ADT END OF WELL REPORT

FOR

STATOIL/ESSO - NORWAY

15/12-2

NORTH SEA - NORWAY

116-P5.11.25

BERT KLEINVELD
ADT ENGINEER

5

TABLE OF CONTENTS

I. ABSTRACT

A BAROID Computerized ADT unit was used on Statoil/Esso well 15/12-2 to assist and recommend in the safe and economical completion of all drilling operations.

This Report reviews the use of BAROID'S ADT service in the successfull completion of this well. Included are discussions of methods used and results obtained by the ADT personnel in the performance of their responsibilities in the areas of well safety, well economics and data collection and analysis.

II. SUMMARY

BAROID furnished the CDC unit 8857 on the "Ross Rig" for the well Statoil/Esso 15/12-2. This unit was equipped with a Honeywell 316 computer and the other instruments used for:

1) Collecting and interpretating geological information.

2) Monitoring and analyzing well conditions to minimize catastrophic and costly occurances.

3) Optimizing drilling rates based on minimum cost operations.

4) Analyzing hole problems, the solutions for which are directly related to drilling fluid properties.

5) To permanently record on magnetic tape the following bit run informations on 1 meter intervals:

Date - day, month, year.
Time, hour, minute, second.
Depth.
Drill rate - min/meter.
Bit weight - average for interval.
Rotary speed - average for interval.
Torque - average for interval.
Meters on bit.
Temperature of mud - flowline and suction pit.
Resistivity of mud - flowline and suction pit.
Hours on bit.
Mud flow - gall/min. standpipe and flowline.
Mud density - ppg. flowline and suction.

Standpipe pump pressure - psi.
Formation density - gm/cc.
Formation factor - ml/gm.
Pit total - bbls.
Pore pressure - ppg.
Pump strokes to drill interval.
Plastic Viscosity.
Yield Point.
Delta Temperature.
Delta Conductivity.
Cost - $ per meter.
Drill rate - meters/hr.
Mud gas - units.
Bit bearing wear.
Bit tooth wear.
"d" exponent - corrected for mud weight.
"k" formation drillability.
Penetration rate, meters/hr. average for bit run.
Pump strokes - pump no. 1 - pump no. 2.

6) To assist Esso in anyway possible to successfully complete the well.

COMMENTS ON DATA MONITORING:

1) BAROID collected cuttings samples at intervals corresponding to the requests of the Esso/Statoil geologists. These intervals were:

10 M on top hole fast drilling.
3 M on lower samples, also samples were caught in special zones of interest.

Samples were described lithologically and checked for hydrocarbon shows.

2) Background, connection and trip gas were continuously monitored by the BAROID "Hot Wire" gas detector. Mud gas samples were prepared, steam distilled and analyzed at regular intervals for content of individual hydrocarbon gases and reported in parts per million methane, ethane, propane, butane and pentane.

3) Shale factor and shale density of samples were recorded and plotted.

4) Mud volumes in pits and flow in and out were continuously monitored to detect either an influx of formation fluid or lost circulation.

5) Mud densities in and out were continuously monitored and plotted. These readings are affected by such things as variation in flow and settling out of materials in the suction tank. Therefore, mud weight was frequently verified by mud balance. Performance of mud density transducers as far as detecting gas cut mud etc., was satisfactory.

6) Surge pressures were calculated for trips.

7) Surge pressures at various speeds were calculated for casing strings.

8) Pressure drop calculations were run daily or as required. This data was used to select proper jet sizes and hydraulics, and maintain minimum annular velocity in the riser.

9) The minimum cost drilling program was used in conjunction with drill-rate data to optimize weight on bit and rotary speed.

10) Bit constant programs were run on the 316 computer to find bearing constant and abrasing factor, in an effort to predict bearing and tooth wear prior to each bit run.

These programs have given close predictions on most sections of the hole. Continuously monitored torque has also been a valuable aid in determining bit wear. Close communication between Esso Drilling Foremen, Ross Superintendents and BAROID personnel has allowed all opinions to be considered.

11) Bit Run Summary Reports were printed after each bit run and sent to the Stavanger office.

12) A daily ADT Morning Report was submitted with data from mud logging, bits, drill string, mud pumps, casing and annular volumes, mud checks, hydraulic calculations, pore pressure, fracture pressure, activity summary and various recommendations.

III. WELL DISCUSSION BY INTERVAL

A. Well 15/12-2
Air Gap 25 M
Water depth 86 M

1) 145.4 M - 370 M.

A 36" hole was drilled from seabed. (111 M from RKB) to 145.4 M, and a 30" conductor was set. A 17½" pilot hole was drilled to 370 M. The riser was pulled and a 26" bit was used to ream to 370 M. The 20" casing was set at a depth of 356 M. Estimated fracture gradient at 20" casing shoe, .666 psi/ft, an equivalent of 12.8 ppg. mud weight.

2) 370 - 1837 M.

Three 17½" bits were used to drill to a depth of 1837 M, in approximately 40 hrs., on bottom time. Penetration rates varieing from 200 - 25 M/hr. This section of the hole was drilled with differential pressures of approximately 200 psi. When making a short trip at a depth of 965 M, 820 units of methane were recorded when bottom up was circulated out. A steady background gas of ± 100 units was recorded while drilling this interval from 965 - 1040 M, with penetration rates up to 275 M/hr.

3) 1837 - 2924 M.

A 12 1/4" hole was drilled from 1837 to TD. A leak-off test at the 13 3/8" casing shoe showed in a fracture gradient of 14.0 ppg. mud weight. At a depth of 2652 M, pore pressure increased from 8.9 - 10.2 ppg. and mud was weighed up to 10.5 ppg.

Estimated pore pressures based on shale properties and "d" exponent. At a depth of 2723 M mud weight was increased to 11.8 ppg. Highest estimated pore pressure of 11.4 at a depth of 2795 M. At this stage a minimum overbalance of 200 psi. was maintained.

When entering the "dogger" sands, the decision was made to core, and a total of 12 M was cored with a 100% recovery.

While drilling, several flow checks were held at severe drilling breaks and/or bottoms up circulated out, but no major gas shows were recorded.

Total depth was reached at 2924 M and the well was plugged and abandoned.

IV. SPECIAL PROBLEMS

A) Improvements on pipe handling techniques.

The average connection time on well 15/12-2 was 10.1 mm.

Average trip time was 18 min/100 M or 57 min/1000 ft.

An improvement was shown, of approximately 15% compared with previous wells drilled by "Ross Rig".

V. CASING PROGRAM

On location 15/12-2 the following strings of casing were set:

Seabed		at	111.0 Meters	from RKB			
30"	casing	at	145.0 Meters	36"	hole at	145.4	Meters
20"	casing	at	355.7 Meters	30"	hole at	370.0	Meters
13 3/8"	casing	at	1812.4 Meters	17½"	hole at	1837.0	Meters
				12 1/4"	hole at	2924.0	Meters

Discussion of program.

This casing program would also allow future wells to be drilled with efficiency in this area.

TD was reached approximately 175 M below the main sands, where high pore pressures resulted in low differential pressures. Towards TD, pore pressures decreased and a differential of 1400 psi. at TD resulted penetration rates were reduced about 400%. No change in casing program has to be made, considering that TD is only 175 - 200 M below the pay-zone.

VI. MUD SUMMARY

The mud used on the 15/12-2 well was Gel/Lignosulfonate.

The total mud bill for this well while drilling was:

Section break-down:

Hole size	Depth M	Section Cost $	Cumulative Cost $
36"	145.4	3.205,50	3.205,50
26"	370.0	6.101,50	9.307,00
17½"	1837.0	21.226,00	30.573,00
12 1/4"	2924.0	55.099,90	76.365,90

In this area mud weights could be as low as 8.8 - 9.0 ppg., and only be increased to ± 11.6 - 11.8 ppg. just before entering the reservoir. The predictions on this well have been fairly close, and specific mud problems did not occur.

NL INDUSTRIES

BAROID (U.K.) LIMITED

BIT AND HYDRAULIC RECORD

WELL NAME 15/12-2

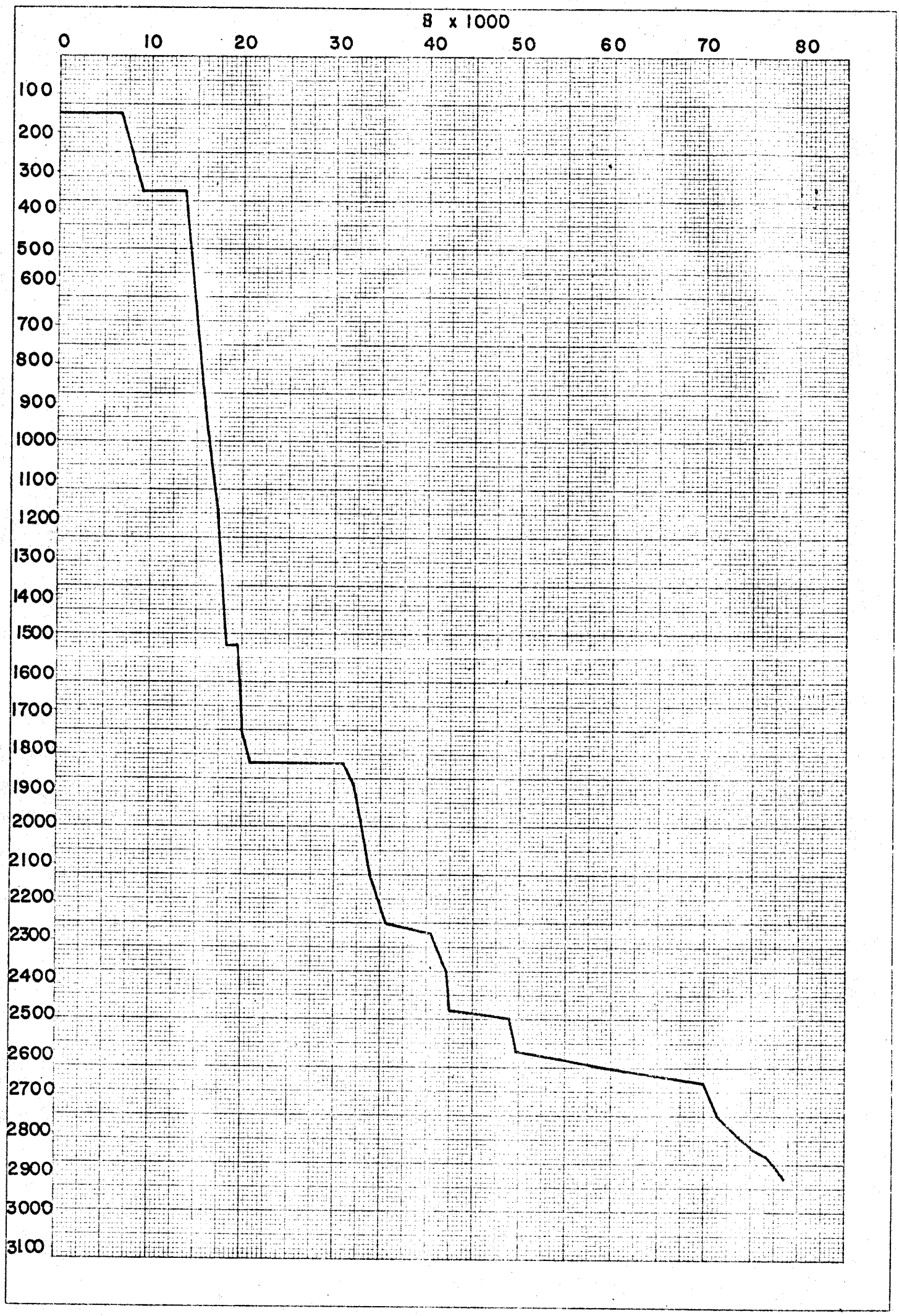
CONTRACTOR Ross Drilling Company

OPERATOR STATOIL/ESSO

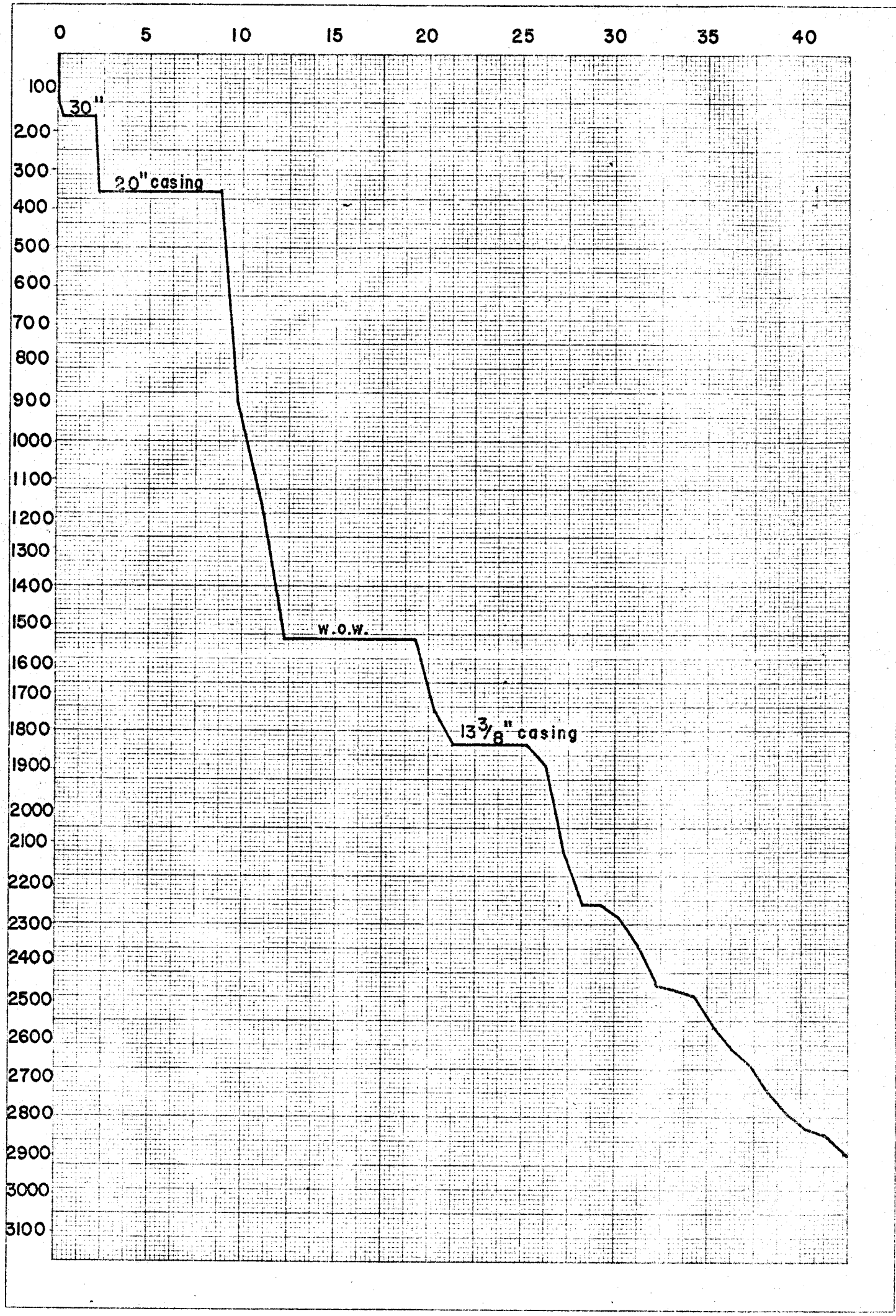
OPERATOR REPR. C.W. Haston, B. Hansel

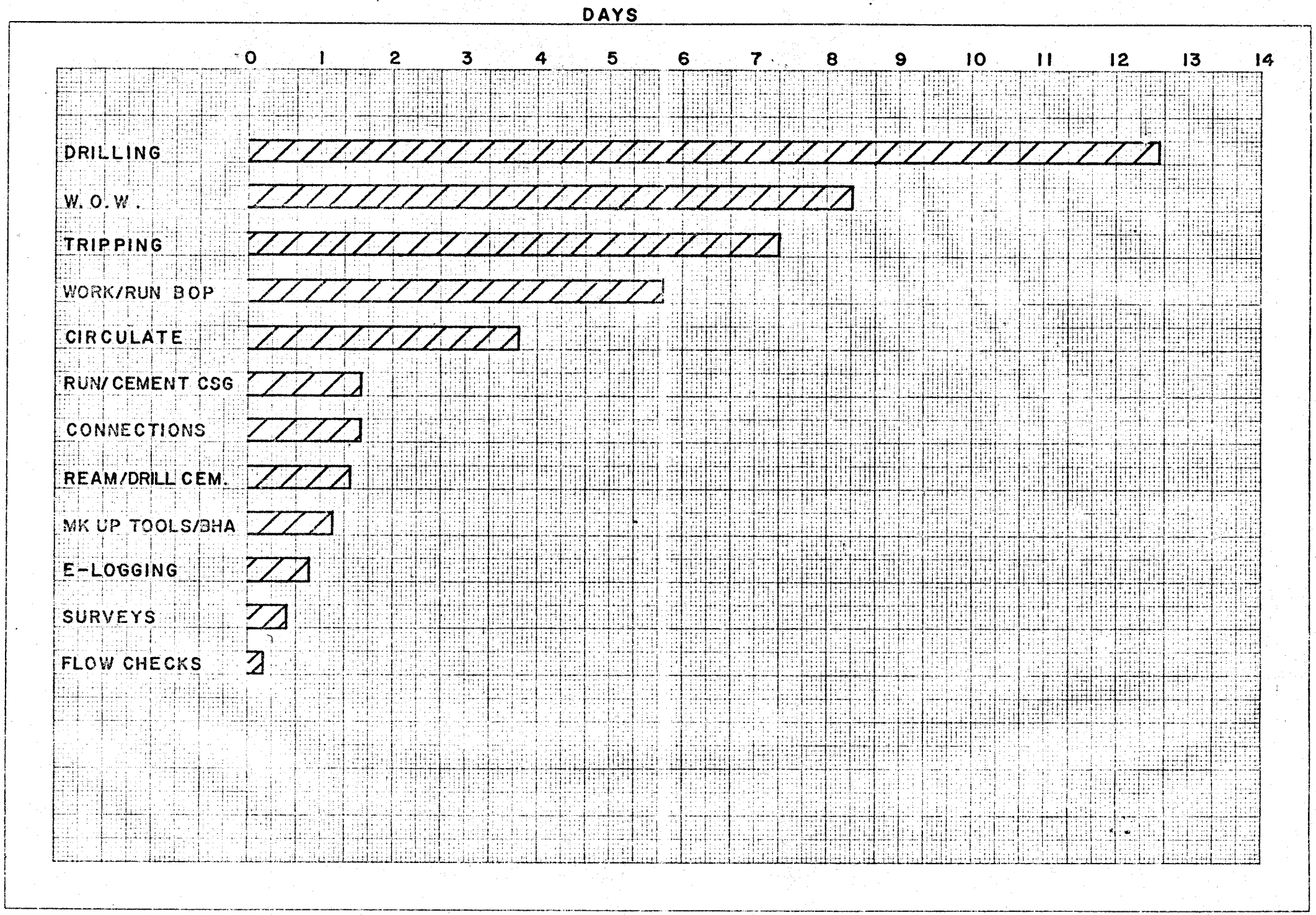
BAROID ENGR. Bert Kleinveld

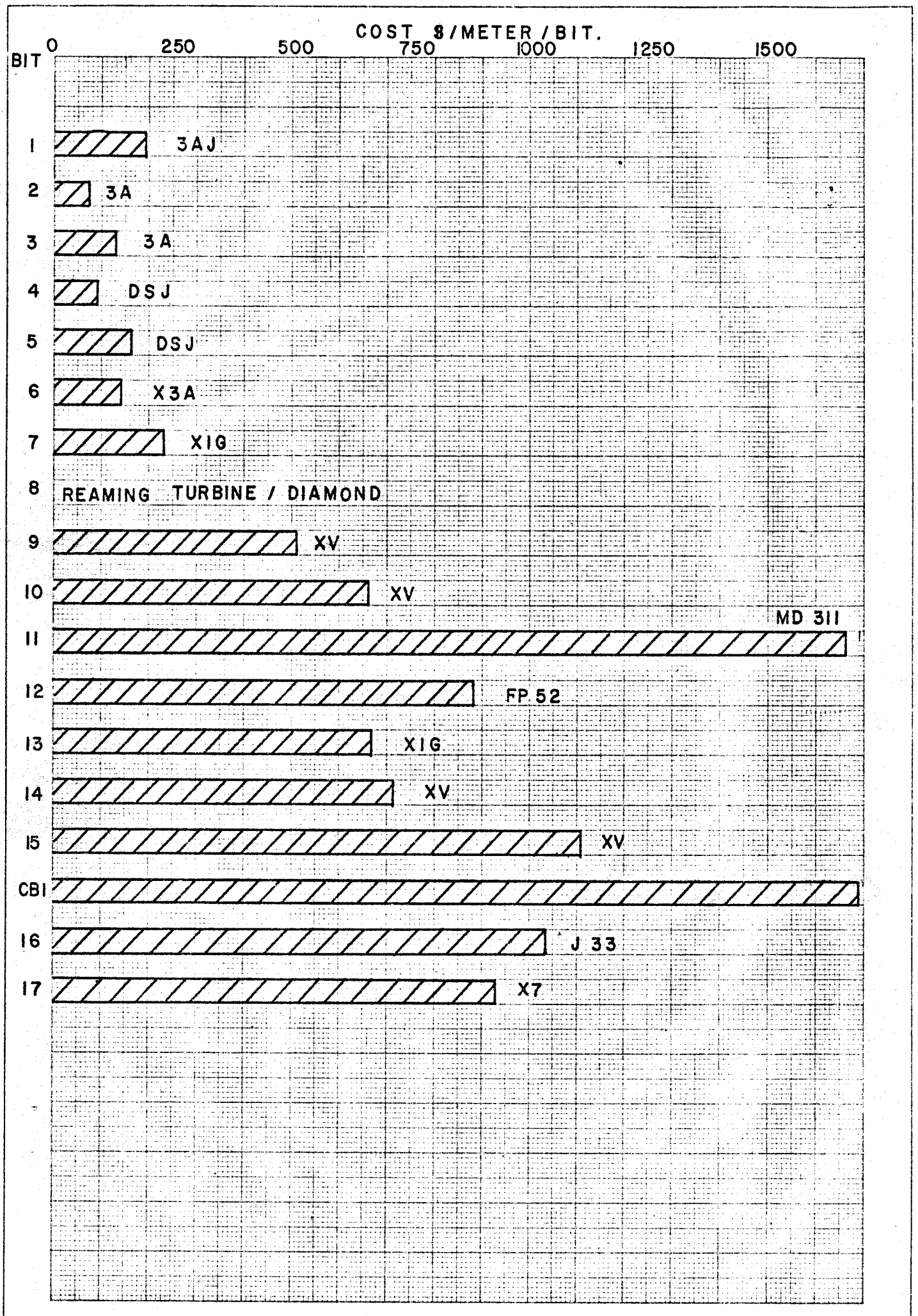
Date	Bit No.	Type	Size	Depth Out	Meter ~~Excxx~~ Drilled	Hours Run	Weight & R P M	Pump Output G P M	Pump P S I	Annular Velocity OP / DC	Linersize & S P M	6 3/4 12 DP P1 Size P2	REMARKS T - B - G
09.01	1	OSC3AJ	26"	145	34	5.25	10.000/60	1100	700		100/100	5"	
10.01	2	3A	17½"	370	225	2.48	15.000/140	1020	850		102/99	5"	2 I I
19.01	3	OSC3A	17½"	1028	653	15.92	24.000/115	1090	2600	94/123	102/100	5"	5 3 I
20.01	4	DSJ	17½"	1533	505	16.01	27.000/122	1090	2600	95/123	102/99	5"	2 2 I
27.01	5	DSJ	17½"	1837	304	7.30	20.000/150	875	2300	63/99	82/80	5"	3 3 I
02.02	6	X3A	12 1/4"	2133	296	13.61	23.000/137	735	3000	139/209	71/65	5"	3 4 I
04.02	7	XIG	12 1/4"	2262	129	6.80	25.000/156	751	3000	142/214	72/67	5"	3 4 I
05.02	8	Christ MD	12 1/4"	Reamed from 1850 - 2000		tight hole	p.o.h.	turbine		/diamond			
06.02	9	XV	12 1/4"	2362	100	15.90	30.000/140	712	2950	135/196	69/63	5"	2 3 I
08.02	10	XV	12 1/4"	2466	104	23.23	30.000/142	690	3050	136/195	69/64	5"	3 5 I
09.02	11	Christ MD 311	12 3/16"	2492	25	11.86	45.000/170	750	3000	147/214	74/68	5"	
10.02	12	FP 52	12 1/4"	2597	105	32.14	52.000/65	700	3050	135/196	70/60	5"	8 8 I
12.02	13	X1G	12 1/4"	2671	74	15.24	30.000/156	710	3000	139/202	71/63	5"	6 4 I
14.02	14	XV	12 1/4"	2796	125	30.2	30.000/90	656	3000	123/180	65/59	5"	3 4 I
16.02	15	XV	12 1/4"	2823	27	8.0	40.000/90	640	3000	123/180	61/58	5"	2 2 I BT
17.02	CBI	C18	8½"	2835	12	5.34	14.000/100	320	1050	62/90	60/0	5"	
18.02	16	J33	12 1/4"	2890	55	18.46	50.000/55	640	3150	126/183	63/60	5"	5 3 I
19.02	17	X7	12 1/4"	2922	32	9.18	50.000/55	625	3100	123/180	60/59	5"	3 3 I


MUD COST vs DEPTH
$ x 1000
0
10
20
30
40
50
60
70
80
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
2200
2300
2400
2500
2600
2700
2800
2900
3000
3100

DAYS vs DEPTH




DAYS
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
DRILLING
W. O. W.
TRIPPING
WORK/RUN BOP
CIRCULATE
RUN/CEMENT CSG
CONNECTIONS
REAM/DRILL CEM.
MK UP TOOLS/BHA
E-LOGGING
SURVEYS
FLOW CHECKS


COST $/METER/BIT.
0
250
500
750
1000
1250
1500
BIT
1
3AJ
2
3A
3
3A
4
DSJ
5
DSJ
6
X3A
7
X1G
8
REAMING TURBINE / DIAMOND
9
XV
10
XV
11
MD 311
12
FP 52
13
X1G
14
XV
15
XV
CBI
16
J 33
17
X7

BAROID DIVISION

NL

WELL 15/12 — 2

COMPANY STATOIL / ESSO NORWAY

PRESSURE PROFILE

ADT LOG