R 4472

NORSK HYDRO a.s

FINAL REPORT

WELL 31/4-1

LICENCE 055

MAY 1980

LIST OF CONTENT

PREFACE

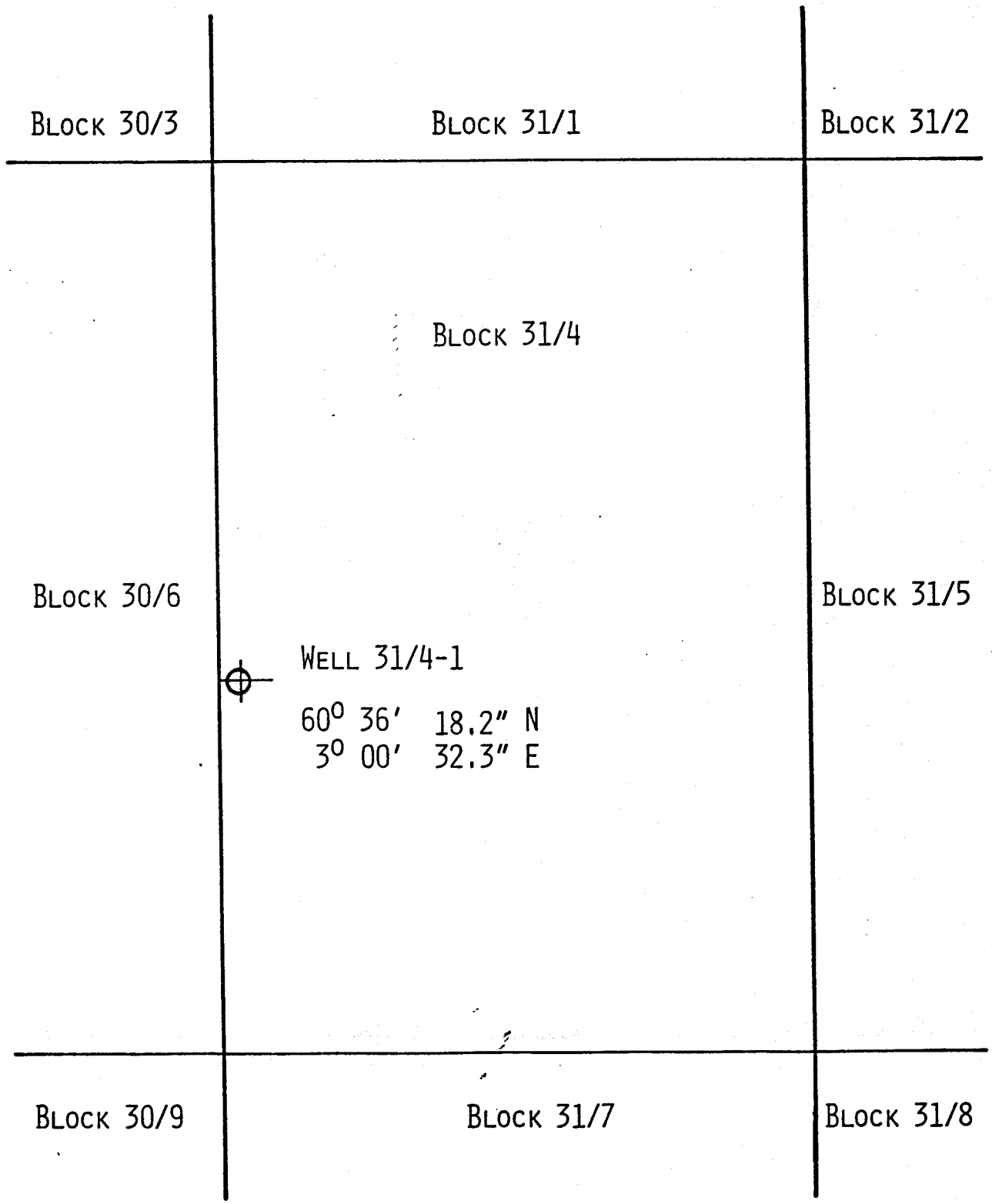
Licence 055 was awarded the Statoil/Hydro/Esso-group April 6, 1979 with Norsk Hydro Produksjon a.s as operator. The licence includes the block 31/4 on Norwegian Continental shelf.

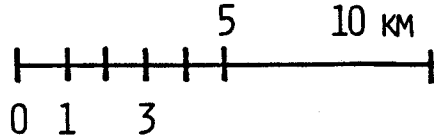
The group consists of the following companies:

Den norske stats oljeselskap	50%
Esso Exploration and Production Norway a.s	20%
Norsk Hydro Produksjon a.s	15%
Arco Norway a.s	10%
BP Petroleum Development of Norway a.s	5%

The well 31/4-1 was drilled by Norsk Hydro Produksjon a.s on behalf of the Statoil/Hydro/Esso-group.

Location Of Well 31/4-1





GR.3/75/

TABLE 1

SUMMARY OF WELL DATA

Location	60° 36' 18.2" N 03° 00' 32.3" E
Operator:	Norsk Hydro Produksjon a.s
Rig:	Norskald
Contractor:	Rowan Drilling Companies
RKB elevation (to MSL)	25 m
Water depth:	144 m

Phase I

Start of operations :	8 September 1979
Well spudded:	9 September 1979
Well permanent abandoned:	25 September 1979
T.D. (Driller):	1000 m
Formation at T.D.:	Silty clays of the Nordland Group

Well program

Hole record :	30" to 232 m 26" to 1000 m
Casing record:	30" set at 231 m (retrieved)

All depths are given with reference to RKB

SECTION A

GEOLOGY

LIST OF CONTENTS

SECTION A

TABLES

1. OBJECTIVES

The objective of the well was to test possible sandstone reservoirs of Jurassic age.

The prime objective was Middle Jurassic sandstones equivalent to the Brent Formation. These sandstones were considered to be part of a prograding delta complex and probably slightly truncated by the Kimmerian Unconformity. A seismic phenomenon - a "flat-spot" - was seen on the seismic sections and tentatively interpreted to represent a gas fluid contact in these sandstones.

A secondary objective of the well was sandstones of Early Jurassic age included in the Statfjord Formation. These were assumed to be developed as a fluvial to transitional marine sandstone sequence.

Sandstone intervals of upper Early Jurassic age, equivalent to the Dunlin Formation and of Triassic age, the Cormorant Formation, were expected to be penetrated, but were not considered to be prospective.

The well was planned to be drilled 100 m into the Triassic to a planned depth of 2930 m (± 90m) (RKB).

2. RESULTS

None of the objectives were tested due to technical problems; the well was plugged and abandoned at 996 m (RKB) (1000 m RKB drillers depth) due to lack of cement support around the 30" casing, experienced when landing the 20" casing.

3. STRATIGRAPHY

The biostratigraphy of well 31/4-1 was performed by the laboratories of the Continental Shelf Institute (IKU) in Trondheim. The study has been done based on ditch cuttings only. The results are listed in the chrono- and lithostratigraphic diagram on page 3. The lithostratigraphic terminology used is taken from Deegan and Scull " A standard lithostratigraphic nomenclature from the Central and Northern North Sea" 1977.

Norsk Hydro

Oslo - Norway

WELL : 31/4-1

DEPTH REF.: K.B. ELEVATION K.B: 25 M ALL DEPTH IN METERS (m)

CRONOSTRATIGRAPHY				LITHOSTRATIGRAPHY	
SYSTEM	SERIES / STAGE	DEPTH	THICKNESS	GROUP	FORMATION / MEMBER
	SEABED	169		169	
QUATERNARY	EARLY PLEISTOCENE		191	NORDLAND GROUP	
		360			
		380			
TERTIARY	PLIOCENE		320		
					707
		700			UTSIRA FORMATION
		720			
	MIOCENE		90		
		810			858
	LOST CIRCULATION ZONE NO INFORMATION		120		
		930			
	MIOCENE - LATE OLIGOCENE		66	996	996
		996 (T.D.)			

4. LITHOSTRATIGRAPHY

This summary is compiled totally from ditch cuttings descriptions. Wire line logs were used as assistance in lithological interpretation.

4.1 QUATERNARY

NORDLAND GROUP (169-360 m)

This interval consists of interbedded sand, sandstones and clays with occasional lignite. The sands are composed of clear, fine to very coarse grained quartz which is angular to subangular, poorly sorted and predominantly loose. A silica cement occasionally appears with depth and glauconite is seen in the lowest part. The clay is light grey, soft, sticky, silty and calcareous. Shell fragments of molluscs, bryozoa and forams occur throughout the section. This interval is of Early Pleistocene age.

4.2 TERTIARY

NORDLAND GROUP (360-996m (T.D.))

360-707m

This section is a continuation of the overlying Pleistocene interval and consists of interbedded sands, sandstones and clays. Shell fragments, mica and glauconite are common, and chert pebbles and pyrite occur.

Utsira Formation (707 - 858m)

This unit forms the Utsira Formation and is composed of loose quartz. It varies in grain size between fine and very coarse and the grains are subangular to subrounded. It has poor to moderate sorting, good porosity with infrequent occurences of shell fragments and glauconite throughout the interval. Age: Miocene.

858 - 996 m (T.D.)

This unit consists of interbedded clays and siltstones with minor sands and occasional thin limestone stringers.

The clays are olive grey, soft, calcareous and very silty in places. They appear to grade into the interbedded siltstones which are dusky yellow brown, soft, slightly calcareous and occasionally micromicaceous. The sands are composed of clear to milky, loose, medium to coarse grained quartz. They are moderate sorted and have good porosity. Limestone stringers are scattered throughout the section and are white, occasionally grey brown, hard and microcrystalline with low porosity. Glauconite and shell fragments are again common throughout, and pyrite rarely occurs.

The Nordland Group extends in the Tertiary interval, from Pliocene (380-700m), through Micocene (720-810m) and down into Miocene - Late Oligocene (930-996m T.D.) in this well.

5. HYDROCARBON SHOWS

Evaluation of hydrocarbon shows at the wellsite was carried out in a conventional manner.

Below 240m a hydrocarbon total gas detecter (50 units = 1%) and a gas chromatograph for automatic and continuous gas analysis, recorded as ppm by volume of C1 through C5, were operational.

5.1 GAS RECORD

240 - 996 m

Throughout the well gas levels varied between 0.1 and 6.4%. Only methane was recorded and gas peaks were seen to coincided with the more porous, clastic units. No obvious correlation between gas peaks and lignite stringers was noted.

5.2 OILSTAINS AND FLUORESENCE

No liquid hydrocarbons occured in the well.

6. CORING

No conventional or side wall cores were taken in the well.

7. WIRE LINE LOGGING

Tne following is a summary list of the wire line logs run in well 31/4-1, and shows dates, logged intervals and run numbers for each log.

Log	Date	Logged interval	Run no.
ISF/SONIC/GR	15.09.79	146.0 - 994 m	1
BHC/CCL	17.09.79	160.0 - 226.5 m	1

8. SPECIAL STUDIES

Tne biostratigraphic evaluation of the well has been performed by the laboratories of the Continental Shelf Institute (IKU) Trondheim. Tne results of this evaluation are combined with the results of a similar evaluation on well 31/4-2. As well 31/4-2 is in very close proximity to well 31/4-1, no samples for biostratigraphic analysis were collected on well 31/4-2 above 1000 m, the samples from well 31/4-1 being used for this purpose. Tne results of this evaluation are thus found in the top 1000 m of the following report:

"Biostratigrapy of Norsk Hydro well (N) 31/4-2" IKU.

APPENDIX 1

WELL SUMMARY

WELL SUMMARY

Coord: 60° 36' 18"2 N 03° 00' 32.3"E
Line: 704-236 , SP 107
Depths datum: R.K.B.
Rig: NORSKALD
Water depth: 144 m RKB. elev: 25 m
Stopped in: NORDLAND GROUP, (Oligocene age)

Spudded: SEPTEMBER 9. 1979
Started drilling: SEPTEMBER 9. 1979
At T.D: SEPTEMBER 14. 1979
Completed: SEPTEMBER 25. 1979

T.D. Driller: 1000 m T.D. Logger: 996 m

Well: 31/4-1

Country: NORWAY

OPERATOR: NORSK HYDRO PRODUKSJON A S

LICENCE: 055 OWNED BY: N.H/ARCO/BP/ ESSO/ STATOIL

TARGETS:
MIDDLE AND LOWER JURASSIC SANDSTONES

RESULTS:
THE WELL WAS PLUGGED AND ABANDONED AT 996 m (1000 m DRLS DEPTH) DUE TO LACK OF CEMENT SUPPORT AROUND THE 30" CASING, EXPERIENCED WHEN LANDING THE 20" CASING.

CASINGS

30" at 231 m
but retrieved before plugging and abandonment

CORES

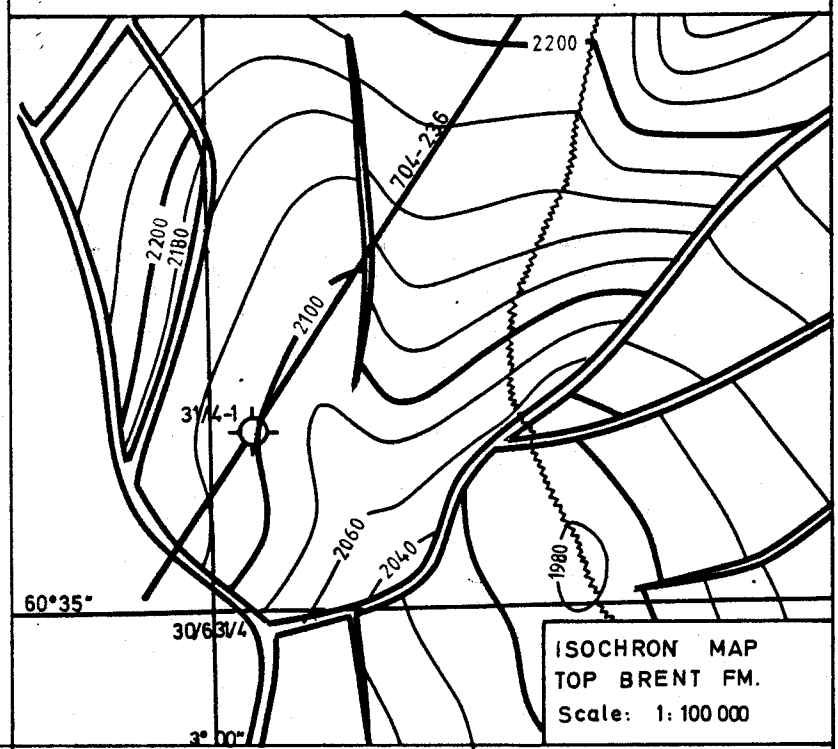
NONE

GAS RECORD

231 - 454 m: <1% Cl
454 - 722 m: 1-6% Cl
722 - 928 m: <1% Cl
928 - 996 m: 1-6.4 % Cl

OIL SHOWS

NONE



ISOCHRON MAP
TOP BRENT FM.
Scale: 1: 100 000

LOGS

ISF/ SONIC/ GR	146.0 - 994 m	1
BHC/ CCL	160.0 - 226.5 m	1

TESTS

NONE

Checked: S.I. LEIVESTAD
Date: 22.05.80

APPENDIX 2

GEOLOGICAL WELL SUMMARY

GEOLOGICAL WELL SUMMARY

LOCATED ON LINE : 704 236
SP : 107
N 60° 36 ' 18.2" E : 03° 00 ' 32.3"
WATER DEPTH : 144 m

WELL: 31/4-1

DEPTHS m KB | LITHO SECTION | SYSTEM | STAGES | SHOWS | DESCRIPTIONS.

25 m Sea Level

169 m Sea Bottom

QUATERN. — EARLY PLEIST.

Cly. lt gy. sft. stky, calc, slty.

231

Intbd w/Sd. clr, f-crs, occ v crs, lse, subang-subrnd, pr srtd.

Tr. Shell frags and Lig.

Cly, lt gy, sft, stcky, calc, slty.

360

Intbd w/Sd, clr, occ fros, f-v crs, lse occ hd, w/silic cmt, ang-subrnd, mica, pr srtd.

380

Tr. Shell frags, Lig.

Tr. Glau. Mica, Chert pbls.

Tr. Lst, wh, firm-hd, chky.

Tr. Pyr.

TERTIARY — PLIOCENE

700

707

720

Sd, clr, f-crs, lse, subang-subrnd glau, pr-mod srtd.

MIOCENE

810

NO SAMPLES

858

Cly, olv gy, sft, stcky, calc, glau, v slty

w/minor Slst, dusky yel brn, sft, sl calc, glau.

930

OLIGOC-MIOCENE

Thin strgs Sd, clr, fros, m-vcrs, lse, subang-subrnd, mod srtd.

996

Tr. Lst, wh, gy brn, hd, micro-xln.

Tr Shell frags, Pyr.

T.D. LOGGER: 996 m.
T.D. DRILLER: 1000 m.

DEPTHS m KB: 50, 100, 150, 200, 250, 300, 350, 400, 450, 500, 550, 600, 650, 700, 750, 800, 850, 900, 950, 1000, 1050, 1100, 1150, 1200, 1250

1300, 1350, 1400, 1450, 1500, 1550, 1600, 1650, 1700, 1750, 1800, 1850, 1900, 1950, 2000, 2050, 2100, 2150, 2200, 2250, 2300, 2350, 2400, 2450

SECTION B

OPERATIONS

LIST OF CONTENTS

SECTION B

TABLES

FIGURES

1. LOCATION SURVEY

From June 10. through June 12. 1979 the vessel M/S "Bømmeløy" performed a site survey in the area for the planned well 31/4-1, at:

60° 36' 18.2" N
3° 00' 32.3" E

The survey area was a square of approximately 3.4 x 3.4 km. The survey equipment used was echo sounder for bathymetric mapping, dual channel side scan sonar, analog boomer and high and low energy sparker.

The gravity cores showed that the sea bed consisted of very soft to soft clay. The clay was shaly and slightly silty and sandy in places. The length of the samples achieved was approximately 2.5 m.

The seismic data indicated 15 - 20 m of soft sediments consisting of clay with layers of sand and silt. In some places, penetration to approximately 40 m below seabed was achieved.

No obstructions or debris were found within the survey area which could envisage problems for the drilling operation. There were no indication of shallow gas zones in the upper layers around the given drilling location.

The water depth at the proposed location was found to be 145 m, referred to Mean Sea Level.

2. POSITIONING AND ANCHORING OF THE RIG

The location for the well 31/4-1 was defined as shot point 107 on seismic line 704-236, with the use of Pulse 8 and Sat.nav. in 3-D mode. The well should be spudded within a radius of 75 m from this position.

The equipment on board the rig for positioning was Pulse 8 and Sat.nav. The rig was transferred from Statoil on September 8, 1979 at 09.00 hrs and moved from the 30/3-1 location to the 31/4-1 location. At 21.00 hrs. all eight anchors were set with piggy-backs on No. 3 and 5 as shown in Fig. B-1.

Prior to spudding on September 9, all the anchors were pretensioned to 890 kN. All the anchors were retested to 1334 kN after setting of the 30" casing.

The final position of the well 31/4-1 was:

60° 36' 18.2" N
03° 00' 32.3" E

3. OPERATION RESUMÉ

3.1 Summary

Norskald was taken over from Statoil September 8, at 09.00 hrs. and moved to the 31/4-1 location. It was ready to spud after 11 hrs. of anchor handling.

The 36" hole was drilled to 232 m RKB, and the 30" casing was set at 231 m RKB and cemented back to the seabed. Attempts were made to grout the 30" casing by stabbing the grouting tubing into the funnel on the guide base without success.

The riser was run and the 17½" pilot hole was drilled to 769 m using sea water.

At 769 m the circulation was lost and gel was spotted in order to regain full returns. The 17½" hole was drilled down to 796 m where the circulation again was lost.

The hole was displaced with mud and lost circulation material to reestablish full returns. Lost circulation appeared again at 847 m, and gel mud was pumped.

The 17½" hole was drilled down to 1000 m. The hole was circulated and cleaned before an ISF/Sonic log was run. Some mud returns were observed away from the wellhead while logging. The riser was pulled before opening the 17½" hole up to 26". The 26" hole was then reamed down to 820 m and circulated before pulling out of the hole. When running in with a 26" bit, a ledge was hit very hard at the 30" casing shoe. This apparently broke the cement bound around the 30" casing resulting in cement falling in the hole and making the subsequent reaming impossible. An attempt was made to squeeze off the lost circulation path and recement the 30" casing shoe. The cement was drilled out and the 26" hole was reamed down to 1000 m with frequent tight spots between 820 m and 1000 m.

A 10 m^3 of Flosal and XC-polymer slurry followed by a 175 m^3 gel slurry were pumped prior to running the 20" casing. When the 20" housing was landed in the 30" housing, the permanent guide base and

the 30" casing fell approximately 3.5 m. The lack of support around the 30" casing, caused the decision to abandon the well.

A cement plug was set from 600 m to 700 m before the 30" casing and the permanent guide base was pulled. A second cement plug was set from 220 m to 270 m.

The well was left as shown in Fig. A.3. The rig was moved over 100 - 150 m in a direction 213 degree N to spud well 31/4-2.

Week	Weeks Progress	Report no.	Page	of
8.9 - 9.9.79		1 - 2	1	

Area	Well	Rig
North Sea	31/4-1	Norskald

Casing	Size	30"					
	Setting depth (m)	231					

Date	Depth (m) / Progress (m)	Pore Press grad (r.d.)	Mud Dens grad (r.d.)	Detailed operation
8.9				Moved the rig to the 31/4-1 location. Set all anchors, and ballasted the rig. Tensioned the anchors, and made ready to pick up the 30" casing.
9.9	232		1.07	Made up bottom hole assembly and ran in the hole. Tagged bottom at 169 m. Drilled 36" hole to 232. m. Pulled out of the hole. Ran the 30" casing, and cemented back to seabed.

1920 HK 8.78 500 VS 81414

Weekly drilling report

Week	Weeks Progress	Report no.	Page	of
10.9 - 16.9.79		3 - 9	2	

Area	Well	Rig
North Sea	31/4-1	Norskald

Casing	Size	30"					
	Setting depth (m)	231					

Date	Depth (m) / Progress (m)	Pore Press grad (r.d.)	Mud Dens grad (r.d.)	Detailed operation
10.9	232		1.07	Tested the anchors. Pulled the guide frame. Ran the grouting tubing, and found cement 4 m below the seabed. Ran the pin connector. Attempted to stab the pin-connector and broke one guide arm. Pulled the pin-connector.
11.9	232		1.07	Made and mounted new guide arm. Ran the pin connector. Bent the guide arm when attempting to land the pin connector. Repaired the guide arm and ran the pin connector. Rigged up the slip joint and the diverter. Made up 17½" bottom hole assembly and ran in the hole.
12.9	682		1.07	Tagged cement at 226.5 m. Drilled the cement and casing shoe. Attempted to pump through diverter lines. Drilled 17½" hole. Changed out leaking kelly cock and repaired make up chain on rotary system. Drilled and surveyed to 682 m.
13.9	796		1.07	Drilled to 769 m. Lost circulation, spotted gel and circulated. Drilled to 796 m. Displaced hole with gel mud. Filled hole with salt water and tried to establish full return.
14.9	1000		1.07	Circulated and drilled to 874 m. Lost circulation. Drilled to 937 m. Circulated to establish full return. Drilled to 1000 m. Ran survey, and pulled out to the 30" casing shoe. Ran in the hole and washed and reamed from 980 m to 1000 m. Displaced salt water with mud.
15.9	1000		1.03	Ran ISF/Sonic log. Observed mud return on the sea floor away from the wellhead. Pulled the riser and the pin connector. Ran in the hole with 26" underreamer and tagged cement at 226 m.
16.9	1000		1.03	Underreamed to 920 m. Circulated to pull out of the hole.

1920 HK 8.78 500 W# 81414

Norsk Hydro

Weekly drilling report

Week	Weeks Progress	Report no.	Page	of
17.9 - 23.9.79		10 - 16	3	

Area	Well	Rig
North Sea	31/4-1	Norskald

Casing	Size	30"					
	Setting depth (m)	231					

Date	Depth (m) / Progress (m)	Pore Press grad (r.d.)	Mud Dens grad (r.d.)	Detailed operation
17.9	1000		1.07	Pulled out of the hole. Ran in with a 26" bit and hit a ledge at the 30" casing shoe. Pulled out of the hole and laid down bent drill pipe. Ran in to the casing shoe. Reamed from 232 m to 241 m with high torque due to cement falling in. Pulled out to check the bit and ran in to 226 m. Attempted to drill. Ran CCL/Sonic log to check if the 30" casing had parted. Made up 17½" bottom hole assembly.
18.9	1000		1.07	Ran in the hole with the 17½" bit. Reamed from 226 to 269 m with excessive torque. Made wiper trip to the casing shoe. Reamed at 269 m. Pulled out of the hole and screwed the 30" running tool into the housing. Squeeze cemented the 30" casing shoe in two stages.
19.9	1000		1.07	Backed out and pulled the running tool. Ran in the hole with 26" bit and tagged the cement at 242 m. Drilled the cement. Reamed the 26" hole to 820 m. Pumped viscous mud.
20/9	1000		1.07	Reamed to 1000 m. Sweept hole with 48 m^3 gel mud and pulled out of the hole. Made up cement head and inspected the wellhead with the TV. Ran in the hole and reamed tight spots from 860 m to 875 m, and from 915 m to 933 m. Repaired pump No. 2. Reamed from 933 m to 943 m. Severe sloughing problems from 939 m to 943 m.
21/9	1000		1.20	Reamed to 1000 m. Pumped 10 m^3 Flosal-XC polymer slurry followed by 175 m^3 gel slurry with equal amount of sea water. Reamed tight spots. Pumped 48 m^3 of 1.2 rd mud and pulled out of the hole. Made up 20" shoe joint and float joint and installed 20" casing guide. Unable to make up casing due to the weather.

1920 HK 8.78 500 Ws 81414

Weekly drilling report

Week	Weeks Progress	Report no.	Page	of
17/9 - 23/9		10 - 16	4	

Area	Well	Rig
North Sea	31/4-1	Norskald

Casing	Size	30"					
	Setting depth (m)	231					

Date	Depth (m) / Progress (m)	Pore Press grad (r.d.)	Mud Dens grad (r.d.)	Detailed operation
22/9	-	-	-	Ran 20" casing and stabbed into the wellhead. When landing the casing in the 30" wellhead, the wellhead fell 3.5 m below the seabed. Tried to latch into the 30" wellhead without success.
23/9	-	-	-	Pulled and layed down the 20" casing. Ran the TV but could not see the wellhead. Ran in the hole to 700 m and rigged up to cement.

1920 HK 8.78 500 VS 81414

Weekly drilling report

Week	Weeks Progress	Report no.	Page	of
24/9 - 25/9		17 - 18	5	

Area	Well	Rig
North Sea	31/4-1	Norskald

Casing	Size	30"					
	Setting depth (m)	231					

Date	Depth (m) / Progress (m)	Pore Press grad (r.d.)	Mud Dens grad (r.d.)	Detailed operation
24/9	PBTD 600 m			Set cement plug from 700 m to 600 m. Pulled out of the hole with the 30" casing and permanent guide base. Set guide base on spider beam, split same and backed out running tool. Pulled and layed down 30" casing.
25/9	PBTD 220 m			Ran in the hole with open ended drill pipe to 270 m and set a cement plug from 270 m to 220 m. Waited on weather to move the rig. Moved over to the 31/4-2 location on September 25, 1979 at 12:30 hrs.

1920 HK 8.78 500 W# 81414

3.3 Time Distribution

The total time used to move the rig to the location, drill the well and to permanent plug and abandon the well 31/4-1 was 17.2 days. The time distribution is shown in table B-1 and Fig. B-2.

The operation can be devided as follows:

1.	Underway and position the rig:	0.8 days
2.	Drilling of the well to TD:	3.4 days
3.	Plug and abandon the well:	2.0 days
4.	Running and cementing casing:	2.6 days

TABLE B.1

TIME DISTRIBUTION

OPERATIONS	HOURS	PERCENTAGE OF TOTAL TIME
1. Underway	6½	1.6%
2. Positioning and mooring	12½	3.0%
3. Drilling	81	19.7%
4. Tripping	52	12.6%
5. Surveying	2	0.5%
6. Reaming	33	8.0%
7. Slipping and cutting drlg. line	1	0.2%
8. Subsea equipment handing	23	5.6%
9. Testing of equipment	2	0.5%
10. Running and cementing casing	61½	15.0%
11. Formation evaluation	7½	1.8%
12. Lost time. Drlg. equipment	1-3/4	0.4%
13. Lost time. Subsea equipment	22-1/4	5.4%
14. Lost time. Hole problem	45	10.9%
15. Lost time. Waiting on weather	10½	2.6%
16. Lost time. Waiting on order	2	0.5%
17. Plugging and abandonment	48	11.7%
Sum total	411½	100%
=	17.2 days	

4. PERMANENT ABANDONMENT OF THE WELL

The abandonment program is shown in Fig. B-3 and was carried out as follows:

1. A 100 m cement plug was set from 600 m to 700 m
2. A 50 m cement plug was set from 220 m to 270 m

The complete wellhead and guide base were recovered in addition to all 20" and 30" casing.

Nothing was reported lost overboard on well 31/4-1.

5. MATERIALS REPORT

5.1 Casing and wellhead

The 30" casing was set as shown in Table B-2.

TABLE B-2

CASING COMPOSITION

Size	Grade	Weight lbs/ft	Length m	Threads	Setting depth m
30"		460	14.5	Vetco ATD	
		309	49.5	Vetco ATD	231

PRINTED IN U. S. A.

BIT RECORD

TABLE B 3

COUNTY	FIELD	STATE	SECTION	TOWNSHIP	RANGE	LOCATION	WELL NO
NORWAY						31/4-1	1

CONTRACTOR	RIG NO.	OPERATOR	TOOLPUSHER	SALESMAN
ROWAN	N	NORSK HYDRO		

SPUD	UNDER SURF.	UNDER INTER.	SET SAND ST.	REACHED T.D.	PUMP NO. 1 LINER	PUMP NO. 2 LINER	PUMP POWER	TYPE MUD

DRILL PIPE SIZE	TYPE	O.D.	NUMBER	O.D.	I.D.	LENGTH	DRAWWORKS POWER
TOOL JOINTS			DRILL COLLARS				

NO.	SIZE	MAKE	TYPE	JET 32ND IN	SERIAL	DEPTH M	M	HOURS	M/HR	ACCUM DRLG HRS	WT 1000 N	R P M	VERT DEV	PUMP PRESS BAR	PUMP OPER-ATION	S P M 1	S P M 2	MUD WT	MUD VIS.	MUD W.L.	DULL. COND. T	DULL. COND. B	DULL. COND. G	DULL. COND. OTHER	FORMATION REMARKS
1	26"	TSK	3S	3.24		232	63	5½	11.5	5½	98	40		138	D	120	120	SEA	WATER						
2	17½"	SeC	M44N	3.22		1000	768	40½	19	46	0/40	90/150		214	D	120	120	SEA	WATER						
3	17½"	SMITH	DS	3.24		820	UNDERREAMING CMT																		
4	25"	SMITH	DS	REG		241	72	DRILLING CM T																	
RR2	17½"	SEC	M44N	3.22		269	43	DRILLING CM T																	
RR4	25"	SMITH	DS	REG		1000	180	UNDERREAMING TO			26" HOLE, REAMING CMT HIGHER UP.														

5.2 Bottom Hole Assemblies

Bit No.	Bit size	Bottom hole assembly
1	26"	Bit - 36" H.O. - 1 x 9" monel - stab - 5 x 9" DC - 13 HWDP
2	17½"	Bit - bit sub - 1 x 9" monel - 5 x 9" DC - XO - 12 HWDP
3	17½"	Bit - 26" H.O. - bit sub - 1 x 9" monel - 5 x 9" DC - XO - 12 HWDP
4	26"	As for bit No. 2
RR2	17½"	Bit - bit sub - 5 x 9" DC - XO - 12 HWDP
RR4	26"	As for bit No. RR2

5.3 MUD REPORT

36" hole, 30" csg.: The 36" hole was drilled with seawater with returns to the seabed. Pumped 5 m^3 of high viscosity mud before every connection. At T.D. the hole was circulated with 57 m^3 high viscosity mud.

26" hole, 20" csg.: The riser was run before the 17½" pilot hole was drilled, using seawater. Gel sweeps were pumped periodically. When drilling from 769 m to 1000 m lost circulation occured several times. Spotted gel, LCM-pills and circulated each time in order to establish full returns. After having squeezed cement at the 30" casing shoe, the hole was reamed to bottom using seawater and gel slugs. At T.D. the hole was displaced with 350 m^3 of prehydrated bentonite and seawater slurry. After a short trip to the casing shoe, 56 m^3 of 1.20 rd mud was placed on bottom.

Materials used in both intervals were barite, bentonite, caustic soda, soda ash, lime, sodiumbicarbonate, Milmica (c), Kvickseal, CMC hi-vis, Flosal and XC-polymer

TABLE B4 MUD SUMMARY
WELL DATA SHEET

OPERATOR : NORSK HYDRO A/S | SURVEY SEC.: | CASING SIZE : | DEPTH | DRLG.DAYS | BIT SIZE

WELL : 31/4-1 | FIELD : 31/4 | SURFACE :

CONTRACTOR: ROWAN | COUNTY: NORTH SEA | INTERMEDIATE:

ENGINEER: KELLY/DUNIFER | STATE : | COUNTRY: NORWAY | PRODUCTION :

DATE	DEPTH	R.D. WT.	VISCOSITY SEC.	VISCOSITY CPS.	PV	YP	GELS 0	GELS 10	PH BECK ☐ STRIP ☒	FLUID LOSS 100 PSI API	FLUID LOSS 400 PSI 300 F HT-HP	CL ☒ CACL ☐ NACL ☐	ALKALINITY PF	ALKALINITY PM	ALKALINITY MF	CA PPM	MG PPM	RETORT % OIL	RETORT % SOL	RETORT % WATER	ACTIVITY As	ACTIVITY AM	RATIO OIL	RATIO H_2O	#BBL CEC	
9/9.79	180	1.07	103		20	38			11.0																	SPUD
10	231	1.07	65						10.5																	
11	231	1.05	70						10.5																	
12	670	1.07	100						11.0																	
13	767	1.07	37		10	5			10.0																	
14	1.000	1.03	35		10	3			10.0			12.000	0.2		0.4			0	3	97						
15	1.000	1.03	38		8	4			10.5			10.000	0.1		0.3			0	3	97						LOG.
16	1.000	1.03	37						10.0			1.400	0.2		0.4			0	4	96						
17	1.000	1.05	130						10.5			8.000														
18	1.000	1.09	73						10.0			10.000														
19	1.000	1.05	50						10.0			8.000														
20	1.000	1.08	75		24	24																				
21	1.000	1.05	7		13																					
22	1.000																									20"CS
23	1.000																									
24	1.000																									

DATE SPUD: 9/9-1979 | DATE T.D.: | B.H.T | COMPLETION FLUID TYPE: | PACKER MUD TYPE: | COST | COST:

5.4 CEMENT REPORT

30" Casing

The 30" casing was set at 231 m and cemented back to the seabed.

Lead slurry:

	Composition	total used
Class "G" cement		9.6 ton
Yield:	1.46 m^3/ton	
Sea water:	1.10 m^3/ton	10.56 m^3
Econolite:	0.05 m^3/ton	0.48 m^3
Density:	1.5 rd.	
Thickening time:	4:20 + hrs. at 7°C BHST (45°F)	

Tail in slurry:

Class "G" cement		28.7 ton
Yield:	0.84 m^3/ton	
Sea water:	0.44 m^3/ton	12.63 m^3
$CaCl_2$:	0.072 m^3/ton	2.07 m^3
Density:	1.87 rd	
Thickning time:	4:00 hrs. at 7°C BHST (45°F)	

Recementing of 30" casing shoe

Lead slurry:

Class "G" cement:		16 ton
Yield:	0.694 m^3/ton	
Fresh water:	0.556 m^3/ton	8.9 m^3
Econolite:	0.0323 m^3/ton	0.516 m^3
Caustic:	0.0026 m^3/ton	0.042 m^3
Density:	1.7 rd/1.8 rd	
Thickening time:	1:00 hr. at 7°C BHST (45°F)	

Pumped first the 1.7 rd slurry and tailed in with the 1.8 rd slurry (same slurry).

Squeeze slurry:

	Composition	total used
Class "G" cement		4 ton
Yield:	5.05 m^3/ton	
Sea water:	16.58 m^3/ton	66.3 m^3
$CaCl_2$:	0.153 m^3/ton	0.613 m^3
Density:	1.9 rd	
Thickening time:	30 min. at 7°C BHST (45°F)	

Slurry composition plug No. 1

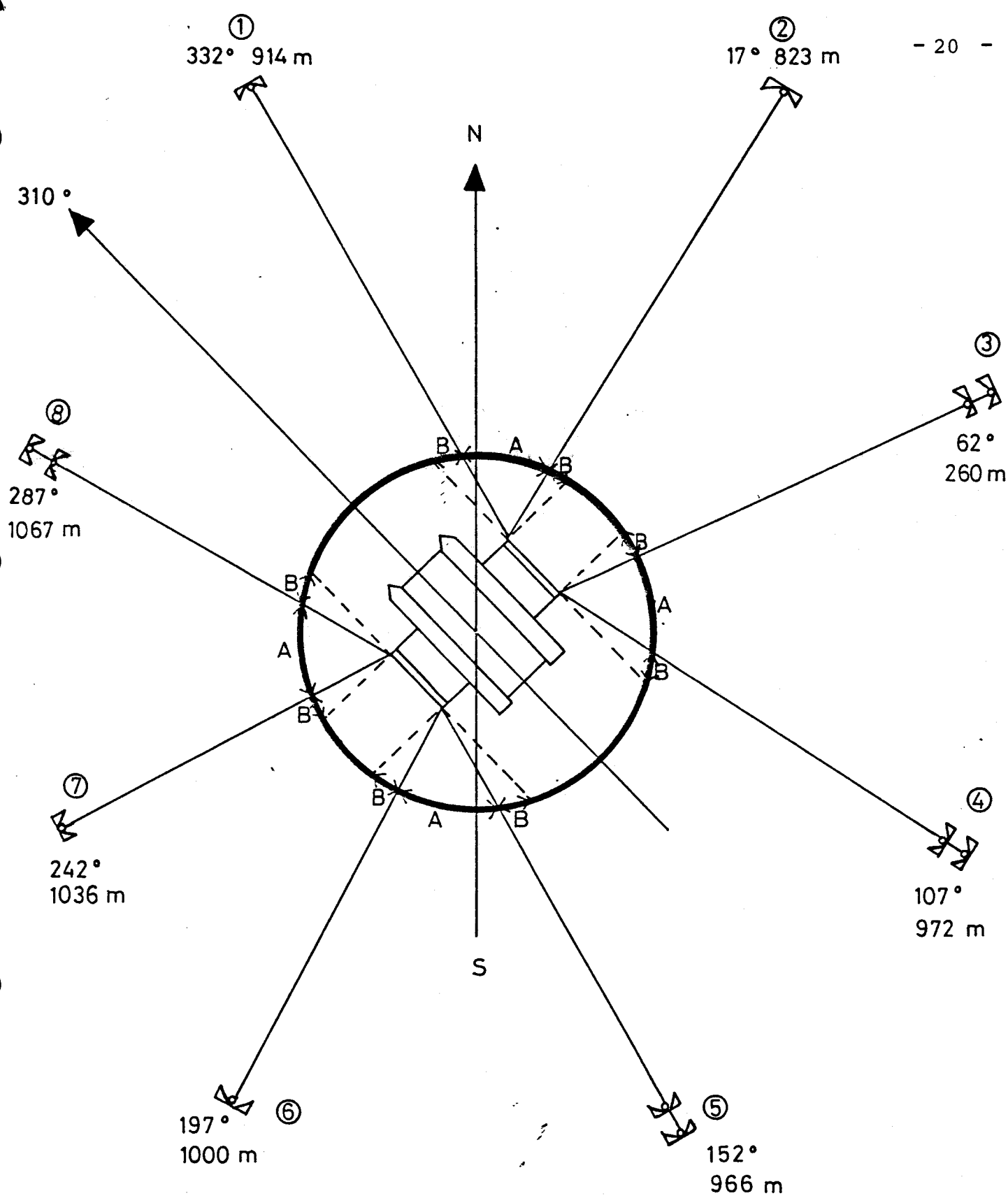
Depth of plug No. 1 700 m - 600 m

Class "G" neat cement		67.2 ton
Yield:	0.764 m^3/ton	
Sea water:	0.44 m^3/ton	29.85 m^3
Density:	1.89 rd	

Slurry composition plug No. 2

Depth of plug No. 2 270 m - 220 m

Class "G" neat cement		41.2 ton
Yield:	0.764 m^3/ton	
Sea water:	0.44 m^3/ton	18.28 m^3
Density:	1.89 rd.	

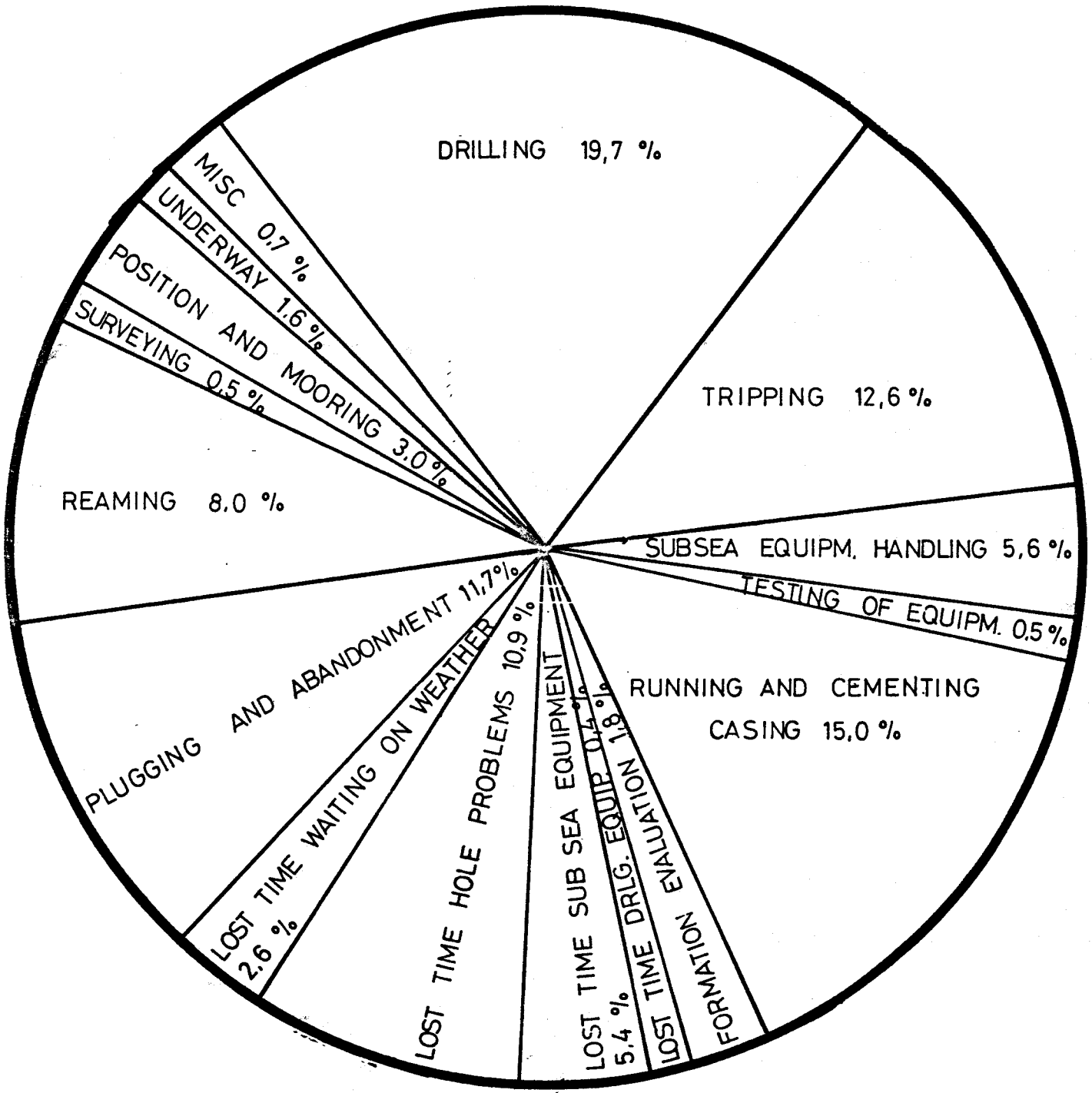


HEADING: 310°

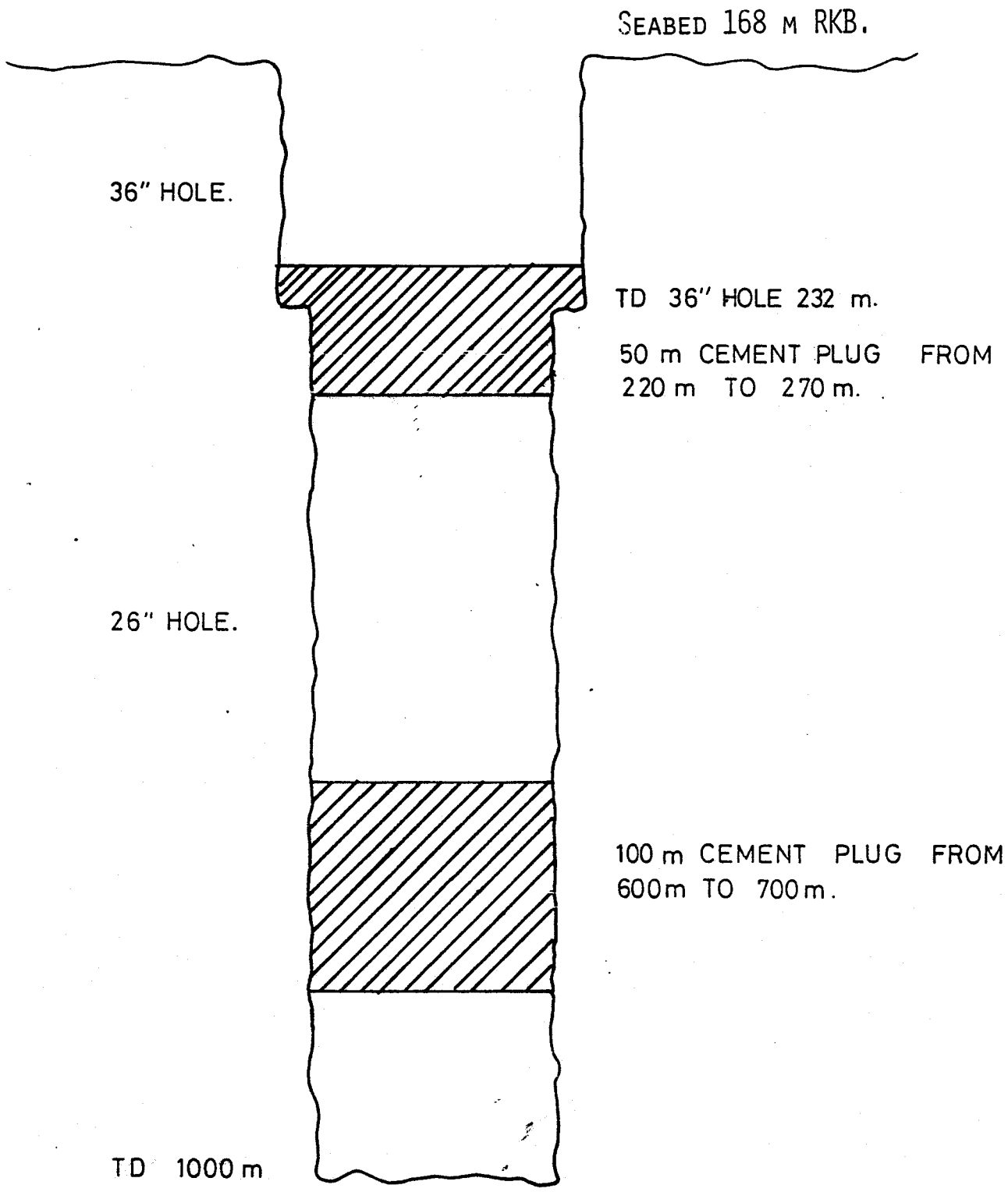
ANGLE A: 45°

ANGLE B: 22,5°

Norsk Hydro Drilling Dept.	Mooring line pattern Norskald well 31/4-1	Gr. no. 3	Fig. B - 1
		Date: 16/11-1979 Sign: LaB'/ Hes	Dwg. no. 81



Norsk Hydro Drilling Dept.	TOTAL TIME DISTRIBUTION WELL 31/4-1	Gr. no. 3	Fig. B-2
		Date: 19.10.79 Sign: LaB/Hes	Dwg. no. 74



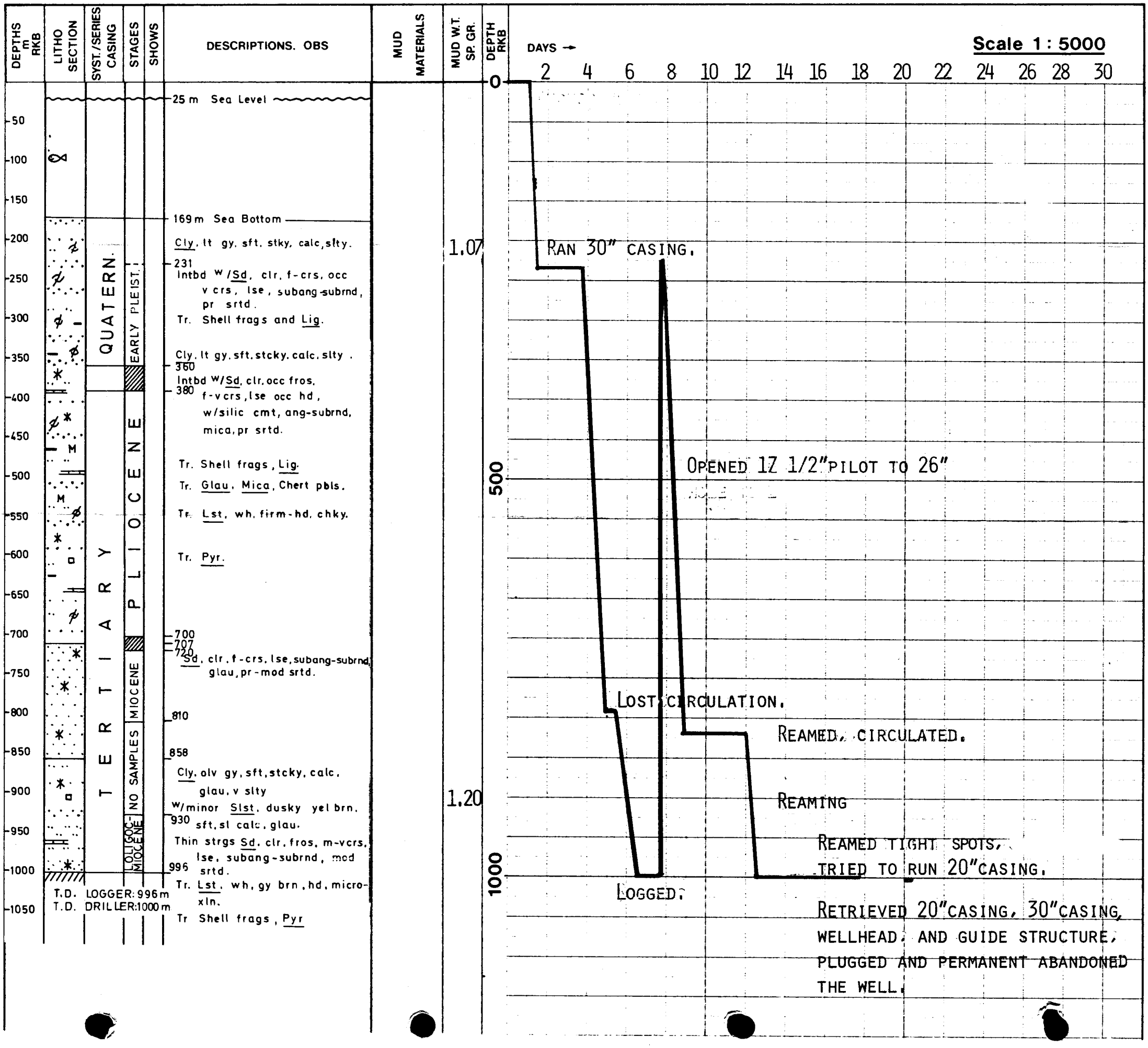
Norsk Hydro Drilling Dept.	PERMANENT ABANDONMENT OF WELL 31/4-1	Gr. no. 3	Fig. B-3
		Date 27/9-1979 Sign: RFø/Hes	Dwg no. 30

Norsk Hydro

Oslo - Norway

DRILLING PROGRESS, WELL 31/4 - 1

OPERATOR	: NORSK HYDRO A.S	SPUD IN	: 9 SEPT.1979	WATER DEPTH	: 144 M
COORDINATES	: 60 DEG 36' 18.2" N	WELL COMPL.	: 25 SEPT.1979	RKB to MSL	: 25 M
	: 03 DEG 00' 32.3" E	RIG	: NORSKALD	RKB to SEABED	: 169 M



L-121489 Vedlegg til R-004472

Norsk Hydro

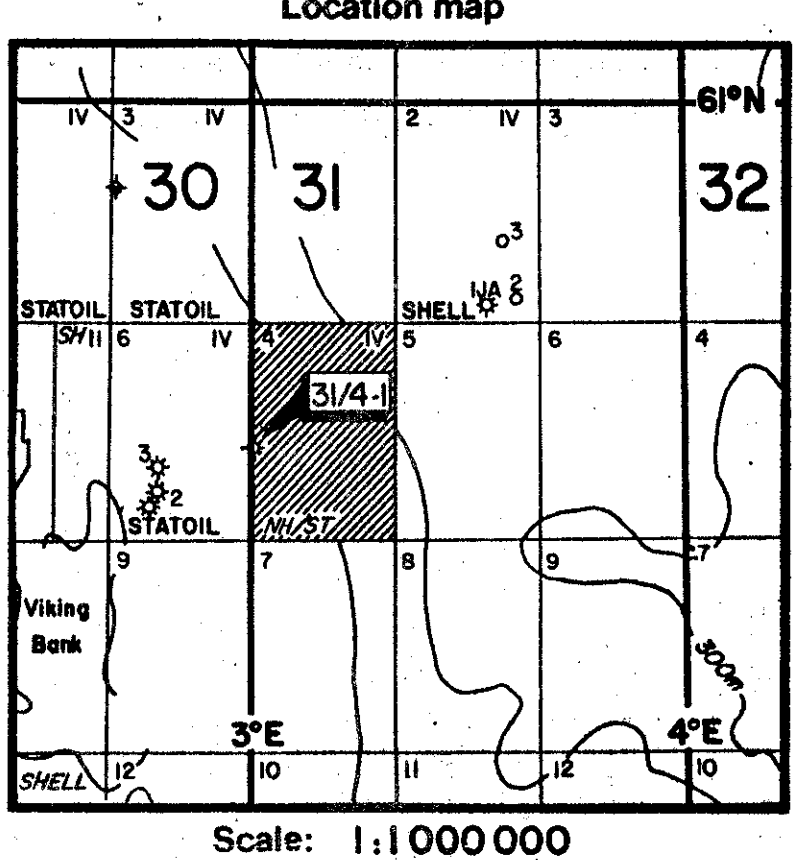
Oslo - Norway

Completion log

Scale 1:500

Well: 31/4-1

Location map



Scale: 1:1 000 000

Coordinates: 60°36'18,2"N 03°00'32,3"E
Elevation K B: 25m
Water Depth: 144m
Total Depth (Driller): 1000m
Total Depth (Logger): 996m
Formation at Total Depth: -Oligocene

Country: Norway
Licence: 055
Owners: Statoil/Esso/Norsk Hydro/Arco/BP
Field: —

Date Spudded: September 9, 1979
Reached Total Depth: September 15, 1979
Completed: September 25, 1979
Well Status: Plugged & abandoned

Rig: Norskald
Contractor: Rowan Drilling Co.
Mudlogging Company: Exploration Logging
Geologists: B. Gustavsen, G. Lunde, L. Beckman.

Prepared by: A. Davies, S.I. Leivestad
Date: May 20, 1980

Casing Records:
30" at 231m (retrieved)
20" at —
13 3/8" at
9 5/8" at
7" liner at

Comments:

The well was plugged and abandoned at 996m (1000m drilled depth) due to lack of cement support around the 30" casing, experienced when landing the 20" casing.

Logs Run

ISF/SONIC	FDC/CNL	HDT			
I. 146 - 994m					
BHC / CCL					
I. 160 - 226,5m					

Legend

CONGLOMERATE, SHALE, CHALK, ANHYDRITE, SANDY VERY / SANDY / SANDY, SLIGHTLY
SAND/SANDSTONE, LIMESTONE, MARL/MARLSTONE, SALT, SILTY, VERY / SILTY / SILTY, SLIGHTLY
SILT/SILTSTONE, DOLOMITE, COAL/LIGNITE, GYPSUM, ARGILLACEOUS
CLAY, DOLOMITIC LIMESTONE, TUFF
CLAYSTONE, CALCAREOUS DOLOMITE, IGNEOUS EXTR./INTR.

C Carbonaceous mat.
Chert
Glauconite
M Mica
Pyrite
Macrofossils
Macrofossils, frag
Microfossils

Hydrocarbon Shows.
Stain
Fluorescence
Cut
Gas Shows

Casing Shoe
Deviation 2°
Dipmeter results 3°
One way time from Velocity survey (depth m K.B.) e.g: 3603 m: 1.450 s

Core Interval
(No recovery)
Side Wall Core
(No recovery)

Perforated Interval
Cement Plug Interval

DST
Through casing
Open hole
Re - Run
RFT/FIT