ACTUATED: time 16:07 date: 20.6.80
 WILL RUN OUT: time 19:23 date: 23.6.80

GAUGE TYPE AND NUMBER: Lynes DMR 312 no. 1136
 DEPTH, PRESSURE ELEMENT: 2056.49 RANGE: 10000 psi
 MODE: 2 min DELAY: 7 hrs.
 ACTUATED: time: 16:05 date: 20.6.80
 WILL RUN OUT: time: 09:13 date: 22.6.80

GAUGE TYPE AND NUMBER: _____
 DEPTH, PRESSURE ELEMENT: _____ RANGE: _____
 MODE: _____ DELAY: _____
 ACTUATED: time: _____ date: _____
 WILL RUN OUT: time: _____ date: _____

LOWER
D.S.T. HANGER at 2063.24 m RKB

GAUGE TYPE AND NUMBER: Sperry Sun MRPG no. 0043
 DEPTH, PRESSURE ELEMENT: 2065.15 m RKB RANGE: 10000 psi
 MODE: 2 min DELAY: 512 min
 ACTUATED: time: 16:11 date: 20.6.80
 WILL RUN OUT: time: 05:00 date: 23.6.80

GAUGE TYPE AND NUMBER: Sperry Sun MRPG no. 0037
 DEPTH, PRESSURE ELEMENT: 2067.20 m RKB RANGE: 7000 psi
 MODE: 4 min. DELAY: -
 ACTUATED: time: 16:15 date: 20.6.80
 WILL RUN OUT: time: 20:00 date: 25.6.80

GAUGE TYPE AND NUMBER: Halliburton APBT
 DEPTH, PRESSURE ELEMENT: 2073.53 m RKB RANGE: 10000
 MODE: 120 hrs clock DELAY: 0
 ACTUATED: time: _____ date: _____

DIARY OF EVENTS		WELL No. <u>34/10-9</u>	DST No. <u>2</u>
		ZONE TESTED <u>Cook</u>	PERFS. <u>2084 - 90 m RKB</u> <u>ref. FDC/CNL</u>
DATE	TIME	OPERATIONS	
18.6	16:30	<u>PERFORATING</u>	
		Rigged up Schlumberger for perforating	
	17:43	Perforated 2084 - 90 m RKB, 82 shoots, 4 shots pr. foot.	
	18:15	Perforating gun to surface, all shots fired	
		<u>RAN TESTSTING</u>	
	18:30	Started to run teststring	
19.6	08:00	Finished pressure testing, OK.	
	08:03	Opened APR-n valve, WHP = 360 psi $P_{\text{formation}} - P_{\text{hyd.}} \approx 1700 - 1800$ psi i.e. sandscreen plugged or APR-n valve not open	
	08:09	Open choke manifold, WHP = 0 Open and close APR-n valve Tried to inject to formation, max. WHP = 4800, no injection. Bled of pressure, unseated packer, sat packer. Pressure tested chicksan, leaked in choke manifold	
	11:00	Tried to open APR-n valve, packer leaked Unseated and sat packer again.	
	11:51	Pressure testing chicksans Leak in S.T.T. (Equalizing valve on manual master valve).	
	14:15	Leak repaired by installing needle valve	
	14:16	Pressure tested chicksans to 5000 OK.	
	14:27	Opened master valve, closed kill valve.	
	14:30	Pressured up annulus 1700 psi (Surface pressure reading 70 psi) Bled of pressure.	

COMMENTS :

PE:

DIARY OF EVENTS		WELL No. <u>34/10-9</u>	DST No. <u>2</u>
		ZONE TESTED <u>Cook</u>	PERFS. <u>2084 - 90 m RKB</u>
DATE	TIME	OPERATIONS	
19.6	14:44	Pressured up tubing (4000 psi) Bled off pressure	
	14:49	Pressured up tubing 4000 psi Bled off pressure	
	15:19	Wellhead pressure 720 psi Increased annulus pressure in 200 psi increments Sheared APR-A (2500 psi) reversed out POOH.	
20.6	04:00	Tested screen for plugging by injecting water. Only a few pores on one side of screen communicated. Otherwise plugged. Max. press. obtained: 200 psi	
		<u>CONCLUSION</u>	
		Bottom hole pressure checked, and APR-n valve functioned. i.e. sandscreen plugged.	
		The sandscreen was then changed with perforated tubing and the test was numbered 2A.	

COMMENTS :

PE:

DIARY OF EVENTS		WELL No. <u>34/10-9</u>	DST No. <u>2A</u>
		ZONE TESTED <u>Cook</u>	PERFS. <u>2084 - 90 m RKB</u> <u>ref.: EDC/CNL-GR</u>
DATE	TIME	OPERATIONS	
20.6.	9:30	Ran GR - CCL	
		<u>PERFORATING</u>	
	11:30	Loaded perforating gun and rigged up Schlumberger RIH w/ perf. gun	
	14:00	Rigged up Schlumberger RIH w/perf. gun	
	15:10	Perforated 2084 - 90 m RKB (. also perforated for DST no. 2)	
	15:30	Perf. gun to surface. All shots fired	
		<u>RAN TEST STRING</u>	
	15:45	Started to RIH w/teststring	
21.6	01:00	Started pressure testing	
	04:00	Finished pressure testing. OK.	
	04:00	APR-n would not open with annular pressure 1700 psi and 2000 psi	
	04:40	Unseated pakcer	
	04:44	Seated packer	
		<u>FIRST FLOW PERIOD</u>	
	04:53	Opened APR-n valve WHP = 1625 psi	
	04:56	Opened Halliburton choke manifold on 24/64" to burner	
	05:15	Mud to surface	
	05:20	Gas to surface	
	05:25	Oil to surface	
	07:00	Flowed through separator	
	08:00	Started measurements on separator	

COMMENTS :

PE:

DIARY OF EVENTS		WELL No. <u>34/10-9</u>	DST No. <u>2A</u>
		ZONE TESTED <u>Cook</u>	PERFS. <u>2084 - 90 m r</u> <u>ref.:FDC/CNL-7</u>
DATE	TIME	OPERATIONS	
21.6	8:30	Flowed to stocktank to check oil rate (Meter factor = 0.84 stock. tank bbls/sep.bbls)	
	13:10	Bypassed separator	
	13:13	Changed choke to 32/64"	
	14:17	Flowed through separator	
		<u>FIRST BUILD-UP PERIOD</u>	
	17:28	Closed APR-n valve for build-up	
	17:31	Closed choke manifold WHP = 1043 psi	
		<u>BOTTOM HOLE SAMPLING</u>	
22.6	01:33	WHP = 1278	
	01:38	Lubricator in derrick	
	01:45	Opened APR-n valve WHP = 2635 psi	
	01:47	Opened on 8/64" fixed choke, flowed gas to tank	
	01:56	Oil to tank	
	02:00	Rate ca. 430 STB/D	
	02:23	Flowed through separator	
	02:26	Flow established through separator	
	02:47	Closed choke manifold WHP = 2585 Tried to close lubricator without success.	

COMMENTS :

PE:

DIARY OF EVENTS-		WELL No. <u>34/10-9</u>	DST No. <u>2A</u>
		ZONE TESTED <u>Cook</u>	PERFS. <u>2084 - 90 m r</u> <u>ref.:FDC/CNL-</u>
DATE	TIME	OPERATIONS	
22.6	02:50	Opened choke 8/64"	
		Tried to close lubricator no success	
	02:55	Closed choke	
	03:04	Opened choke	
		Tried to close lubricator no success.	
	03:05	Closed choke manifold	
	03:09	Closed master valve	
	03:10	Opened choke manifold bled off pressure to 100 psi	
	03:13	Closed choke manifold. Observed for pressure build-up, OK.	
	03:20	Opened kill & swab valves to 2400 psi pr. test OK!	
	03:30	Closed kill valve	
		Opened master valve	
		WHP = 2585	
		RIH with bottomhole samplers	
	04:15	Stopped running in due to leak in Flopetrol stuffing bc	
	04:15	Not able to repair	
		Started to pull out of hole	
	04:40	Samplers at surface	
	04:45	Closed master valve	
		Repaired stuffing box and made ready to RIH.	
	05:47	Started clocks in samplers	
	06:02	Opened kill line	
	06:07	Pressure up to 2320 psi	
	06:09	Opened master valve, closed kill valve and bled off pressure.	
	06:12	RIH w/samplers	
	06:40	Opened well on 8/64" choke to tank.	
	07:00	Flowed through separator	
	08:30	Samplers closed	
		Bypassed separator	

COMMENTS :

PE:

DIARY OF EVENTS		WELL No. <u>34/10-9</u>	DST No. <u>2A</u>
		ZONE TESTED <u>Cook</u>	PERFS. <u>2084 - 90 m RK</u> ref.: FDC/CNL-GR
DATE	TIME	OPERATIONS	
22.6	09:05	Closed choke manifold WHP = 2580	
	09:08	Started POOH with samplers	
	09:10	Stuffing box leaked	
	09:26	Fixed leak	
	09:27	Continued pulling out.	
	09:50	Samplers at surface Closed master valve	
	09:59	Bled off pressure at choke WHP = 0 psi above master valve	
	10:10	Rigged down wireline equipment	
	10:15	Both samplers checked for leaks, both OK.	
	15:00	Started to pull teststring Pressure recorders at surface, Lynes and Halliburton recorders OK, Sperry Sun computer failure, impossible to read data.	

COMMENTS :

PE:

APPENDIX A3, DST no. 3

Page

DST analysis	A3-2
Pressure, choke and flowdiagram	A3-10
Rate data	A3-12
Layout of teststring	A3-13
Gauge arrangement	A3-15
Diary of events	A3-16

BOTTOM HOLE PRESSURE REPORTWell 34/10-9Test no. DST no. 3Test Date 26.6.80Date of analysis 21.11.80Gauge no. Ly. DMR 312, 1136

SUMMARY OF THE RESULTS

	Horner analysis	
Kh md·ft	100463	
K md	362	
S	+ 10.6	
\bar{P} psia at <u>-1857m ss</u>	4509	

Max recorded Temp. 76.8°CRemarks

Signature

Well 34/10-9, DST no. 3

Test date 26.6.80

Reservoir Parameters

Perforations 1904-1910 m RKB

Zone(s) Rannoch

Wellbore radius 0.11 m

RKB Elev 25 m

Midpoint Production 1882 m ss Bomb at 1882 m RKB 1857 m ss

Pressure Functions Evaluated at ss

Datum Depth ss

Delta P required to correct to datum psig

Gradient psi/ft

Estimated Average Pressure psig

Formation Volume Factor 1.257 vol/vol

Viscosity 0.91 cp

Thickness 84.5 m

Porosity 30 %

Drainage Area acres

Oil Saturation 83 %

Oil Compressibility 8.8 x 10⁻⁶ psi⁻¹

Water Saturation 17 %

Water Compressibility 3.0 x 10⁻⁶ psi⁻¹

Gas Saturation %

Gas Compressibility 10⁻⁶ psi⁻¹

Formation Compressibility 3.0 x 10⁻⁶ psi⁻¹

System Compressibility $C_t = S_o C_o + S_w C_w + S_g C_g + C_f$

$$C_t = 0.83 \times 8.8 \times 10^{-6} + 0.17 \times 3.0 \times 10^{-6} + \text{---} \times \text{---} \times 10^{-6} + 3.0 \times 10^{-6}$$

$$C_t = 10.8 \times 10^{-6} \text{ psi}^{-1}$$

Rates Reported on Test.

Choke 32 / 14 inches Oil Rate 4575 STBPD Gas Rate 1.594 MMSCFD

FTP psig Water Rate 0 BWD GOR 348 SCF/STB

ρ_{API} 32 Gas Spec. Grav. 0.634

Cumulative Production Oil 873 STB. Gas

Water

Well 34/10-9, DST no. 3Test Date 26.6.80Horner AnalysisEffective Production Time t_p = Cumulative Production / Rate Reported on Test.

$$t_p = \frac{873}{4575} = 274 \text{ mins.}$$

Straight line starts at _____ hrs

Slope = 8.47 psi/cycle

$$P_{wf's} = \frac{4377.0}{\text{psia}}$$

$$P_{1hr} = \frac{4502.6}{\text{psia}}$$

$$P^* = \frac{4508.9}{\text{psia}}$$

Calculated Values

$$Kh = \frac{162.6}{M} \frac{Q B u}{M} = \frac{162.6 (4575)(1.257)(0.91)}{8.47} = 100463 \text{ md.ft}$$

$$K = Kh/h = \frac{100463}{((84.5)(3.28))} = 362 \text{ md.}$$

$$S = 1.1513 \left[\frac{P_{1hr} - P_{wf's}}{M} + \text{Log} \left[\frac{t_p + 1}{t_p} \right] - \text{Log} \left[\frac{K}{\phi \mu C_r r_w^2} \right] + 3.2275 \right]$$

$$S = 1.1513 \left[\frac{4503 - 4377}{8.47} + \text{Log} \left[\frac{274 + 60}{274} \right] - \text{Log} \left[\frac{362}{(.30)(1.12)(10.8 \times 10^{-6})(0.35)^2} \right] + 3.2275 \right]$$

$$S = +10.6 \quad \Delta P_s = 0.87 m S = 78 \text{ psi}$$

$$t_{DA} = \frac{0.000264 K t}{\phi \mu C_r A} = \frac{0.000264}{\text{---}}$$

$$P_{DMBH} = 0$$

$$\bar{P} = P^* - P_{DMBH} \left[\frac{M}{2.303} \right] = \frac{4509}{\text{psia}} @ \frac{1857}{\text{m}} \text{ s}$$

$$= \text{---} @ \text{---} \text{ ss Datum}$$

$$PI_a = \frac{4575}{4509 - 4377} = 34.7 \text{ STBPD/psi} = 80.0 \text{ m}^3 \text{ PD/bar}$$

$$PI_{s=0} = \frac{4575}{4509 - 4377 - 78} = 86.3 \text{ STBPD/psi} = 199 \text{ m}^3 \text{ PD/bar}$$

Well 34/10-9, DST no. 3Test date 26.6.80PARTIAL PENETRATION SKIN FACTOR

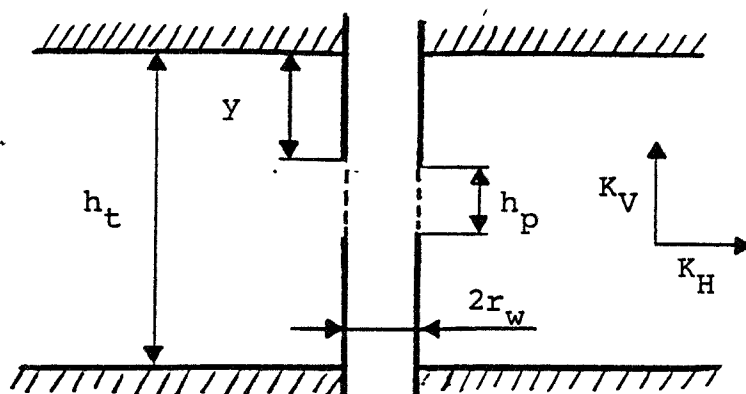
$$h_t = \underline{84.5\text{m}, 277.2\text{ft}}$$

$$h_p = \underline{6\text{m}, 19.7\text{ft}}$$

$$y = \underline{50\text{m}, 164\text{ft}}$$

$$r_w = \underline{0.11\text{m}, 0.35\text{ft}}$$

$$K_H/K_V = \underline{1}$$



$$z_m = y + h_p / 2$$

$$r_{wc} = r_w e^{0.2126(z_m/h_t + 2.753)}$$

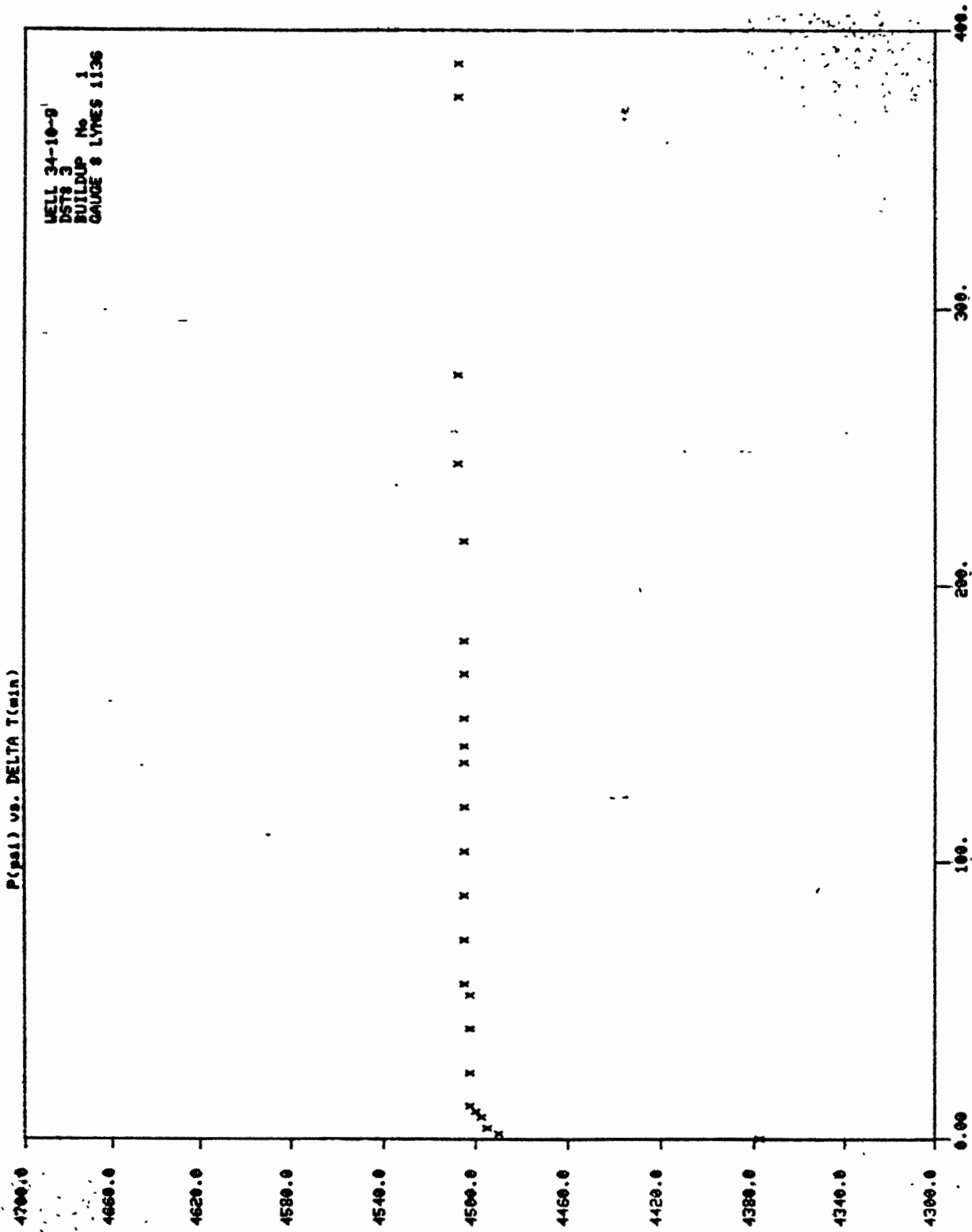
$$s_p = 1.35 \left((h_t/h_p - 1)^{0.825} (\ln(h_t (K_H/K_V)^{0.5} + 7) \right.$$

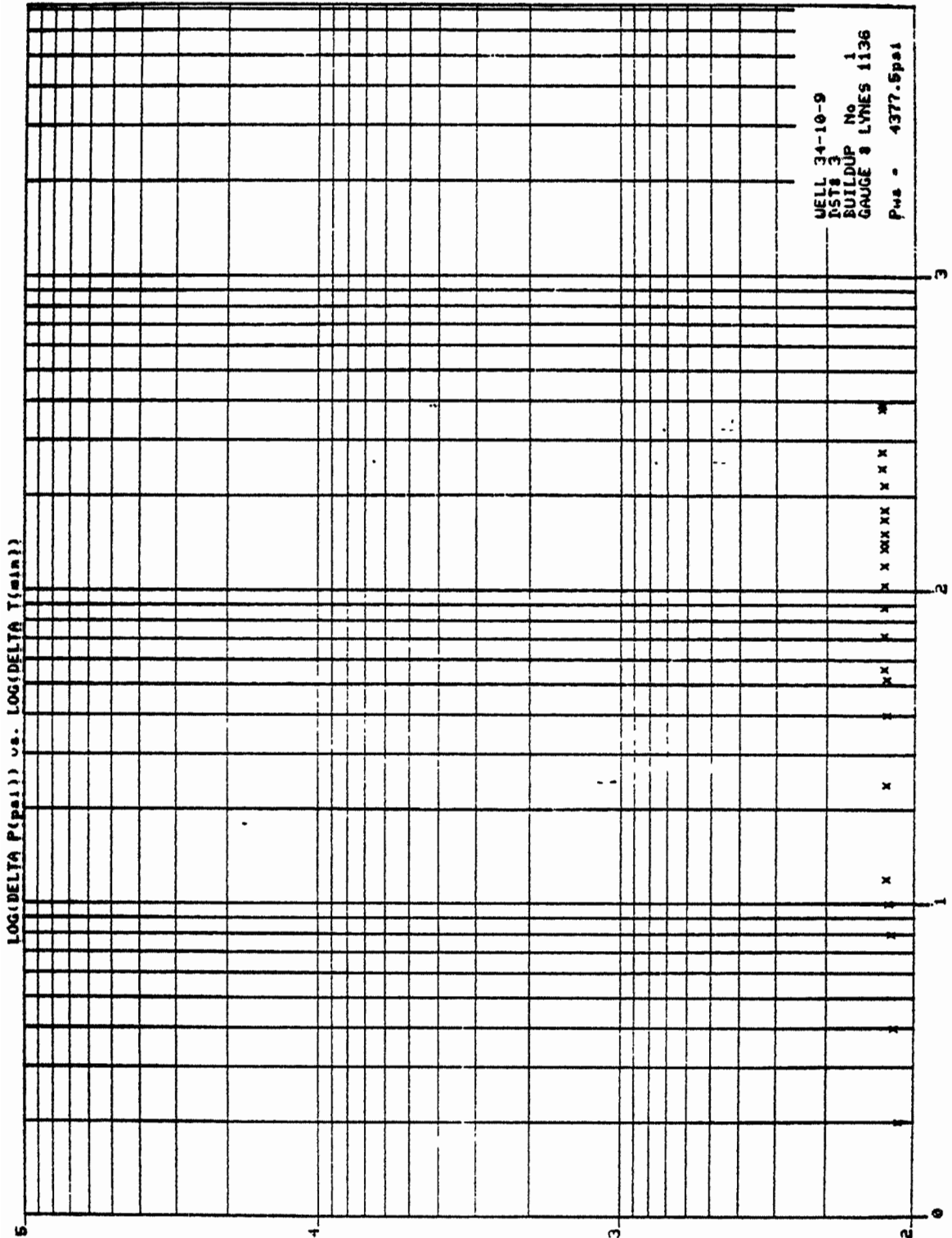
$$\left. - (0.49 + 0.1 \ln(h_t (K_H/K_V)^{0.5})) \ln r_{wc} - 1.95 \right)$$

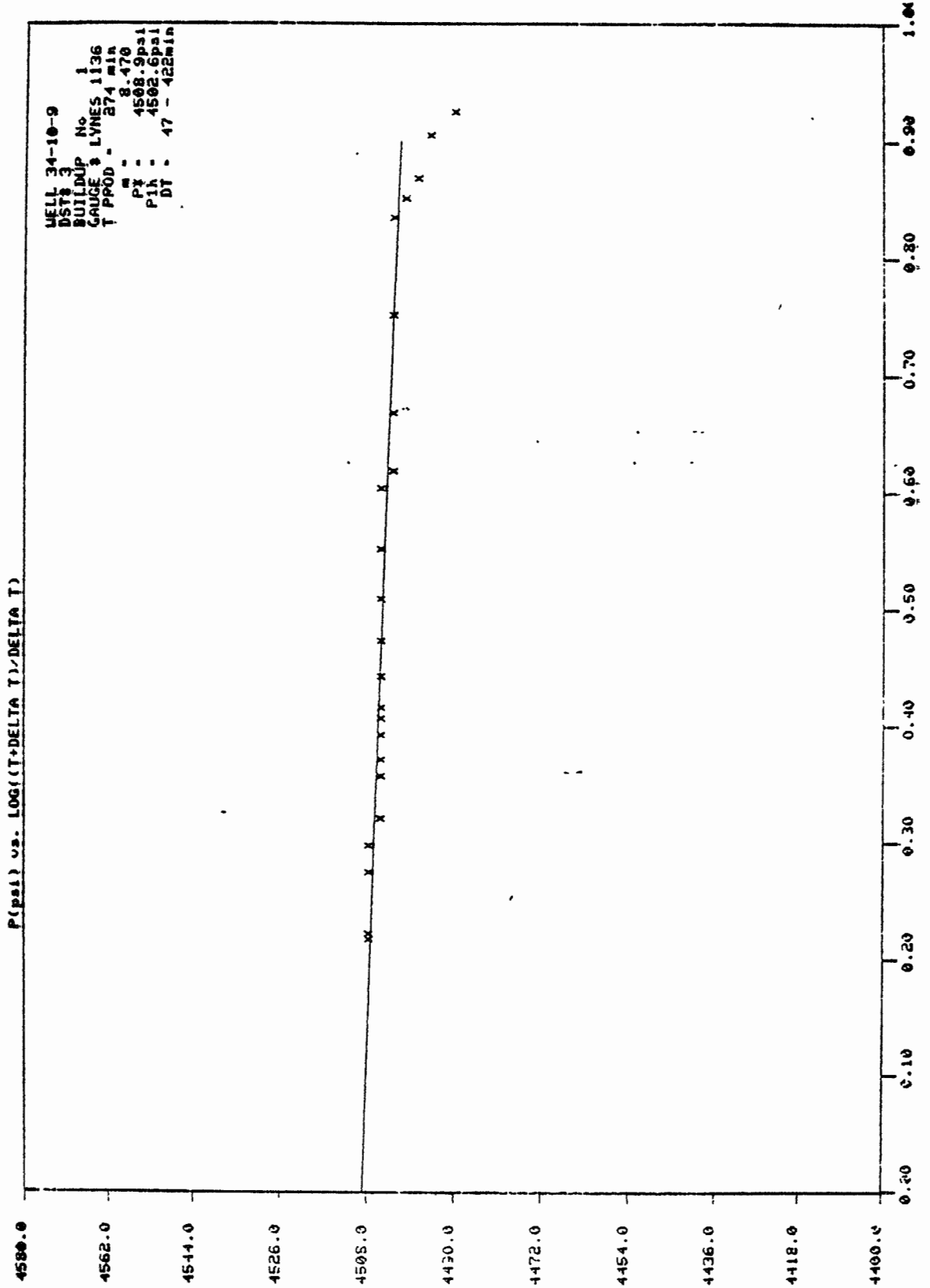
$$s_p = \underline{+45.6}$$

BRØNN 34-10-9 DST# 3
 BUILDUP NUMMER 1
 GAUGE LYNES 1136

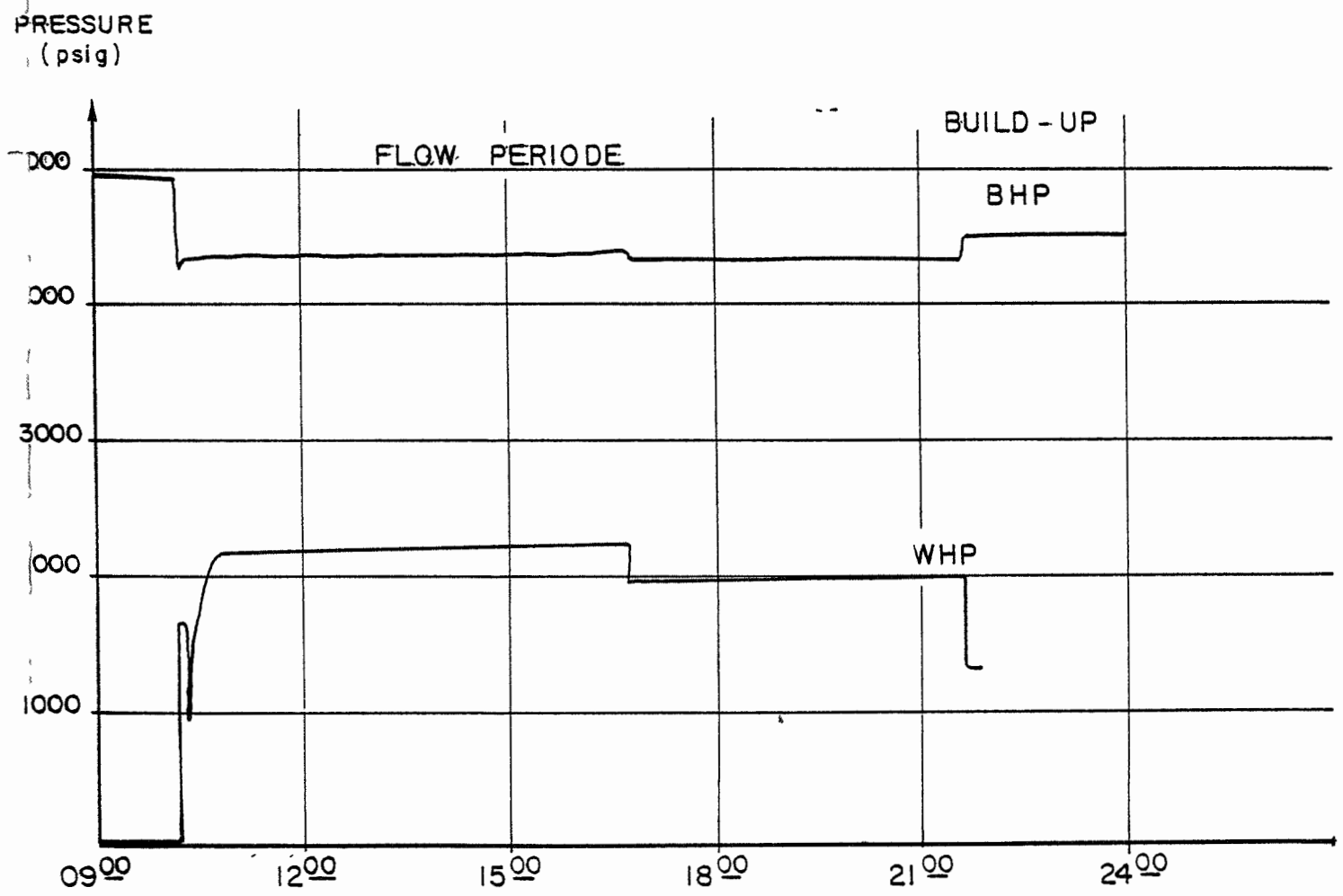
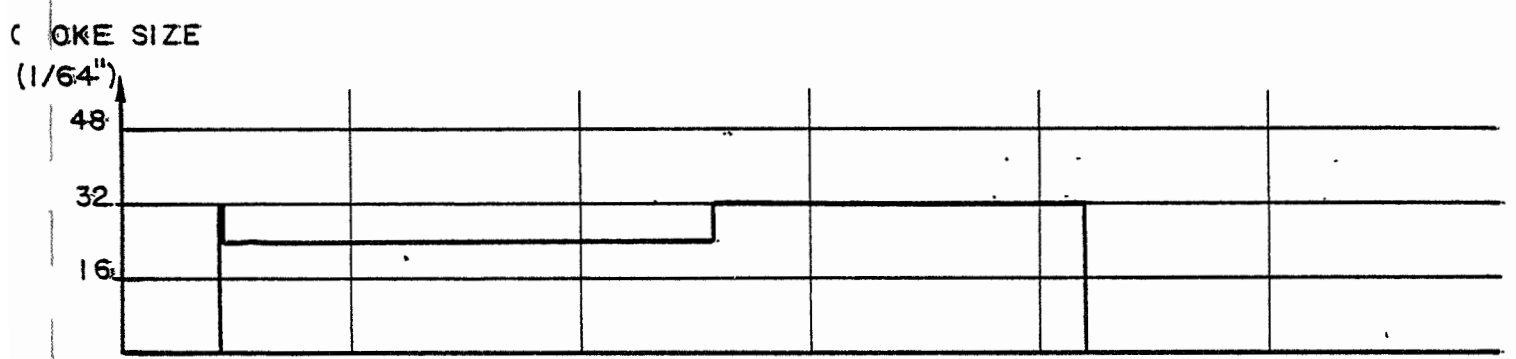
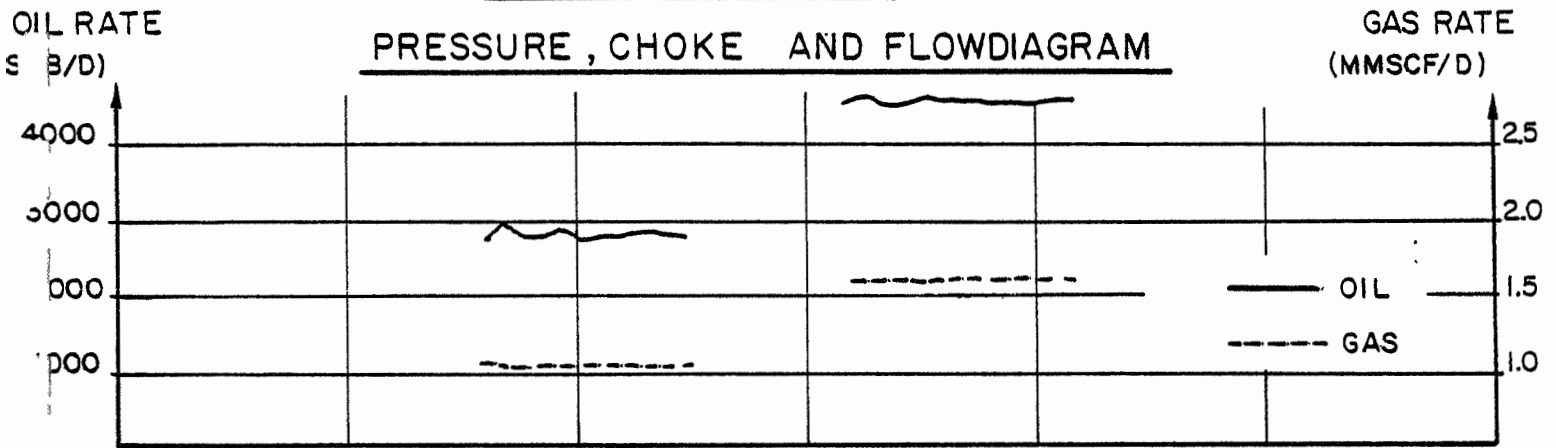
NR. ---	TID ---	TRYKK -----
1	21.35	4377.500
2	21.37	4490.000
3	21.39	4495.000
4	21.43	4497.500
5	21.45	4500.000
6	21.47	4502.500
7	21.59	4502.500
8	22.15	4502.500
9	22.27	4502.500
10	22.31	4505.000
11	22.47	4505.000
12	23.03	4505.000
13	23.19	4505.000
14	23.35	4505.000
15	23.51	4505.000
16	23.57	4505.000
17	0.07	4505.000
18	0.23	4505.000
19	0.35	4505.000
20	1.11	4505.000
21	1.39	4507.500
22	2.11	4507.500
23	3.51	4507.500
24	4.03	4507.500





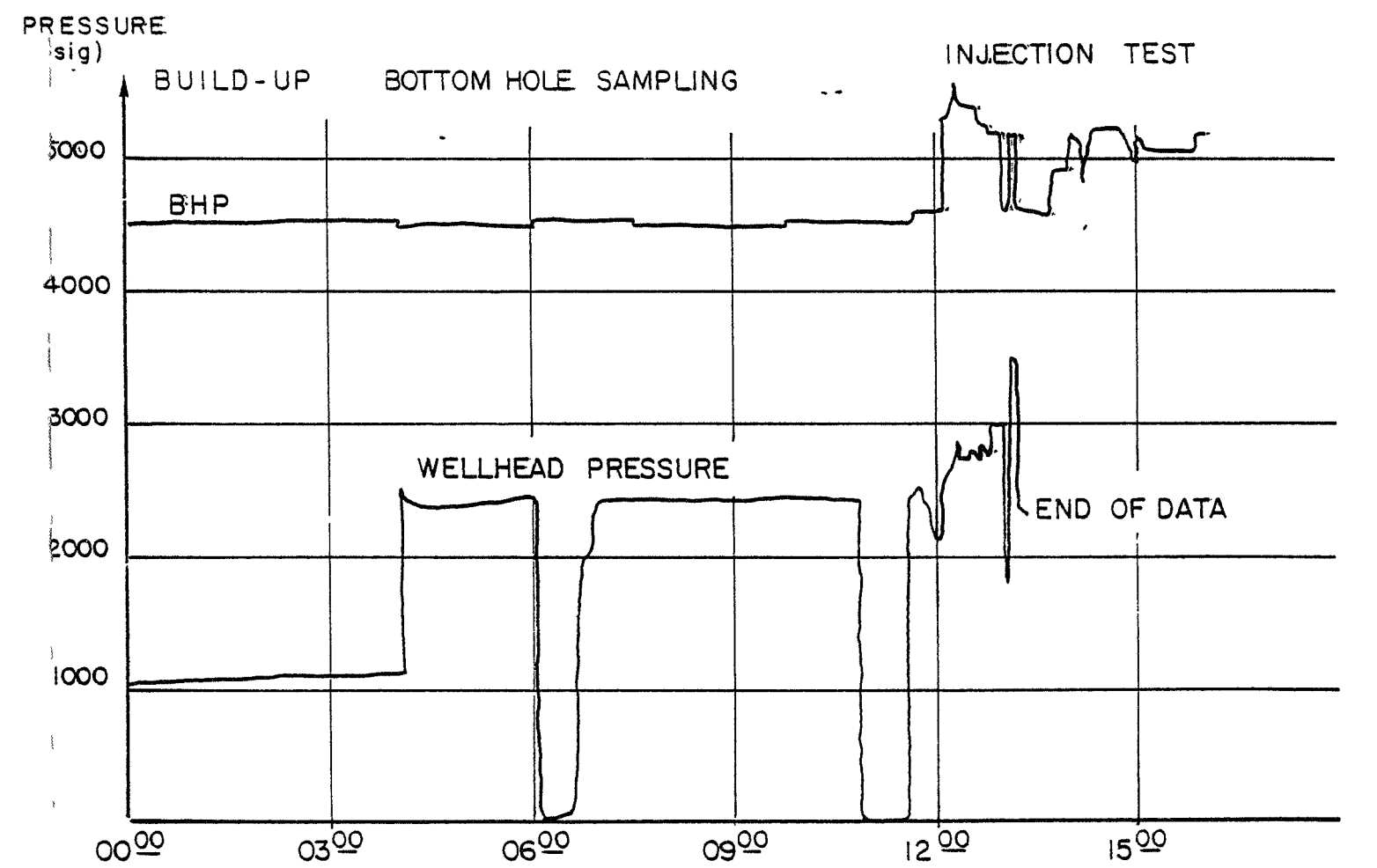
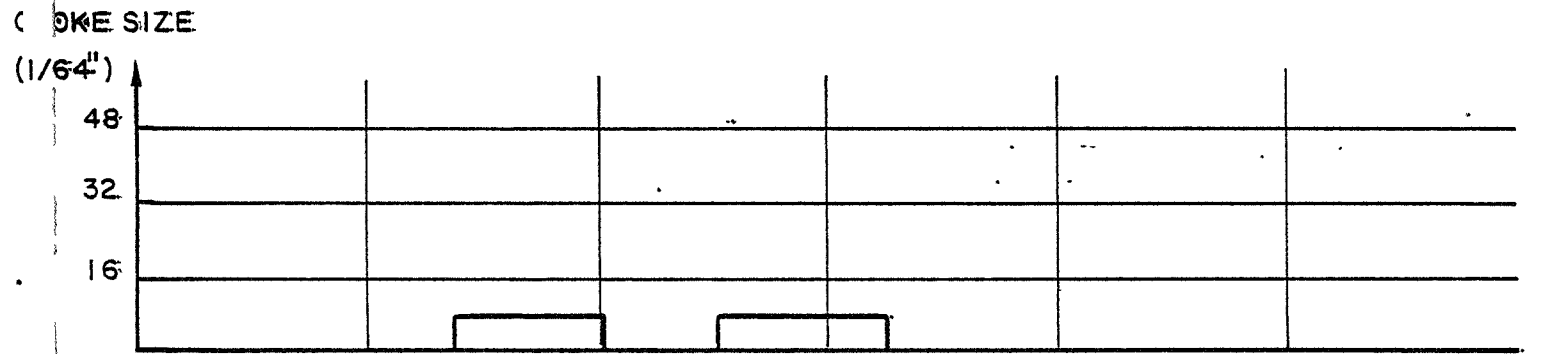
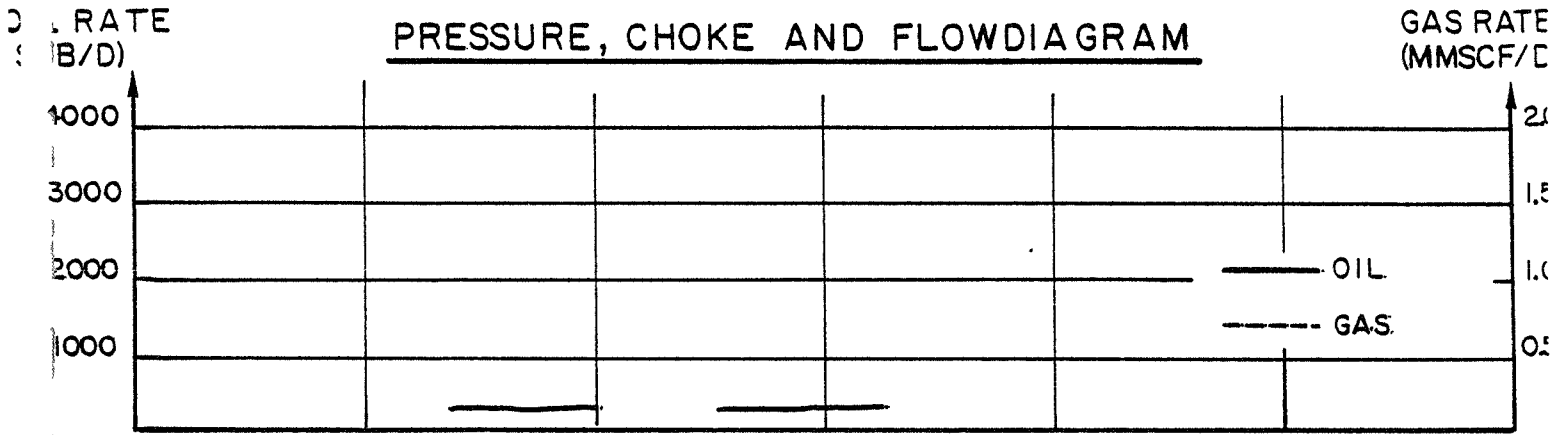


34/10-9, DST # 3



A3-11

34/10-9, DST # 3



25. JUNE 1980

(All pressure data from Lynes)

Date/Time	Bottom hole		Well head		Chokes		Separator data FLOPETROL							Liq. and gas analysis at goos neck							
	Press. Pslg	Temp. OF	Press. Pslg	Temp. OF	Manifold	Heater 64. inc.	Temp. OF	Press. Pslg	Temp. OF	Gas rat. mmscf/d	Oil rate stb/d	GOR scf/\$tb	Oil API	Gas S.G.	Water %	PH	Sedim. %	Oil API	Co2 %	H2S	
24-06-80																					
I2-30		FLOWED THROUGH SEPARATOR																			
I3-45	4367	I63	2196		24/64"			415	97	I.04	2724	382	31.9	.639							
I4-00	4370	I63	2197		"			415	96	I.02	2939	347	"	"							
I4-15	4370	I64	2198		"			418	96	I.02	2748	371	"	"							
I4-30	4372	I64	2202		"			421	98	I.03	2782	370	"	"							
I4-45	4375	I64	2204		"			420	100	I.03	2839	363	"	"	0		Tr.	31.2	0.15	0	
I5-00	4375	I64	2205		"			419	100	I.02	2773	367	"	"							
I5-30	4375	I64	2208		"			419	100	I.02	2748	365	"	"							
I6-00	4375	I65	2209		"			420	102	I.03	2831	362	"	.630	0		Tr.	31.1	0.13	0	
I6-30	4375	I65	2210		"			422	103	I.03	2758	372	"	"							
I6-45		CHANGED TO 32/64" CHOKE																			
I8-15	4302	I66	1985		32/64"			529	105	I.58	4580	345	32.1	.633	0		Tr.	31.7			
I8-30	4302	I66	1988		"			529	108	I.58	4637	341	"	"							
I8-45	4302	I66	1990		"			526	109	I.58	4536	348	"	"							
I9-00	4302	I66	1990		"			527	110	I.58	4552	347	"	"							
I9-15	4302	I66	1990		"			527	110	I.61	4612	349	31.9	"							
I9-30	4302	I66	1991		"			501	110	I.62	4574	354	"	"							
20-00	4305	I66	1994		"			502	111	I.61	4582	351	"	"	0		Tr.	31.1	0.18	0	
20-30	4305	I67	1997		"			506	110	I.60	4528	353	"	.637	0		Tr.	31.3	0.18	0	
21-00	4305	I67	1997		"			503	110	I.59	4574	348	"	"							

A3-12

WELL 34/I0-9

DST # 3 (1906 - 1910 m RKB)

I.D.	O.D.	Description	Length (m)	Depth (:
		surface tree		4.52 abc
		x-over 6 I/2-4acme pinx3 I/2 tds pin		rig floc
		3 I/2 tds tubing, 2 sgls	19.00	14.48
		x-over 3 I/2 tds box x 4 I/2 - 4 acme pin		
		Lubricator valve	2.50	15.98
		x-over 4 I/2 - 4 acme pin x 3 I/2 tds pin		
		3-I/2 tds tubing pup jnt,	4.00	19.98
		3-I/2 tds tubing, 7 stds + 1 sgl	197.72	217.70
		x-over 3-I/2 tds box x 4-I/2 - 4 acme pin		
		e-z subsea test tree and latch assy		
		x-over 4-I/2 -4 acme pin x 3-I/2 tds box		
		slick joint 3-I/2 tds tubing		
		x-over 3-I/2 tds box x 4-I/2 4 acme pin		
		fluted hanger landed in wellhead	7.78	225.48
		x-over 4-I/2 - 4 acme pin x 3-I/2 tds box		
		x-over 3-I/2 tds pin x pin	0.66	226.14
		3-I/2 tds tubing, 158 jts + 1 pup jt.	1419.93	1646.07
		x-over 3-I/2 tds box x 3-I/2 if pin	0.46	1646.53
2.25	5.00	5''x2-I/4''slip joint (open)	5.54	1652.07
2.25	5.00	5''x2-I/4 slip joint (closed)	4.01	1656.08
2.25+	4.75	4-3/4 drill collars, 5 stands	142.00	1798.08
2.43	4.75	x-over, 3-I/2 if box x 2-7/8 pin	0.24	1798.32
2.44	4.87	7'' rtts circulating valve	0.84	1799.16
2.25	5.00	x-over, 2-7/8 eue box x 3-I/2 if pin	0.21	1799.37
2.25+	4.75	4-3/4 drill collars, 1 stand	28.40	1827.77
2.25	5.00	5''x2-I/4''slip joint (closed)	4.01	1831.78
2.25	5.00	5''x2-I/4''slip joint (closed)	4.01	1835.79
2.25+	4.75	4-3/4 drill collars, 1 stand	28.40	1864.19
2.25	5.00	5'' apr-a reversing valve	0.91	1865.10
2.25	5.00	5'' apr-n test valve	3.90	1869.00
2.25	4.63	4-5/8''hydraulic by-pass	1.93	1870.93
2.37	4.63	4-5/8''big john jars	1.52	1872.45
2.44	5.00	rtts safety joint	1.00	1873.45
2.55	5.76	7''rtts packer, above set point	0.52	1873.97
2.36	5.65	7''rtts packer, below set point	0.81	1874.78
2.50	2.875	x-over, 2-7/8 eue pin x 2-3/8 eue pin	0.22	1875.00
	2.875	perforated tubing, 2-7/8 box x 2-7/8 box	3.30	1878.30
2.00	2.875	x-over, 2-7/8 eue pin x 2-3/8 eue pin	0.25	1878.55

Cont.

WELL 34/I0-9

DST # 3(1904 - 1910 m RKB)

I.D.	O.D.	Description	Length (m)	Depth (
1.81	2.375	baker 'f' nipple	0.24	1878.79
2.00	2.875	x-over, 2-3/8 eue box x 2-7/8 eue pin	0.30	1879.09
	2.875	2-7/8 tubing	9.80	1888.89
	2.875	2-7/8 tubing	9.25	1898.14
	2.875	x-over, 2-7/8 eue box x 2-7/8 dp pin	0.10	1898.24
	3.875	howco equipment carrier for pressure recorder.	1.67	1899.91

WELL NO.: 34/10-9 DST NO.: 3 DATE: 23.6.80

7

WIRELINE NIPPLE 1878.79 m RKB

GAUGE TYPE AND NUMBER: Sperry Sun MRPG no. 0043
 DEPTH, PRESSURE ELEMENT: 1880 . 83 m RKB RANGE: 0 - 10000 psi
 MODE: 1 minute DELAY: 1024 minutes
 ACTUATED: time 23:16 date: 23.6.80
 WILL RUN OUT: time 24:00 date: 25.6.80

GAUGE TYPE AND NUMBER: Lynes DMR 312 1010 no, 1136
 DEPTH, PRESSURE ELEMENT: 1882.43 RANGE: 10000
 MODE: 2 min DELAY: 7 hrs
 ACTUATED: time: 23:12 date: 23.6.80
 WILL RUN OUT: time: 16:20 date: 25.6.80

D.S.T. HANGER at 1888:89 m RKB

GAUGE TYPE AND NUMBER: Sperry Sun SPG no. 0113
 DEPTH, PRESSURE ELEMENT: 1890 . 94 m RKB RANGE: 0 - 7000 psi
 MODE: 4 minutes DELAY: 0
 ACTUATED: time: 23:10 date: 23.6.80
 WILL RUN OUT: time: 03:00 date: 27.6.80

GAUGE TYPE AND NUMBER: Lynes DMR 312 1010 no. 1100
 DEPTH, PRESSURE ELEMENT: 1892.94 RANGE:
 MODE: 4 min. DELAY: 7 hrs
 ACTUATED: time: 23:09 date: 23.6.80
 WILL RUN OUT: time: 02:25 date: 27.6.80

GAUGE TYPE AND NUMBER: Halliburton APBT
 DEPTH, PRESSURE ELEMENT: 1899.4 m RKB RANGE: 10000 psi
 MODE: 120 hrs clock DELAY: 0
 ACTUATED: time: 23.00 date: 23.6.80
 WILL RUN OUT: time: 23 00 date: 28.6.80

DIARY OF EVENTS		WELL No. <u>34/10-9</u>	DST No. <u>3</u>
		ZONE TESTED <u>Brent</u>	PERFS. <u>1904 - 10 m RI</u> <u>ref. FDC/CNL-GR</u>
DATE	TIME	OPERATIONS	
23.6	21:00	<u>PERFORATING</u>	
	21:50	Started to rig up Schlumberger	
	22:24	RIH w/ gun 4 shots/foot	
	22:50	Perforated 1904 - 1910 m RKB	
		Out of hole, all shots fired	
		<u>RAN TESTSTRING</u>	
	23:05	Started RIH w/teststring	
24.6	09:50	Finished pressure testing	
	10:04	Sat packer.	
		<u>FIRST FLOW PERIOD</u>	
	10:12	Opened APR-n valve	
		WHP = 1660 psi	
	10:17	Opened well on 32/64" choke	
	10:19	Choked back to 24/64" choke	
	10:33	Mud to surface	
	10:35	Gas to surface	
	10:36	Lighted flare	
	10:40	Oil to surface	
	10:45	WHP = 2155	
	10:56	WHP = 2159	
	12:32	Flowed through separator	
	14:15	Flowed to stocktank	
14:30	Bypassed stocktank.		

COMMENTS :

PE:

DIARY OF EVENTS		WELL No. <u>34/10-9.</u>	DST No. <u>3</u>
		ZONE TESTED <u>Brent</u>	PERFS. <u>1904 - 19 m RKB</u> <u>ref.FDC/CNL-GR</u>
DATE	TIME	OPERATIONS	
<u>SAMPLING AT SEPARATOR</u>			
24.6	15:45	Started PVT sample no. 1.	
	16:00	Finished sampling	
	16:25	Started PVT sample no. 2.	
	16:40	Finished sampling	
	16:43	Bypassed separator	
	16:45	Changed to 32/64" choke, WHP = 1965 psi	
	18:05	Flowed through separator	
	18:30	Flowed to tank	
	18:35	Bypassed stocktank	
	19:55	Started taking emulsion sample on separator (20 l)	
	21:05	Finished taking sample	
	21:33	Bypassed separator	
	21:35	Closed APR-n valve	
	21:38	Closed choke manifold for build-up WHP = 1011	
<u>BOTTOM HOLE SAMPLING</u>			
25.6.	04.05	WHP = 1110	
	04.08	Opened APR-N. WHP = 2510	
	04.11	Opened on 8/64" choke, flow to flare	
	04.21	Oil to surface	
	04.33	WHP = 2370. Well slugging. Wait for stabilized flow	
	04.16	Flowed through separator. Unable to get stable flow	
	05.42	Bypassed separator. Waited for stabilized flow. Flowed stable enough.	
	05.52	Closed well in at choke manifold. WHP = 2430 psi	
	06.03	Closed lubricator. Bled off surface pressure with choke to 575 psi. OK.	
	06.07	Bled off on choke to zero WHP.	
	06.33	Mounted lubricator	

COMMENTS :

PE:

DIARY OF EVENTS		WELL No. <u>34/10-9</u>	DST No. <u>3</u>
		ZONE TESTED <u>Brent</u>	PERFS. <u>1994-1910</u>
DATE	TIME	OPERATIONS	
25.6.	06.38	Opened swab and kill valve. Pressured up with BJ-pump to WHP = 2190. Pressure dropped probably due to air in system.	
	06.52	Closed kill valve	
	06.54	Opened lubricator. WHP = 2440. RIH with samplers. Stopped 1820 m	
	07.33	Opened well on 8/64" choke flowed to flare slug flow	
	09.04	Flowed to separator. Oil rate 300 bbls/day	
	09.46	Bypassed separator	
	09.48	Closed choke manifold	
	09.50	Started to pull out with samplers. Wireline got stuck in stuffing box several times from 160 m and up.	
	10.48	Closed lubricator valve. Bled off pressure on choke Disconnected Flopetrol lubricator.	
	11.10	Rigged down wireline. Checked BH samplers, OK	
		<u>BULLHEADING WITH WATER AND FRACTURE TEST</u>	
	11.41	Started bullheading	
	12.13	Finished bullheading	
	12.18	Started fracture test	
	13.15	Finished fracture test	
	15.00	Started to pull out of hole with teststring	
	26.6.	Pressure recorders at surface, all OK except Sperry Sun MRPG no. 0043 due to plugging w/ mud.	

COMMENTS :

PE:

APPENDIX A4, RFT and FIT data 34/10-9	Page
RFT data 34/10-9 Brent	A4-2
RFT data 34/10-9 Cook	A4-3
FIT data 34/10-9	A4-4
RFT data plotted vs. depth	A4-5
RFT data from well 34/10-9 compared with data from previous drilled wells	A4-6

RFT data, 34/10-9 Brent

<u>Depth</u> <u>(m MSL)</u>	<u>Corr.</u> <u>pressure</u> <u>(psig)</u>
- 1813	4448
- 1816	4449
- 1817	4452
- 1817	4451
- 1822	4458
- 1830	4465
- 1835,5	4472
- 1838	4474
- 1842	4478
- 1845,5	4483
- 1847,5	4467
- 1850	4487
- 1856,5	4494
- 1863	4499
- 1869	4506
- 1882	4520
- 1898	4537
- 1907	4551
- 1919	4561
- 1925	4567

RFT data 34/10-9 Cook

<u>Depth</u> <u>(m MSL)</u>	<u>Corr.</u> <u>pressure</u> <u>(psig)</u>
- 2061	4825
- 2061	4810
- 2061,5	4813
- 2062	4827
- 2062	4831
- 2063	4816
- 2064	4832
- 2067	4831
- 2067	4819
- 2069,5	4832
- 2073	4841
- 2079	4851
- 2079	4837
- 2098,5	4868
- 2106	4878

34/10 - 9FORMATION INTERVAL TESTS

FIT NO 1 Sampled at 2132 m RKB

The drawdown was approximately 80 psi during sampling with final shut in of 4866 psi. Sample bled on rig. Chamber contained water.

pH = 9.0

 $P_f = 0.25$

NaCl = 17500

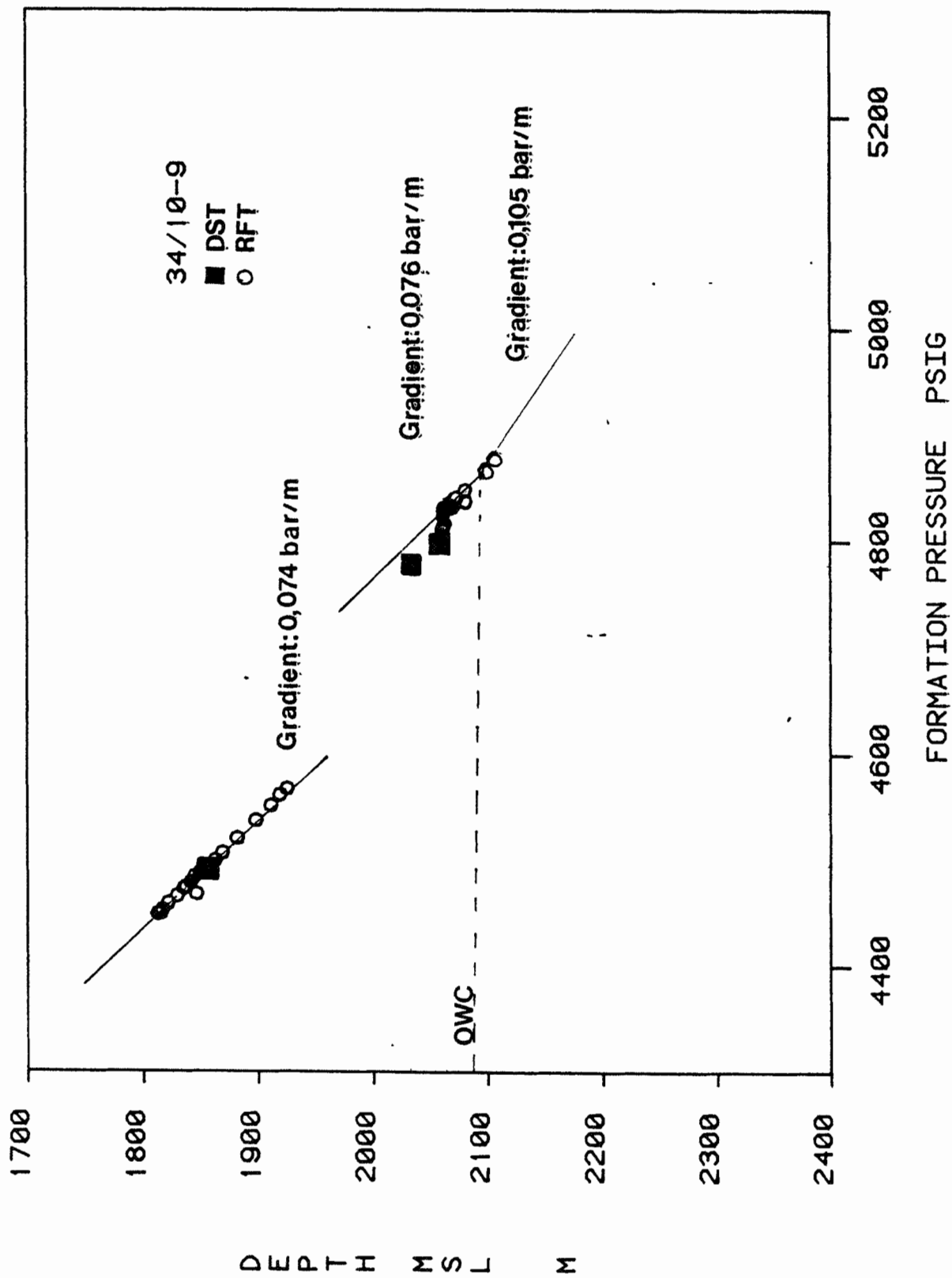
TH = 180 ppm

Ran two Sperry - Sun ganges. (SPG 113, 15 sec. mode, 10000 psi - SPG 266, 30 sec. mode 10000 psi.)

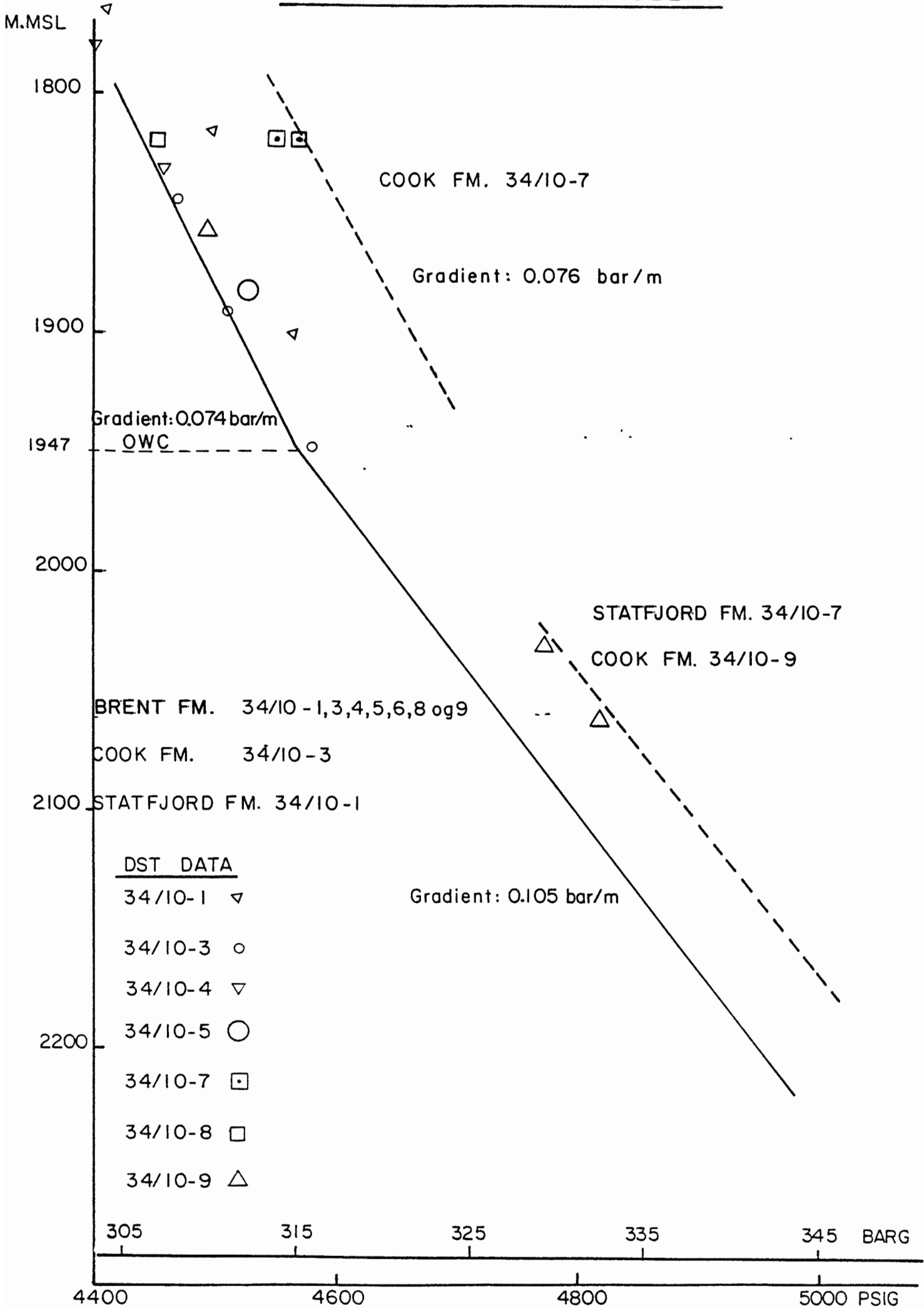
FIT NO 2 Sampled at 1840 m RKB

Segregated sample attempted with Sperry - Sun pressure recorders attached (SPG 113, 15 sec. mode, 8000 psi - SPG 266, 15 sec. mode, 8000 psi). Surface monitoring of pressure indicated drawdown, but plugging. No final buildup seen on either chamber. Gas bled off while dismantling Sperry - Sun ganges. Chambers were sealed and sent to Statoil PVT - lab.

RFT 34/10

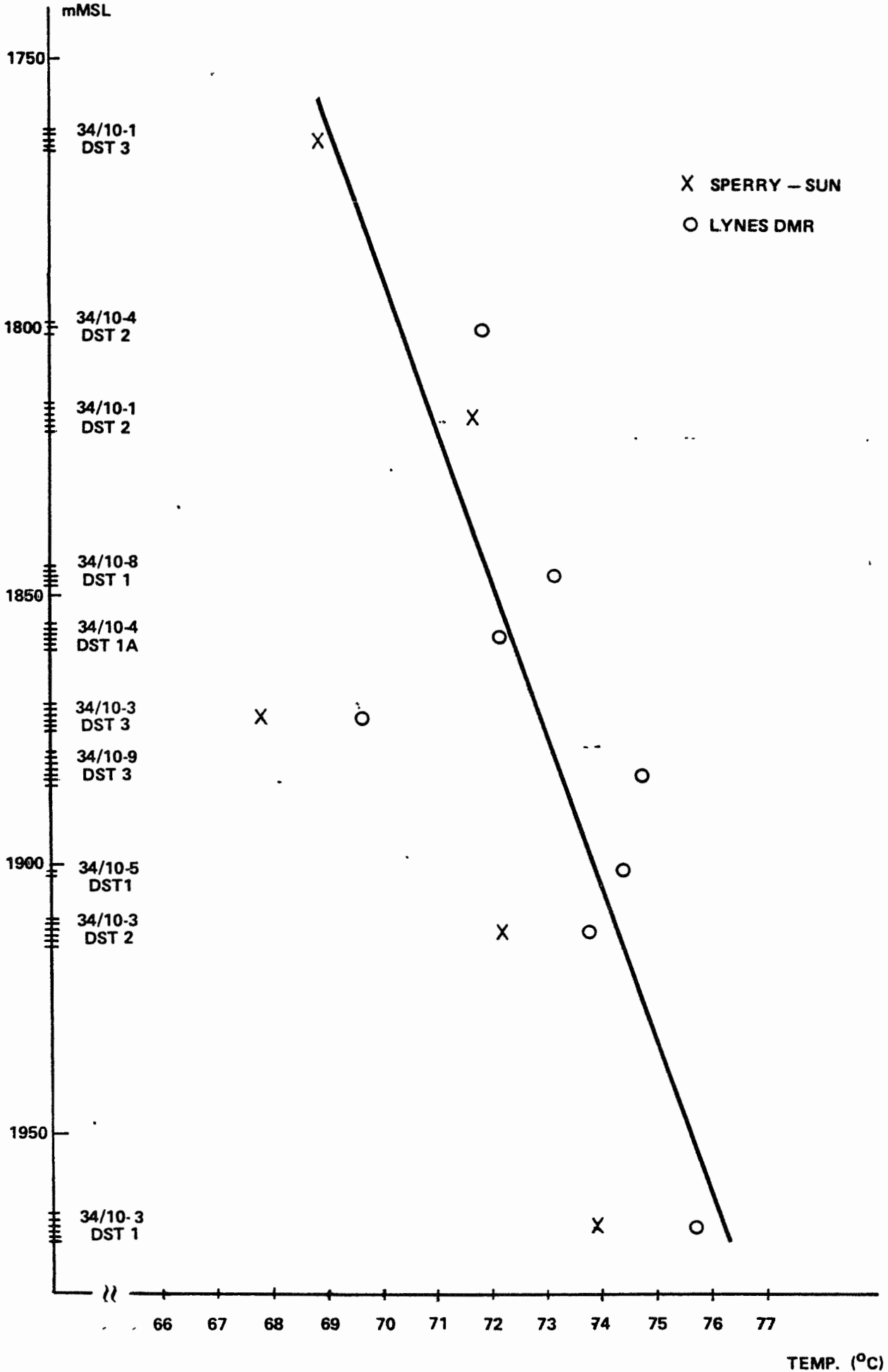


A4-6
RFT OG DST DATA 34/10 DELTA

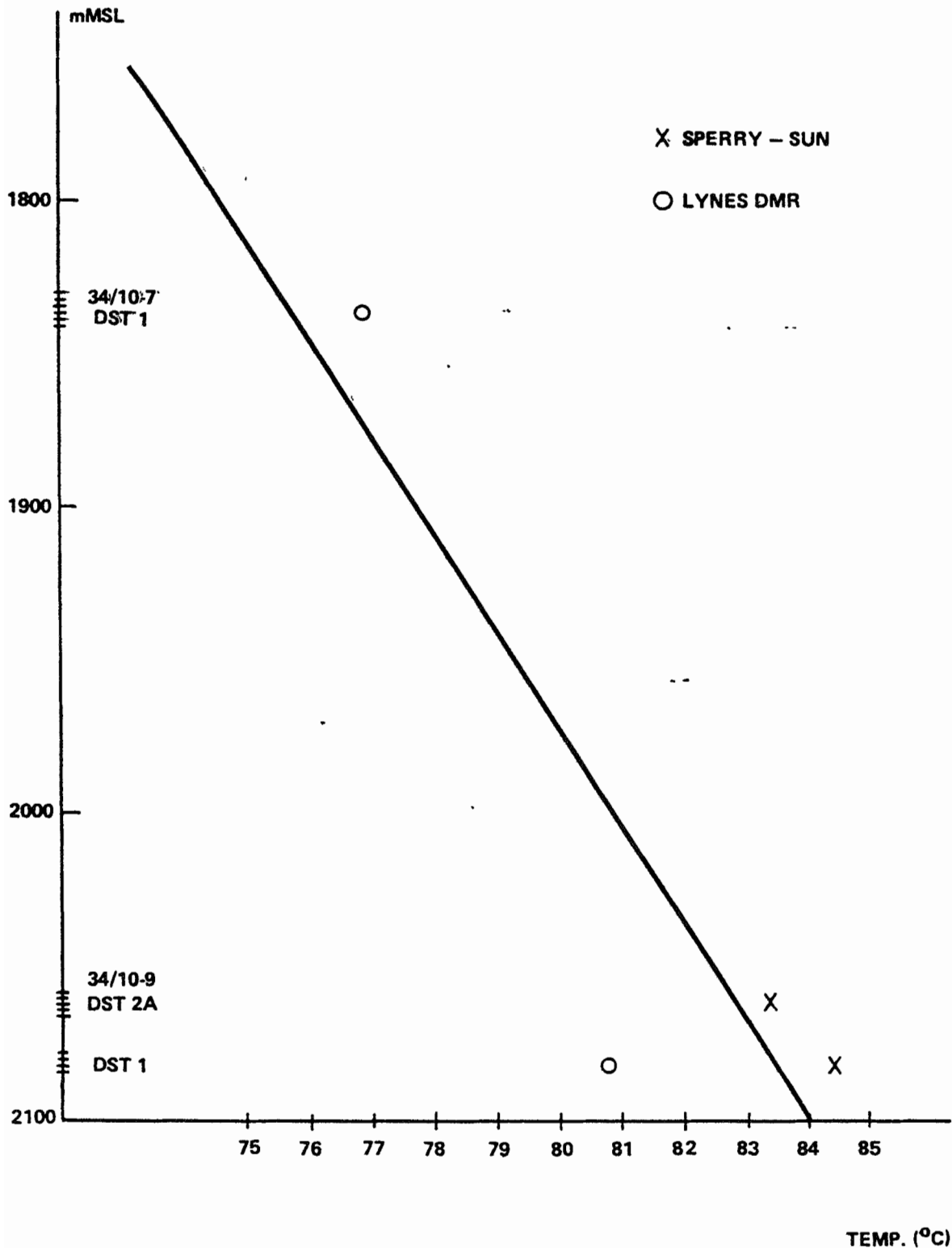


APPENDIX A5, Reservoir temp.	Page
Reservoir temperature 34/10 - Delta, Brent	A5-2
Reservoir temperature 34/10 - Delta, Cook	A5-3

34/10 - BRENT



34/10 - COOK



APPENDIX A6, Sampling	Page
Wellhead sampling, DST no. 1	A6-2
Surface sampling, DST no. 2A	A6-3
Bottomhole sampling, DST no. 2A	A6-3
Wellhead sampling, DST no. 2A	A6-3
Surface sampling, DST no. 3	A6-4
Bottomhole sampling, DST no. 3	A6-4
Wellhead sampling, DST no. 3	A6-4
Reservoir fluid properties of samples from Cook	A6-5
Reservoir fluid properties of samples from Brent	A6-6

WELLHEAD SAMPLES

WELL NO: 34/10-9 TEST NR. 1

INTERVAL 2103 - 09 m RKB DATE 15 - 16/6-80

TIME	PLACE	DESCRIPTION
15:30	Goose neck	1 l oil sample
20:48	Goose neck	1 l "
22:00	Goose neck	1 l "
00:48	Goose neck	1 l "
03:30	Stock tank	oil sample, 1 bbls
03:30	Stock tank	oil sample, 2 jerry cans
02:00	Separator	2 x 1 l alum. bag w/ gas

SURFACE SAMPLING AT SEPARATOR
DST N° 2 A (2084 - 2090 m RKB)

DATA/TIME	SAMPLE N°	TYPE OF SAMPLE	TRANSFER TIME	BOTTLE N°
21.06.80				
11.55	1	Emulsion (5 l)	20 min	A3221
12.20	2	"	15 min	A3218
12.55	3	Oil	15 min	20524
12.55	4	Gas	15 min	A-10486
17.05	5	Oil	15 min	16251/36
17.05	6	Gas	15 min	A7156

BOTTOMHOLE SAMPLING

DATE/TIME	BOTTLE N°	OPENING PRESSURE	ESTIMATED P _B AT RES. COND. (FROM FLOPETROL ON RIG)
22.06.80			
08.20	2681-44	1740 psi	2850 psi at 161°F
08.20	13266/6	1760 psi	2920 psi at 161°F

WELLHEAD SAMPLES

12 x 1 l oil samples from goose neck
 1 barrel
 1 x 10 l
 1 x 20 l " } from separator

SURFACE SAMPLING ON SEPARATOR
DST no. 3 (1904-1910 m RKB)

DATE/TIME	SAMPLE NO.	TYPE OF SAMPLE	TRANSFER TIME	BOTTLE NO.
24.06.80				
15.45	1	OIL	15 min	20584-2
15.45	2	GAS	15 min	A 7112
16.25	3	OIL	15 min	20475-93
16.25	4	GAS	15 min	A 4276
20.00	5	EMULSION	1 hour	A 8169

BOTTOM HOLE SAMPLING

DATE/TIME	BOTTLE NO.	OPENING PRESSURE	ESTIMATED P _B AT RES. COND: (From Flopetrol on rig)
25.06.80		--	
09.15	13266/149	1980 psi at 58°F	3220 psi at 166°F
09.15	20584-81	1960 psi at 58°F	3230 psi at 166°F

WELLHEAD SAMPLES

12 x 1 1 oil samples from gooseneck
 1 x 10 1 jerrycan oil }
 1 x 20 1 -----"----- } separator
 1 barrel oil }

STATOIL PRODUCTION LABORATORY

statoil

Issued:	RESERVOIR FLUID STUDY STATOIL WELL 34/10-9 BOTTOM HOLE SAMPLES	Report:
19.9.80		PVT-20
File: PLO 50 DEL 34/10-9		Page:
050-P5.17.04		

Reservoir fluid properties of samples from cook

BHS No.	3	4
Bottle No.	13266/6	2681/44
Formation temp. (°C)	73.0	73.0
Initial fluid pressure (bar)	334	334
<u>Components</u>		
Nitrogen	2.10	2.26
Carbondioxid	0.23	0.20
Methane	40.13	40.03
Ethane	4.39	4.56
Propane	3.85	4.01
iso-butane	1.07	1.10
n-butane	2.26	2.21
iso-pentane	1.22	1.12
n-pentane	1.35	1.20
Hexanes	2.35	2.18
Heptanes +	<u>41.05</u>	<u>41.13</u>
	100.00	100.00
C ₇₊ mol wt.	238	237
<u>C₇₊ density (g/cc)</u>	0.861	0.860
ρ_{rf} density res. fluid (g/cc):	0.710	0.712
Bubble pt., (Bar)	: 192	190
Co ⁽³⁾ , (vol/vol/bar x 10 ⁵)	: 16.8	17.3
Gor, (SM ³ /M ³) (1)	: 111	111
Bo, (M ³ /M ³) (2)	: 1.348	1.349
ρ_o density of oil, (g/cc)	: 0.8502	0.8504
γ_g , gravity of gas	: 0.80	0.81
Mol weight stock tank oil	: 222	222

STATOIL PRODUCTION LABORATORY

statoil

Issued: 19.9.80	RESERVOIR FLUID STUDY STATOIL WELL 34/10-9 BOTTOM HOLE SAMPLES	Report: PVT-20
File: PLO 50 DEL 34/10-9		Page:
050-P5.17.04		

Reservoir fluid properties of samples. Brent

BHS No.	1	2
Bottle No.	20584/81	13266/149
Formation temp. (°C)	73	73
Initial fluid pressure (bar)	315	315
<u>Components</u>		
Nitrogen	0.99	0.80
Carbondioxid	0.16	0.15
Methane	41.74	42.23
Ethane	4.56	4.59
Propane	2.39	2.48
iso-butane	0.77	0.81
n-butane	1.33	1.36
iso-pentane	0.80	0.81
n-pentane	0.73	0.74
Hexanes	1.59	1.58
Heptanes +	<u>44.94</u>	<u>44.45</u>
	100.00	100.00
C ₇₊ mol wt.	247	247
<u>C₇₊ density (g/cc)</u>	0.878	0.878
ρ_{rf} density res. fluid (g/cc):	0.752	0.755
Bubble pt., (Bar)	: 209.5	206.0
Co ⁽³⁾ , (vol/vol/bar x 10 ⁵)	: 16.2	15.7
Gor, (SM ³ /M ³) (1)	: 97	99
Bo, (M ³ /M ³) (2)	: 1.277	1.275
ρ_o density of oil, (g/cc)	: 0.8715	0.8722
γ_g , gravity of gas	: 0.75	0.75
Mol weight stock tank oil	: 237	237

APPENDIX A7, Fracture test

Page

Fracture test, 34/10-9, DST no. 3

A7-2

FRACTURE TEST34/10-9 , DST # 3

After finishing bottomhole sampling, the well was bullheaded with water. WHP decreased during bullheading until it increased to 2800 psi after 45 barrels had been pumped. Slowed down pumprate to ~ 0.32 bbls/min, and started injection test.

See enclosed tables and plot for injection test data.

The formation was fractured at ~ 12.17 pm, after 45 barrels had been pumped. This can be seen on the pressure - time plot. The BHP has a peak of 5562 psi, which is greater than the estimated fracture pressure of 5492 psi. From then on the BHP steadily decreases. The WHP increases during the injection test due to friction loss in the tubing.

A plot of WHP versus barrels pumped can not be used, due to the effect of friction loss and the fact that the formation was fractured at the start of the injection test.

Calculated fracture gradient from maximum bottomhole pressure:
$$\frac{5562 \text{ psi} \times 10}{14.5 \times .98 \times 1904} = \underline{\underline{2.06 \text{ g/cc}}}$$

A7-3

FRACTURE TEST, 34/10-9 , DST # 3

<u>Real Time</u>	<u>Cum.inj. (bbls)</u>	<u>Rate (bbl/min)</u>	<u>WHP Lynes #1136</u>	<u>Comments</u>
BULLHEADING				
11.41.20	0	—	2410	
11.44.40	5	1.50	2488	
11.47.50	10	1.38	2432	
11.51.00	15	1.58	2350	
11.54.40	20	1.58	2280	
11.57.10	25	1.36	2229	
12.00.30	30	2.00	2156	
12.03.30	35	1.50	2089	
12.06.30	40	1.67	2028	
12.13.00	45	0.77	2867	
FRACTURE TEST				
12.18.00	46	—	2897	Stage 1
12.21.30	47	0.29	2763	1
12.26.00	48	0.22	2710	1
12.27.30	49	0.67	2752	2
12.28.30	50	1.00	2765	2 change rate
12.31.20	55	1.77	2754	2
12.34.40	60	1.50	2734	2 change rate
12.36.50	65	2.73	2820	3
12.38.35	70	2.86	2762	3
12.40.10	75	3.16	2733	3
12.41.50	80	2.91	2713	3 change rate

A7-4

<u>Real Time</u>	<u>Cum.inj. (bbls)</u>	<u>Rate (bbl/min)</u>	<u>WHP Lynes #1136</u>	<u>Comments</u>
12.43.10	85	3.76	2854	Stage 4
12.44.40	90	3.33	2838	4
12.46.00	95	3.76	2834	4
12.47.15	100	4.00	2822	4
12.49.55	105	1.87	2786	4
12.51.30	110	3.16	2783	5 change rate
12.53.30	120	5.00	3003	5
12.54.35	125	4.63	2989	5
12.55.35	130	5.00	2978	5
12.56.38	135	4.76	2973	5
12.57.38	140	5.00	2971	5
12.58.40	145	4.85	2973	5
12.59.45	150	4.63	2978	5
13.05.05	5	—	3567	6*)
13.05.50	5	6.67	3569	6
13.06.35	5	6.67	3549	6
13.07.15	5	7.50	3537	6
13.10.00	5	6.00	3434	7**)
13.15.00	5	6.00	3284	7

*) Problems getting second pump started.
Measured time to pump 5 barrels.

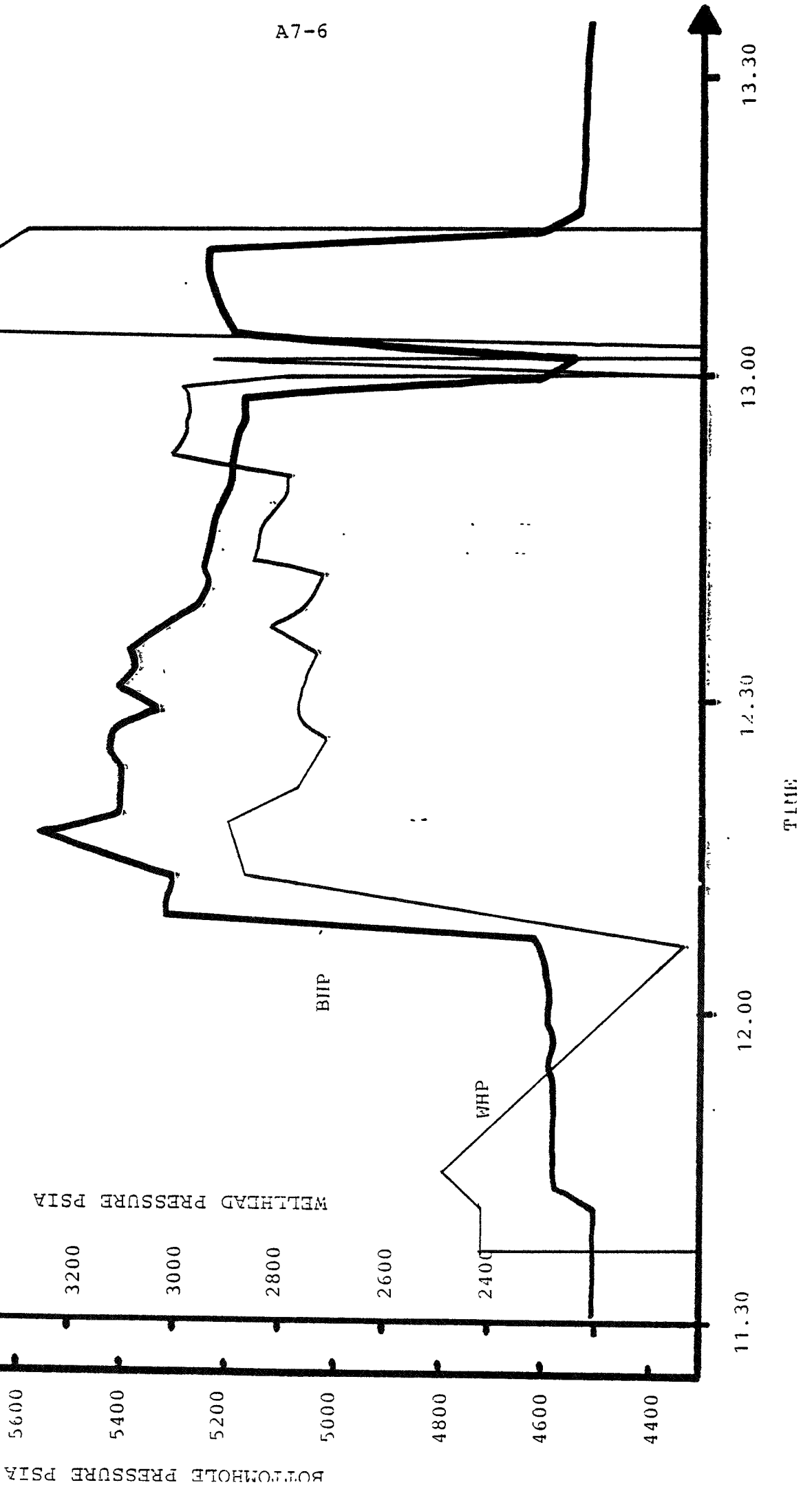
***) Stage 7 lasted 5 minutes. Two individual
rate measurements each gave ≈ 6 bbls/min.

AVERAGE VALUES

STAGE	AVG. RATE (BBLs/MIN)	AVG. WHP (PSIA)	AVG. BHP (PSIA)
1	0.26	2720	5413
2	1.24	2737	5383
3	2.94	2756	5243
4	3.34	2810	5218
5	4.63	2980	5172
6	6.95	3540	5200
7	6.00	3292	5240

A7-6

FRACTURE TEST, 31/10-9
D.S.P. NO. 3



APPENDIX A8, CPI log for well 34/10-9

Page

CPI log for Brent

A8-2

CPI log for Cook

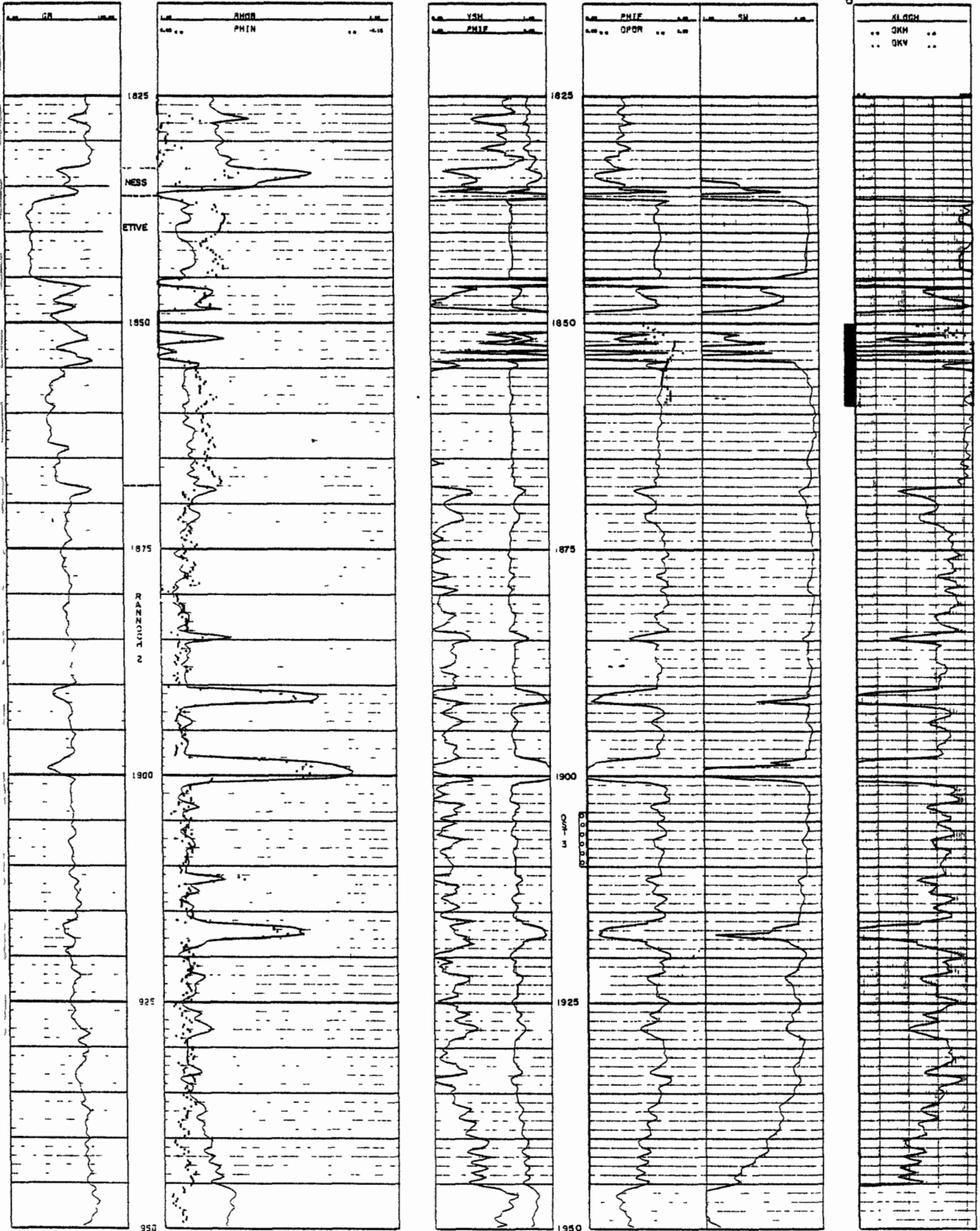
A8-3

GRAPHICAL LOG-PRESENTATION

WELL : 34-10-6 DEPTH INTERVAL : 1825.00-1950.00 (METER)
 ENGINEER : TNY SCALE 1:200
 DATE : 12.50.13 1 OCTOBER 1980



SUMMARY LOG 34/10-9



DST DATA

DST . 3
 INTERVAL - 1904 - 1910
 CHOKE 1/2"
 OIL 4575 STB/D
 GAS 16 · 10⁶ SCF/D

LOCATION
 61° 12' 55.3" N
 02° 15' 00.5" E

KB ELEVATION · 25 m
 WATER DEPTH · 203 m

STATUS
 SPUDDED 24/3 - 1980
 RIG RELEASED 3/7 - 1980
 PLUGGED AND ABANDONED

OCT 1980
 PE/EVALTEK

GRAPHICAL LOG-PRESENTATION

WELL : 34/10-9 DEPTH INTERVALL : 2075.00-2175.00 (METER)

ENGINEER : THY SCALE 1:200

DATE: 12.57.99 28 AUGUST 1980



STATOIL

A8-3

COOK-MEMBER MICRO-POROSITY CONCEPT
USING HYDROGEN INDEX AND C.E.C.

