2.06 MUD DATA AND CHEMICAL CONSUMPTION

DEPTH INTERVAL	WEIGHT ppg	VISCOSITY sec. M.F.	WATER LOSS cc API	FANN PROPERTIES APP VISC	PLASTIC VISC	YIELD PT	GELS 0/10min	ALKALINITY pH	pF	SOLIDS %	Cl ppm	Ca^{++} + Mg ppm
0 - 1360	9.2	42	50	-	-	-	-	-	-	-	-	-
1360 - 5035	9.9	44	9.0	25	16	18	3/45	9.0		15.0	22,000	1200
5035 - 9651	11.0	47	6.5	45	32	26	3/26	10.0	2.7	13.0	23,000	380
9651 - 10260	12.0	48	6.0	30	23	14	2/20	9.0	2.3	17.0	24,000	400
10260 - 11165	12.8	46	5.0	30	22	16	2/25	9.0	2.5	22.0	29,000	400
11165 - 14858	13.5	48	4.5	50	40	20	1/15	10.0	3.5	24.0	34,000	Nil
14858 - 15256	15.7	53	4.5	43	32	18	1/32	9.0	0.8	-	34,000	400
15256 - 16000	14.0	48	5.5	52	42	16	3/16	12.5	5.2	33	180,000	160

2.06

CHEMICAL CONSUMPTION WELL 1/3-1

From 6/7 To 11/11/68

CHEMICALS		UNIT	TOTAL CONSUMPTION	UNIT COST $	TOTAL COST $
Barytes	sacks	100 lbs	65912	3.00	197,736
Salt gel	sacks	80 lbs	1743	4.67	8,140
Magcogel	sacks	100 lbs	3731	3.25	12,126
Lime	sacks	25 kg	786	1.875	1,474
Spersene	sacks	50 lbs	4400	9.38	41,272
XP-20	sacks	50 lbs	2053	9.64	19,791
CMC (L.V.)	sacks	56 lbs	1375	12.28	16,885
CMC (H.V.)	sacks	56 lbs	225	17.64	3,969
Caustic Soda	sacks	112 lbs	540	9.94	5,368
Soda-Ash	sacks	112 lbs	974	5.08	4,948
Drilling Detergent	drums	55 gal	85	242.00	20,570
Magconol	drums	55 gal	37½	325.26	12,197
My-Lo-Gel	sacks	56 lbs	297	7.11	2,112
Mica F / C	sacks	56 lbs	370/230	5.69	3,414
Nut Plug F + M/C	sacks	25 kg	180/240	7.38	3,100
Cell-O-Seal	sacks	28 lbs	285	4.00	1,140
Kwik Seal	sacks	40 lbs	67	14.89	998
Salt	sacks	50 kg	1256	2.16	2,713
Bit Lube	drums	55 gal	107	126.39	13,524
Pipe Lax	drums	55 gal	-	375.00	
Dia Seal M	sacks	80 lbs	39	9.29	362
TOTAL MUD CHEMICALS					371,839
DEPTH OF WELL		16000'			
DAYS DRILLING		128			
MUD COST / FT		$ 23.24			
MUD COST/DAY		$ 2905			
MUD CHEMICALS CONSUMED:		$ 371,839			
CHEMICALS WASTED OR LOST :		$ 3,260			
TOTAL CHEMICALS CONSUMED AND LOST :		$ 375,099			

2.09 TESTING

Three drill stem tests were carried out.

DST No. 1

Well Data

Depth of well	16000'
Plugged back	15095'
7" casing shoe	15038'
Interval tested	15038' - 15095' Open hole 5-7/8"
Formation	Lower Cretaceous Limestone

DST Assembly

BT Pressure recorder (15000 psi - 12 hr clock)
Perforated tail pipe (15')
RTTS packer
VR safety joint
Hydraulic jar
BT pressure recorder (15000 psi - 24 hr clock)
Hydrospring tester
DCIP valve
Handling sub and choke manifold
4-3/4" drill collars (114')
Impact reversing sub
4-3/4" x 2-1/4" drill collars (342')
3½" IF 13.3 lbs/ft drill pipe to surface
CB control head and wrap around manifold

RTTS packer set in 7" casing at 14912'
Bottom choke 5/8". Surface choke ½"
Cushion 10000' (72 bbl) 16.2 lbs/gal mud.

Times

1st flowing period	15 mins
1st closed in period	30 mins
2nd flowing period	15 mins
2nd closed in period	15 mins

Due to depth and hole deviation (18°) it was difficult to tell when the tool was open or closed. The upper B.T. chart indicated that the tool had in fact been open 3 times for a total of 45 mins.

Recovery In Pipe

10.000' (72 bbl)	mud cushion
100' (0.74 bbl)	gas cut mud - weak fluorescence

B.T. Pressure Recorder Charts

Final interpretations of B.T. charts from Halliburton are enclosed.

Results

Total inflow in 45 minutes = 0.74 bbl

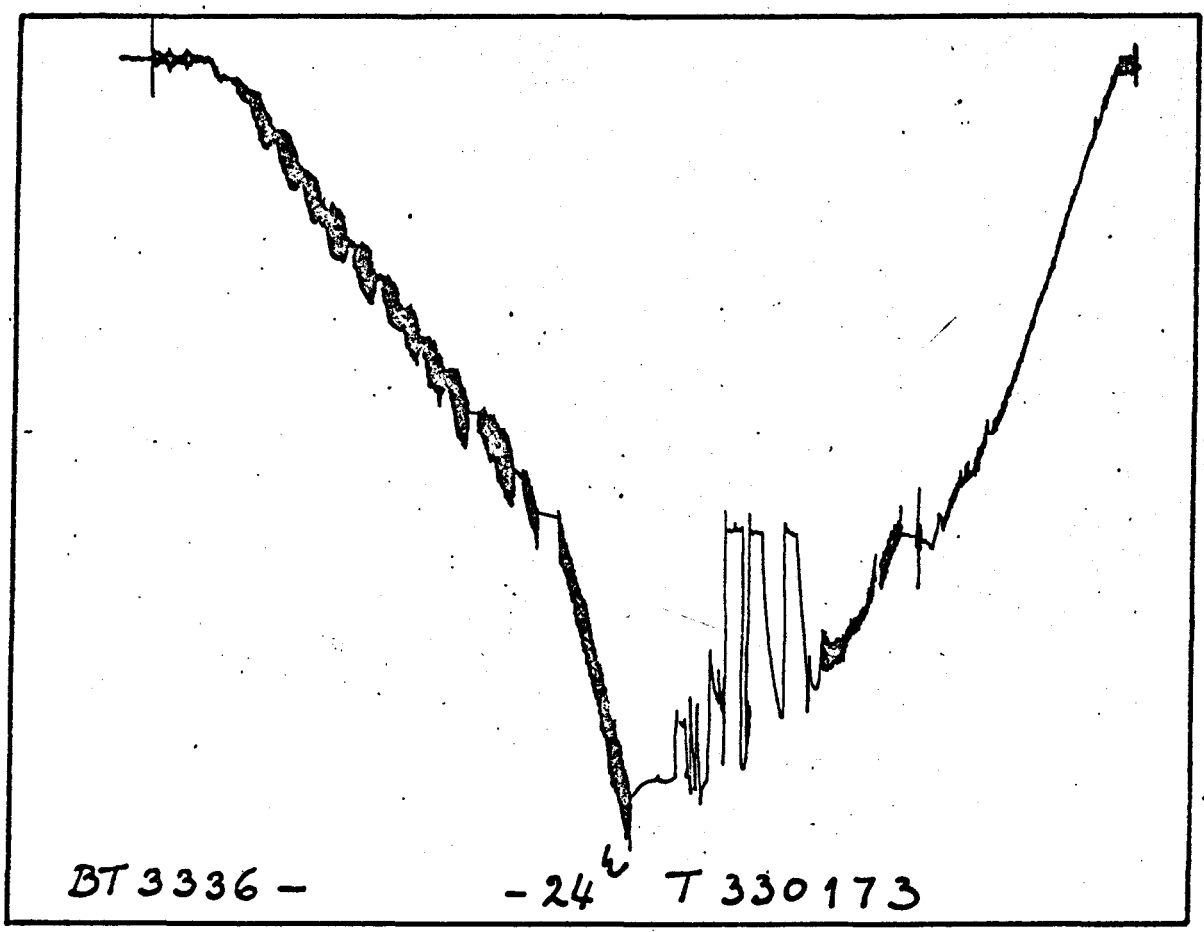
ie 0.99 bbl/hr with a drawdown of 4000 psi.

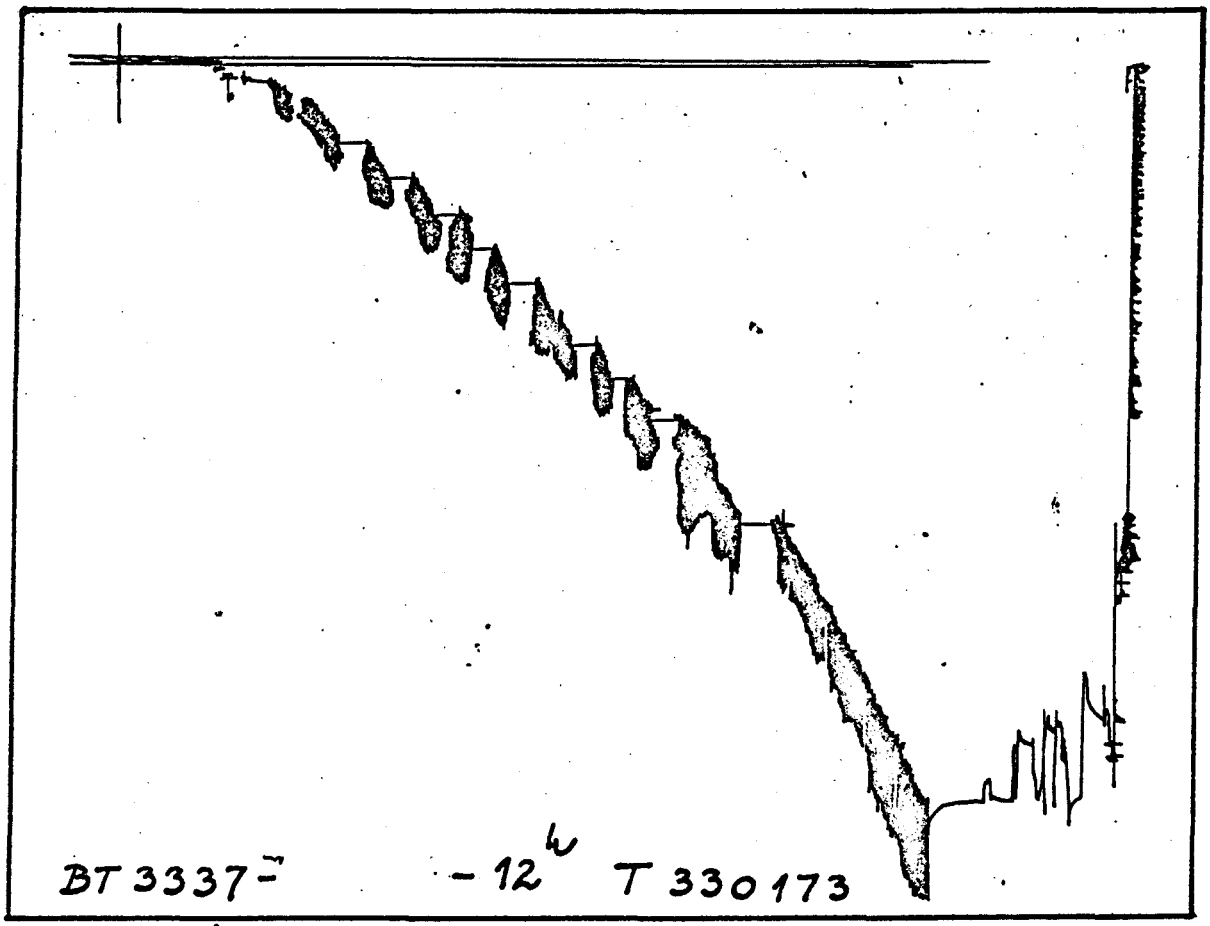
This is equivalent to a gas flow at surface of about 40 MCFD. (Check:- from pressures observed during the second flow period, inflow rate = 0.76 bbl/hr assuming that 16.2 ppg mud enters the drill collars.)

For condensate flow in the formation:-

Transmissibility	=	1.13 md ft/cp
Indicated Flow Capacity	=	0.11 md ft (taking μ = 0.1 cp)
Average Effective Permeability	=	0.002 md
Theoretical P.I.	=	1.28×10^{-3} BPD/psi
Observed P.I.	=	5.9×10^{-3} BPD/psi
Extrapolated Formation Pressure	=	12790 psi.

Thus it appears that damage is negligible and that the low flow rates are due to tight formation.


BT 3336 –
– 24 h T 330173


BT 3337 –
– 12 h T 330173

Company NORSKE SHELL   Date 30.10.68

	Time	psi
Initial Hydro Mud Pressure	—	13487.7
1st Initial Flow	—	—
1st Final Flow	15	—
Initial Closed In Pressure	30	—
2nd Initial Flow	—	—
2nd Final Flow	15	—
Final Closed In Pressure	30	—
Final Hydro Mud Pressure	—	—

Ticket No. T 330173

Lease 3/1

Well No. 1   Test No. 1

BT No. 3337   Depth 15020'

12 Hr. Clock No.

Temperature 350 °F

	1st Flow Pressure		Initial CIP		2nd Flow Pressure		Final CIP	
	Time Defl. .000"	Temp. Corr. psi	Time Defl. .000"	Temp. Corr. psi	Time Defl. .000"	Temp. Corr. psi	Time Defl. .000"	Temp. Corr. psi
P0	.000		.000		.000		.000	
P1								
P2	NO FLOW PRESSURE —							
P3								
P4	NO C.I.P. —							
P5								
P6								
P7								
P8								
P9								
P10								
	Minute Intervals		Minute Intervals		Minute Intervals		Minute Intervals	

Remarks:

Company NORSKE SHELL   Date 30.10.68

	Time	psi
Initial Hydro Mud Pressure	—	13393.8
1st Initial Flow	—	8838.5
1st Final Flow	15	8782.1
Initial Closed In Pressure	30	12144.1
2nd Initial Flow	—	8806.2
2nd Final Flow	15	8818.4
Final Closed In Pressure	30	11747.5
Final Hydro Mud Pressure	—	—

Ticket No. T 330173

Lease 3/1

Well No. 1   Test No. 1

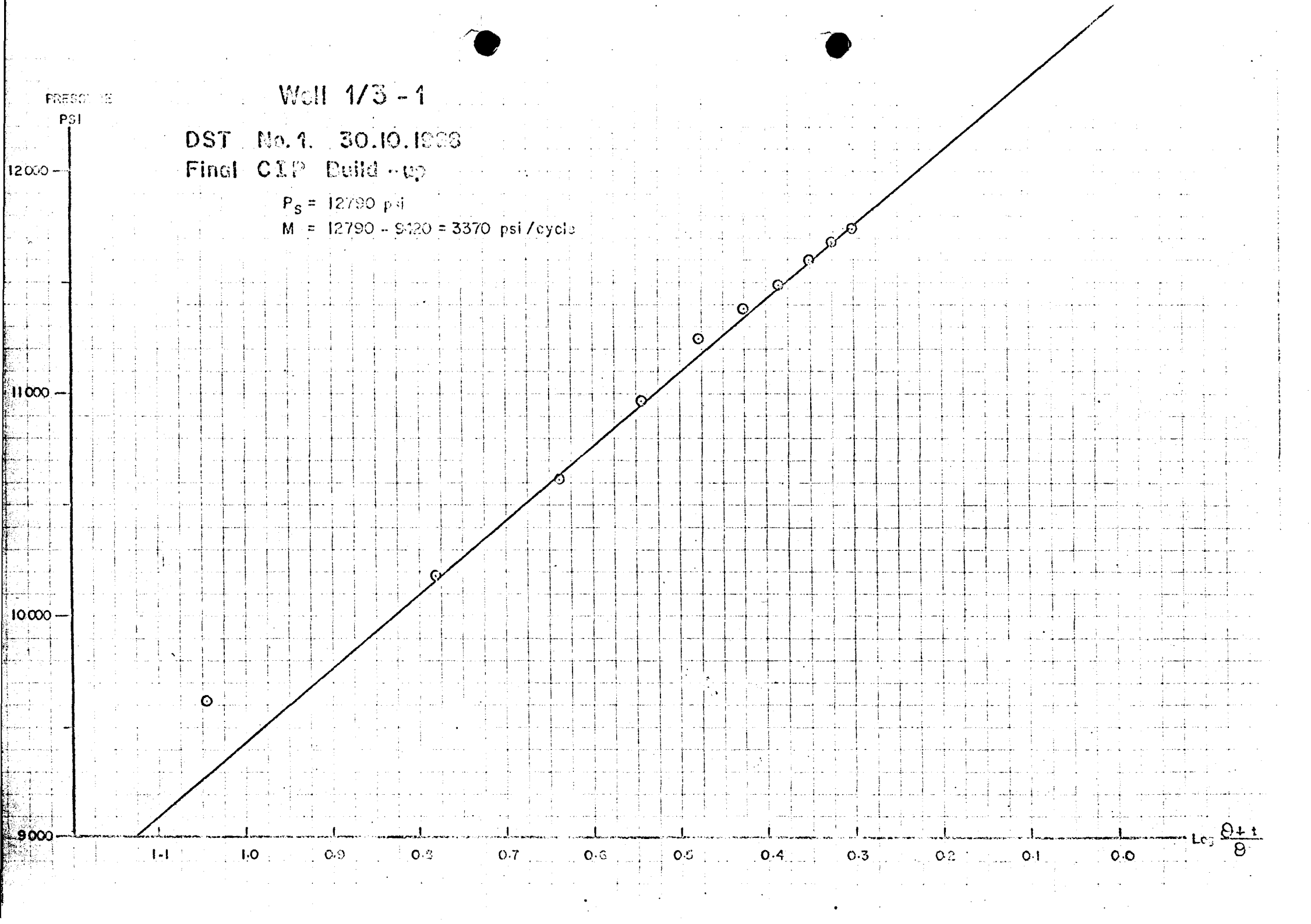
BT No. 3336   Depth 14985'

24 Hr. Clock No.

Temperature 350 °F

	1st Flow Pressure		Initial CIP		2nd Flow Pressure		Final CIP	
	Time Defl. .000"	Temp. Corr. psi	Time Defl. .000"	Temp. Corr. psi	Time Defl. .000"	Temp. Corr. psi	Time Defl. .000"	Temp. Corr. psi
P0	.000	8838.5	.000	8782.1	.000	8806.2	.000	8818.4
P1	.020	8806.2	.010	9709.2	.012	↓	.010	9608.4
P2	.040	8794.2	.020	10266.8	.024	8806.2	.020	10179.4
P3	.060	8782.1	.030	10697.0	.036	8810.3	.030	10616.9
P4			.040	11042.2	.048	8818.4	.040	10967.5
P5			.050	11299.0	.060	8818.4	.050	11248.0
P6			.060	11523.5			.060	11381.8
P7			.070	11719.8			.070	11492.0
P8			.080	11877.2			.080	11601.7
P9			.090	12023.0			.090	11685.5
P10			.100	12144.1			.100	11747.5
	5 Minute Intervals		30. Minute Intervals		3.0 Minute Intervals		3.0 Minute Intervals	

Remarks: 1. FLOW TIME = 15 MIN. — INITIAL CIP = 30 MIN.


Well 1/3 - 1
DST No. 1. 30.10.1968
Final CIP Build - up
P_s = 12790 psi
M = 12790 - 9420 = 3370 psi / cycle
PRESSURE
PSI
12000
11000
10000
9000
1·1
1·0
0·9
0·8
0·7
0·6
0·5
0·4
0·3
0·2
0·1
0·0
$\log \frac{\theta + t}{\theta}$

DST No. 2

Well Data

Depth of well	16000'	
Plugged back	15095'	
7" casing shoe	15038'	
Intervals tested	14972' - 14980'	Perforations in 7" casing
	15004' - 15020'	
	15027' - 15032'	
	15038' - 15095'	Open hole 5 7/8"
Formation	Lower Cretaceous Limestone	

DST Assembly

Anchor shoe
4-3/4" drill collars (143')
BT pressure recorder (15000 psi - 24 hr clock)
Perforated tail pipe (15')
Expanding shoe wall packer
VR safety joint
Hydraulic jar
BT pressure recorder (15000 psi - 24 hr clock)
Hydrospring tester
DCIP valve
Handling sub and choke manifold
4-3/4" drill collars (114')
Impact reversing sub
4-3/4" drill collars (256')
3½" IF 13.3 bbl/ft drill pipe to surface
CB control head and wrap around manifold

Expanding shoe wall packer set at 14920'
Bottom choke 5/8". Surface choke ½"
Cushion 10000' (72 bbl) mud 13.0 lbs/gal, 110000 ppm Cl.

Times

1st flowing period	20 mins
1st closed in period	60 mins
2nd flowing period	120 mins
2nd closed in period	120 mins

Recovery In Pipe

5400' (40 bbl) mud
7000' (50 bbl) gas and gascut mud with 0 to 10% condensate
12400'

Salinity of mud 110000 - 150000 ppm Cl.

B.T. Pressure Recorder Charts

The stylus of the upper BT failed to make contact with the chart. A final interpretation of the lower chart is enclosed.

Results

As the extrapolated formation pressure obtained from the build up curves was unreliable it was necessary to use the formation pressure obtained from DST No. 1 (12790 psi) for evaluation (ie m = 3490 psi/cycle).

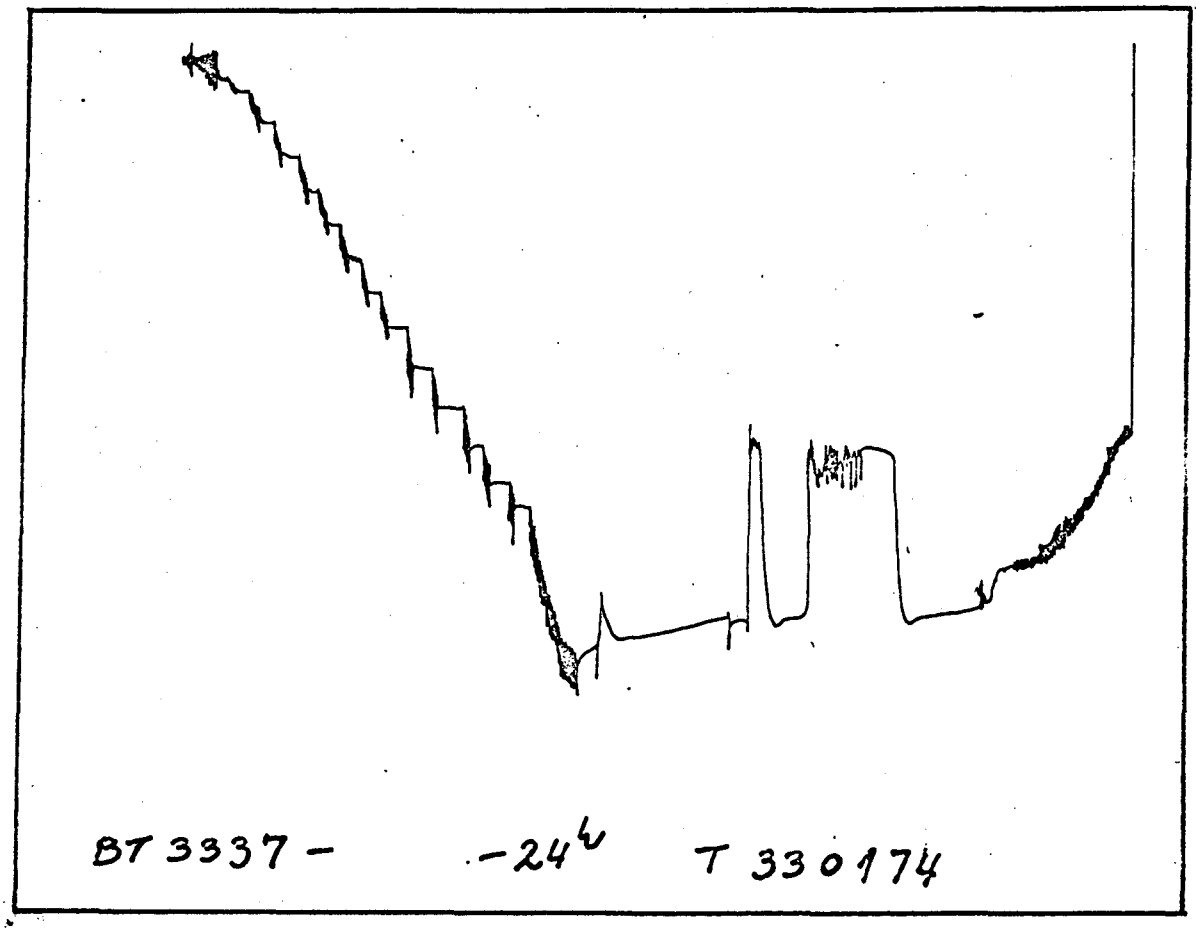
Total inflow during 140 minutes = 17.8 bbl fluid
ie maximum production rate = 7.15 bbl/hr

which is equivalent to about 234 MCFD gas at atmospheric conditions. (Check:- assume that condensate (sg. 0.72) flows in the formation, then the inflow rate calculated from the pressure increase at the end of the second flowing period = 4.12 bbl/hr which is in reasonable agreement with the above estimate.)

Then for condensate flow in the formation:-

Transmissibility	=	19.9 md ft/cp
Indicated Flow Capacity	=	1.99 md ft (assuming μ = 0.1 cp)
Average Effective Permeability At Perforations	=	0.031 md
Theoretical P.I.	=	54×10^{-3} BPD/psi
Observed P.I.	=	31×10^{-3} BPD/psi

Thus the damage ratio is less than 2 indicating negligible damage. The formation at the perforations has appreciably higher permeability than that of the open hole. This is as expected on the basis of Sonic Log cycle skipping.


BT 3337 -
-24
T 330174

Company NORSKE SHELL Date 2. 11. 68

		Time	~~std~~ — psi
Initial Hydro Mud Pressure		—	10303.2
1st	Initial Flow	—	6831.1
1st	Final Flow	15	7043.3
Initial Closed In Pressure		60	10272.1
2nd	Initial Flow	—	7241.7
2nd	Final Flow	120	7293.3
Final Closed In Pressure		120	10116.4
Final Hydro Mud Pressure		—	—

Ticket No. T 330174

Lease 3/1

Well No. 1 Test No. 2

BT No. 3337 Depth 15023'

24 Hr. Clock No.

Temperature 350 °C °F

	1st Flow Pressure		Initial CIP		2nd Flow Pressure		Final CIP	
	Time Defl. .000"	Temp. Corr. ~~std~~ — psi	Time Defl. .000"	Temp. Corr. ~~std~~ — psi	Time Defl. .000"	Temp. Corr. ~~std~~ — psi	Time Defl. .000"	Temp. Corr. ~~std~~ — psi
P0	.000	6831.1	.000	7043.4	.000	7241.7	.000	7293.3
P1	.015	7039.4	.020	9344.9	.078	7241.7	.039	9811.2
P2	.030	↓	.040	10159.3	.156	7400.4	.078	10338.3
P3	.045	7043.3	.060	10419.9	.234	7289.3	.117	10299.4
P4			.080	10381.0	.312	7241.7	.156	10272.1
P5			.100	10326.5	.390	7293.3	.195	10248.7
P6			.120	10291.6			.234	10217.6
P7			.140	↓			.273	10198.3
P8			.160				.312	10163.1
P9			.180	10287.6			.351	10143.8
P10			.200	10272.1			.390	10116.4
	5.0 Minute Intervals		6.0 Minute Intervals		24.0 Minute Intervals		12.0 Minute Intervals	

Remarks:

DST No. 3

Well Data

Depth of well	16000'
Plugged back	11080'
7" casing shoe	15038'
Interval tested	15038'
Formation	11008 - 11023 (Perforations in 7" csg)

DST Assembly

BT Pressure recorder (8000 psi - 24 hr clock)
Perforated tail pipe (15')
RTTS packer
VR Safety joint
Hydraulic jar
BT Pressure recorder (8000 psi - 24 hr clock)
Hydrospring tester
DCIP valve
Handling sub and choke manifold
4-3/4" drill collars (114')
Impact reversing sub
4-3/4" x 2-1/4" drill collars (342')
$3\frac{1}{2}$" IF 13.3 lbs/ft drill pipe to surface
CB control head and wrap around manifold

RTTS packer set in 7" casing at 10960'.
Bottom choke 5/8". Surface choke $\frac{1}{2}$".
Cushion 7000' (50 bbl) water, 2000 ppm Cl.

Times

1st flowing period	20 mins
1st closed in period	60 "
2nd flowing period	25 "
2nd closed in period	45 "

Recovery In Pipe

940'	(7 bbl)	water cushion
5800'	(43 bbl)	strongly gas cut water cushion
4220'	(29 bbl)	strongly gas cut mud with slugs of gas and condensate.

(Last stand above Hydrospring had a weight of 8.0 ppg, salinity 170,000 ppm Cl.)

B.T. Pressure Recorder Charts

Final interpretations from Halliburton are enclosed.

Results

When pulling pipe an apparent gain of 29 bbl was observed. Since gas cutting occurred throughout most of the fluid column in the drill pipe it is probable that this figure is an upper limit for inflow.

Rate of inflow = 29 bbl in 45 minutes = 39 bbl/hr.

At surface condition this is equivalent to 1000 MCFD. Assuming there is condensate flow in the formation (sg 0.72) then a check on the above estimate is provided by the pressure increase on the upper BT gauge during the second flow period. This is equivalent to about 40 bbl/hr. The agreement is good in view of the assumptions made.

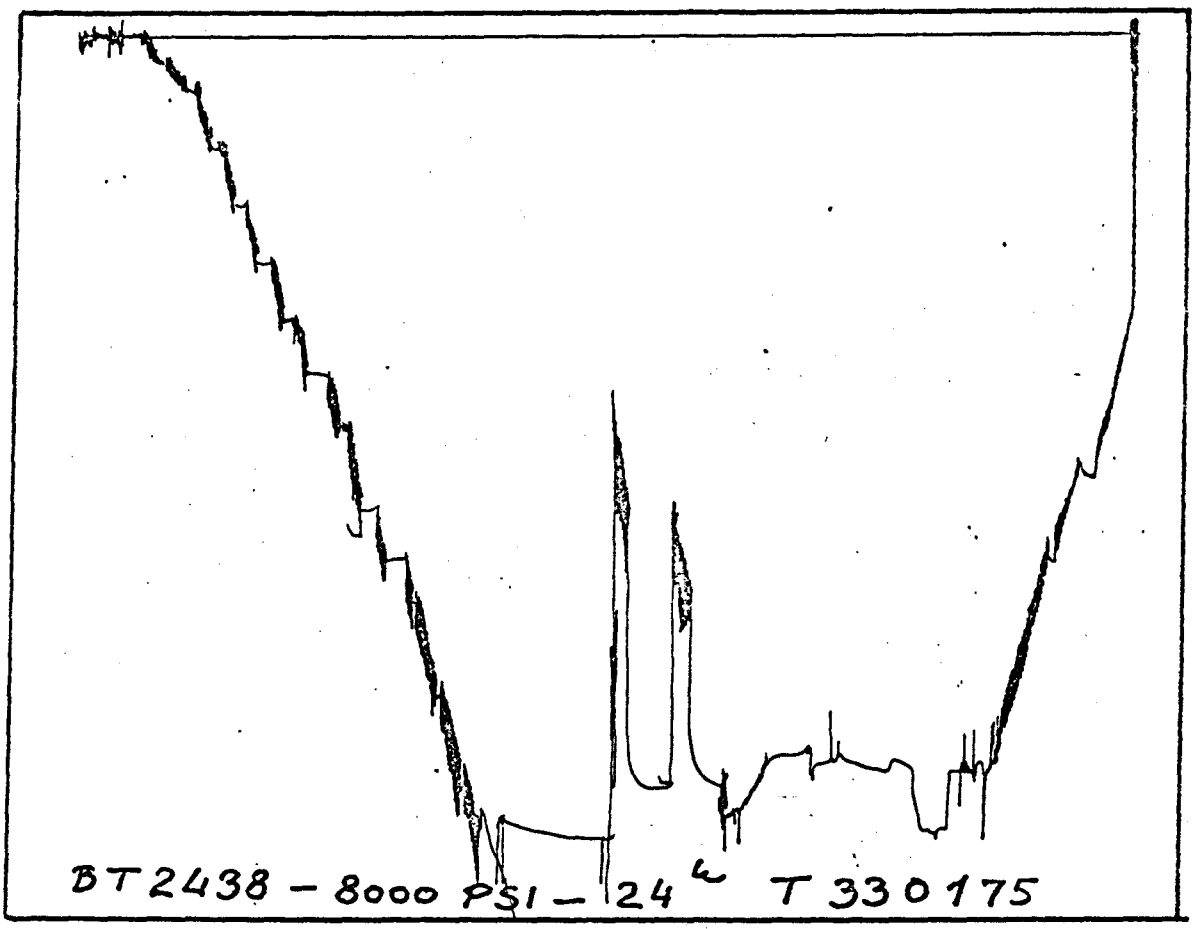
Transmissibility	= 286 md ft/cp
Indicated Flow Capacity	= 28.6 md ft (assuming μ = 0.1 cp)
Average Effective Permeability	= 1.9 md
Theoretical P.I.	= 323×10^{-3} BPD/psi
Observed P.I	= 405×10^{-3} BPD/psi
Extrapolated Formation Pressure P_s	= 7662 psi

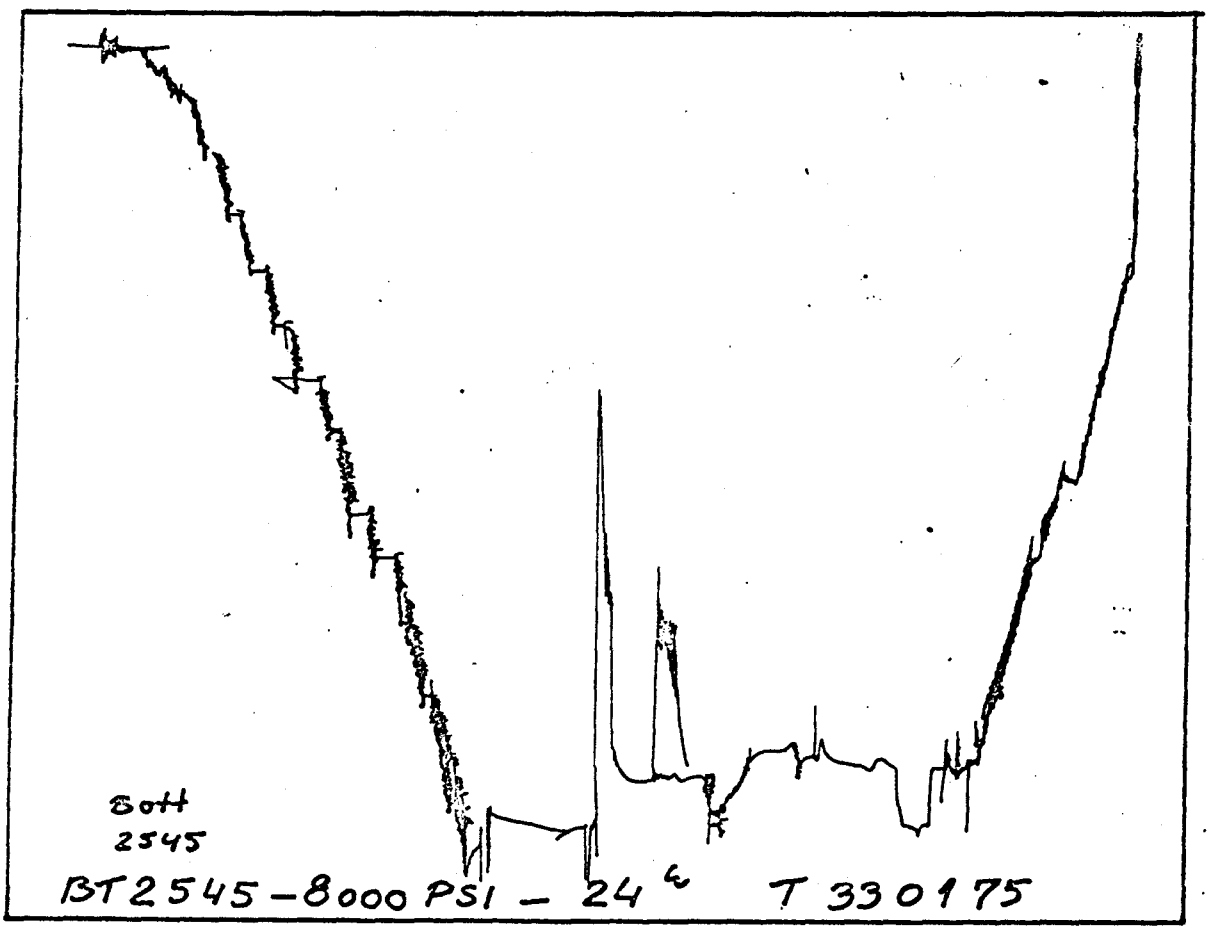
Damage is negligible.

Note:

In the above estimates a value of 0.1 cp has been taken for the viscosity of the formation fluid. This is arbitrary and to that extent the calculated flow capacities and permeabilities are uncertain.

Pressure build up plots have been made on the assumption that the effective flow in the formation may be analysed as for a liquid.


BT 2438 – 8000 PSI – 24 ℄ T 330175


Bott
2545
BT 2545 – 8000 PSI – 24 ℄ T 330175

Company NORSKE SHELL Date [redacted]11. 68

		Time	~~atü~~ — psi
Initial Hydro Mud Pressure		—	8028.5
1st	Initial Flow	—	3554.0
1st	Final Flow	20	5635.5
Initial Closed In Pressure		60	7529.7
2nd	Initial Flow	—	5306.6
2nd	Final Flow	25	5886.6
Final Closed In Pressure		45	7503.2
Final Hydro Mud Pressure		—	7940.2

Ticket No. T 330175

Lease 3/1

Well No. 1 Test No. 3

BT No. 2545 Depth 10990'

24 Hr. Clock No. 8548

Temperature 350 °C °F

	1st Flow Pressure		Initial CIP		2nd Flow Pressure		Final CIP	
	Time Defl. .000"	Temp. Corr. ~~atü~~ – psi	Time Defl. .000"	Temp. Corr. ~~atü~~ – psi	Time Defl. .000"	Temp. Corr. ~~atü~~ – psi	Time Defl. .000"	Temp. Corr. ~~atü~~ – psi
P0	.000	3554.0	.000	5635.5	.000	5306.6	.000	5886.6
P1			.020	7322.2			.015	7108.1
P2			.040	7430.4			.030	7260.4
P3	.063	5635.5	.060	7485.5			.045	7346.5
P4			.080	7501.0			.060	7397.3
P5			.100	7509.8	.080	5886.6	.075	7432.6
P6			.120	7516.4			.090	7456.8
P7			.140	7520.9			.105	7474.5
P8			.160	7525.3			.120	7487.7
P9			.180	7527.5			.135	7498.8
P10			.200	7529.7			.150	7503.2
	—	Minute Intervals	6.0	Minute Intervals	—	Minute Intervals	4.5	Minute Intervals

Remarks:

Company NORSKE SHELL Date 6. 11. 68

		Time	~~atü~~ — psi
Initial Hydro Mud Pressure		—	8037.2
1st	Initial Flow	—	3518.7
1st	Final Flow	20	4798.6
Initial Closed In Pressure		60	7529.5
2nd	Initial Flow	—	4989.0
2nd	Final Flow	25	5736.5
Final Closed In Pressure		45	7503.3
Final Hydro Mud Pressure		—	7967.4

Ticket No. T 330175

Lease 3/1

Well No. 1 Test No. 3

BT No. 2438 Depth 10950'

24 Hr. Clock No. 8551

Temperature 350 °C °F

	1st Flow Pressure		Initial CIP		2nd Flow Pressure		Final CIP	
	Time Defl. .000"	Temp. Corr. atü – psi	Time Defl. .000"	Temp. Corr. atü – psi	Time Defl. .000"	Temp. Corr. atü – psi	Time Defl. .000"	Temp. Corr. atü – psi
P0	.000	3518.7	.000	4798.6	.000	4989.0	.000	5736.5
P1			.020	7329.0			.015	7122.0
P2			.040	7422.7			.030	7268.0
P3	.065	4798.6	.060	7481.6			.045	7346.5
P4			.080	7499.0			.060	7396.6
P5			.100	7507.7	.085	5736.5	.075	7431.4
P6			.120	7514.2			.090	7457.6
P7			.140	7516.4			.105	7475.0
P8			.160	7525.1			.120	7488.1
P9			.180	7527.3			.135	7499.0
P10			.200	7529.5			.150	7503.3
	—	Minute Intervals	6.0	Minute Intervals	—	Minute Intervals	4.5	Minute Intervals

Remarks:

Well 1/3 - 1

DST No. 3 6.11. 1968 (Upper B.T. Gauge .)

P_s = 7662 psi

M = 532 psi/cycle