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T O R

(17/4 - 1x)

FINAL GEOLOGICAL REPORT

Mars 1970

M. C. BERTHON.

I - GENERAL -

A - Location

Coordinates of exploration well TOR are :

x : E 03° 16' ~~15~~ 05"

y : N 58° 35' ~~47~~ 54"

or :

E 399.456
N 6.496.550 UTM system belt 3133

This point is located in field 17, bloc 4 of the Norwegian waters included in PETRONORD's drilling licence 007.

B - Prospect geology and objectives

The TOR test was located on top of a big and gentle anticline trending WSW - ENE.

This structure was originated by a salt pillow, itself related to a horst feature in prezechstein. The well was due to investigate the sedimentary section down to the prepermian; and particularly to test the hydrocarbon potential of :

- mesozoïc sands (Jurassic and Triassic)

- Zechstein dolomites

and evaluate :

- Lower Permian and/or prepermian reservoirs if present.

C - Technical data

- Contractor and rig : ODECO NORWAY, "OCEAN VIKING"

- Dates : Spudded 15.6.68
  Drilling 17.6.68
  At TD 22.8.68
  Completed 30.8.68

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- RKB elevation + 27 m (datum)
- Water depth - 105 m
- <u>Drilling and casing data</u> :
  - Drilled 36" hole to 158 m
    26" hole to 444 m
  - Set and cemented together 30" guide at 158 m and 20" casing at 439 m.
  - Drilled 17 1/2" hole to 1.812 m.
    Set and cemented 13 3/8" at 1.803 m.
  - Drilled 12 1/4 hole to 3.942 m
  - Drilled 8 1/2 hole to 3.997 m (TD)
- <u>Muds</u> :
  - Drilled with sea-water and returns on the sea floor down to 444 m.
  - Drilled with an LFC - LC sea-water ; type mud to 1.812 m at which depth the system was salt saturated.
  - Drilled with an inverted oil-base mud from 2.900 m to TD (3.997 m).
- <u>Coring</u> :

  See Appendix 1.
- <u>Logging</u> :

  See Appendix 2.
- <u>Tests</u> :

  None.
- <u>Status</u> :

  Plugged and abandoned.

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II - STRATIGRAPHY -

1 - Recent - Tertiary 132 - 1.161 m (th. 1.029 m) -

As the first returns were obtained at 445 m the lithologies down to this depth are inferred from the Gamma-Ray curve and bit samples.

1.1 - Recent - Scaldisian 132 - 264 m (th 132).

Sand and gravels with some light-grey very soft clay interbeds, and thick-shelled pelecypool debris.

1.2 - Diestian - Middle Miocene 264 - 544 m (th. 280 m).

Clay, soft, light-greenish grey, silty-sandy and micaceous, with lignite flakes is the main lithology of this unit. Some thin shaly sands occur towards the base of this unit ; they are very fine to medium grained and very glauconitic (442/444 m - 502/507 m and 541/544 m).

1.3 - Brown clays group 544 - 981 m (th. 437 m).

1.3.1 - 544 - 826 m

This interval consists of brown very soft "gumbo" type clays originating numerous wash-outs and bridges.

Numerous glauconite pellets occur at the top of this unit ; and some red brown, sideritic, limestone stringers are present above 650 m. These clays are dated Oligocene by their mannoflora content and are analogouc to the Cilleborg and Septarien clays of Denmark.

1.3.2 - 826 - 981 m

In this zone the clays are becoming more grey and admit more stringers of brown to buff sideritic micrites.

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The nannoflora of this zone is characteristic of Lower Oligocene - Upper Eocene.

Henceforth this could be an equivalent of the Sovind marls of the danish outcrops.

1.4 - Lower Eocene - Upper Paleocene - 981 - 1.096 m (115 m).

Light green fissile pyritic clays mark the top of this unit followed downwards by mottled purple and red-brick silty shales and after 1.041 m volcanic tuffs interbeds hard, grey to pink, appear. This formation can be compared with Lillebelt, Roesnaes, and Mo clays of Denmark and is dated Lower Eocene - Upper Paleocene by its nannofossils.

1.5 - Paleocene - 1.096 - 1.161 m (th. 65 m).

Light grey calcareous shale make up this unit and are dated Paleocene by nannopalynology.

2 - Upper Cretaceous chalk - 1.161 - 1.444 m (th. 283 m) -

2.1 - 1.161 - 1.250 m (th. 89 m).

Chalk, white, very soft (Δ t 90 - 105 μ sec/ft) with rare black cherts and echinids spines.

2.2 - 1.250 - 1.393 m (th. 142 m).

From 1.250 to 1.326 m this unit is composed of chalky, whitish-grey, pyritic, limestones followed by more compacted pink chalky sandy and glauconitic, limestones (Δt 80 μ sec/ft) with silicified stringers.

2.3 - 1.393 - 1.444 m (th. 52 m).

In this unit numerous lithologies alternate in beds a few meters thick :

- Silicified very hard greenish-white, glauconitic limestone.
- Calcareous, hard, glauconitic, sandstones fine to medium grained.

.../...

- White-grey finely sandy and glauconitic limestones with Inoceramus shells debris.

- Marls : greenish grey fissile.

The first two units of this chalk section are dated Maestrichtian and the Lower one Turonian - Cenomanian by their nannoplankton, thus denoting a lower Senonian hiatus.

3 - Lower Cretaceous - 1.444 - 2.122 m (th. 678 m) -

This is a rather monotonous section of olive-grey silty and micaceous claystones, with thin interbeds and nodules of grey to brown very hard dolomitic microcrystalline limestones.

These intercalations are more frequent below 1.974 m and the base of this sequence (2.080 - 2.122) is marked by an incoming of marly, variegated, pyritic, microcristalline limestones.

On palynological and micropaleontological grounds this sequence is divided as follows :

3.1 - 1.444 - 1.681 m (th. 237 m) - Albian, possibly lower Cenomanian for the upper part.

3.2 - 1.681 - 1.695 m (th. 14 m) - Aptian.

The base of this unit beeing marked by a brick red limestone stringer indicative of remote diastrophic events.

3.3 - 1.695 - 2.122 m (th. 427 m) - Neocomian.

Barremian to Valanginian.

4 - Jurassic shales - 2.122 - 2.264 m (th. 142 m) -

Black fissile very radioactive shales (up to 216 API units) with black carbonaceous flakes, resin and fish scales make up this formation. The shale are becoming sandy and less radioactive below 2.217 m.

This section is assigned to Upper Jurassic for its upper part and to Callovian - Oxfordian at its base, by palynology.

.../...

A special arenaceous microfauna recalling the Callovian - Oxfordian of Great Britain, occurs at 2.225 m.

5 - Jurassic ? sands - 2.264 - 2.352 m (th. 88 m) -

A cyclic deposition of sandstones with shale partings is characteristic of this unit.

Each cycle, some decimeters thick, begins with a microconglomerate scouring the previous one, followed by greenish-grey friable sandstones with grain size decreasing upwards and ending with green calcareous clay.

Together with angular to subangular quartz grains, mica flakes and rock debris (granite, volcanics, quartzites) are common.

An abundant epigenetic calcareous cement binds the grains sometimes with a pseudo-oolitic appearance and reduces sharply the reservoir properties of these sandstones.

On the core taken at the top of the unit, scouring surfaces, cross bedding dipping 10 - 15°, ripple marks, mud cracks, clay chips were observed.

These features associated with granulometric studies point towards a fluvial deposition. Paleontologically, these sandstones are barren.

Garnet is the main heavy mineral associated with some apatite.

6 - Triassic - 2.352 - 2.665m(th. 313 m) -

6.1 - Bunter ? sandstone - 2.352 - 2.531 m. (th. 179 m)

In this unit shaly sandstones brick red to grey, friable, poorly sorted, fine to very coarse grained, a few meters thick, alternate with red silty-sandy shales increasing downwards.

Rare Ovalipollis specimens indicative of a Triassic age were observed at 2.420 m.

In the heavy fraction epidote is the main constituent associated with garnet and apatite, iron oxyde (oligist) appears at 2.440 m.

.../...

6.2 - Lower Bunter ? Shale - 2.531 - 2.596 m (th. 65 m).

This is a monotonous section of massive calcareous and anhydritic red shale.

6.3 - Lowermost Triassic "Bröckelschiefer" - 2.596 - 2.665 m. (th. 69 M).

This unit, transitional to Permian evaporites, is characterized by shaly sandstones, red, fine to medium grained with red clay interbeds, followed after 2.646 m by red clays with increasing anhydrite intercalations.

7 - Zechstein - 2.665 - 3.834 m (th. 1.169 m) -

The classical german subdivisions can be applied to this section whose thickness is partly resulting from halokinesis.

7.1 - Cycle IV - 2.665 - 2.716 m (th. 51 m) subdivided as follows :

7.1.1 - 2.665 - 2.685

. Three anhydrite beds separated by red shale (Grenzanhydrit).

7.1.2 - 2.683 - 2.703 m

Massive halite (Jungstes steinsalz).

7.1.3 - 2.703 - 2.716 m

Interbedding of salt and anhydrite (Pegmatitanhydrit eq.)

7.2 - Cycle III - 2.716 - 3.492 (th. 776 m).

7.2.1 - 2.716 - 2.735 m

This interval equivalent of the Rotersalzton is made up of brick-red undercompacted saliferous clays, with some fine grained shaly and salt cemented sandstone beds.

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7.2.2 - 2.735 - 2.783 m

Pink to clear halite (Decksteinsalz III).

7.2.3 - Kalilager III - 2.783 - 2.897 m

Based on E. logs interpretation. This potash zone shows :

2.783 - 2.790 m	Carnallite
2.790 - 2.807 m	Halite
2.807 - 2.820 m	Carnallite
2.820 - 2.889 m	Low grade carnallite and Halite
2.889 - 2.897 m	Kaïnite

7.2.4 - 2.897 - 3.446 m - Salt II (Junges steinsalz)

Clear massive halite with only two anhydrite stringers at 3.073 and 3.114 m.

7.2.5 - Hauptanhydrit - 3.446 - 3.474 m

White anhydrite with microcristalline light grey dolomite laminae.

7.2.6 - Platy dolomite 3.474 - 3.485 m

This horizon is present here,under its basinal faciès of dark-grey very fine shaly dense dolomite (Stinkschiefer) and grades downwards to.

7.2.7 - Grauersalzton 3.485 - 3.492 m

Black, fissile, dolomitic,sloughing shale.

7.3 - Cycle II - 3.499 - 3.829 m (th. 337 m).

7.3.1 - 3.492 - 3.500 m - Deckanhydrit

White massive anhydrite.

.../...

7.3.2 - 3.500 - 3.820 - Salt II

(Alteres steinsalz).

7.3.3 - 3.820 - 3.829 m - Basal anhydrit - Haupt dolomit -

In this rather thin interval, grey-whitish anhydrite is interbedded with brown, shaly, tight, dolomite (basinal facies).

7.4 - Cycle I - 3.829 - 3.834 m (th. 5 m).

Grey shaly anhydrite (Werra) encountered between 3.829 and 3.832 m is followed downwards by black grey, fissile, carbonaceous, very radioactive shale (Kupferschiefer) excellent marker on the gamma-rey curve.

8 - Rotliegend ? 3.834 - 3.996,5 (TD) - (th. 163 m) -

The Zechstein evaporites are underlain by red very hard conglomerates.

In these rocks pebbles of: quarztites, granite, gneiss, micaschists, acid volcanics (quartz porphyry, trachytes orthophyry, keratophyry), are binded together by a red ferrugineous, ankeritic and siliceous cement giving an extremely tight and hard formation.

No sorting is present, some pebbles are bigger than 10 cm, the detritic fragments are angular to subangular and some facets are present on the pebbles, these characters point towards a fluvio-glacial environment.

The formation is barren, and an absolute datation was impossible to be done on it, due to its extreme detrital nature. However, the importance of porphyry pebbles, the heavy mineral composition (garnet, apatite, oligist) indicates rather a Permian age than a Devonian one.

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III - PETROLEUM GEOLOGY -

1 - Shows -

1.1 - Gas shows

C1 shows were observed while drilling the tertiary section with readings increasing to a maximum 2 % at the base.

(N.B. The Geoservices mud logging unit was equipped with a GD 1 gas detector and a GAL 21 chromatograph).

The next shows appeared in the radioactive jurassic shale at 2.130 m C1 + C2 + C3 followed by C4 at 2.240, with a maximal value of 6 % in a trip gas.

Only a back ground of C1 ($\leq$ 1 %) was seen below,in Jurassic and Triassic sections.

Nitrogen, resulting probably from air reduction in the drilling mud was present in Tertiary and in a greater amount in Mesozoic.

Below 3.300 m in Zechstein evaporites drilled with an oil base mud, formation nitrogen occured,and was present in trip-gases down to TD. Thus nitrogen saturation of the Permian reservoirs, if any, is to be considered in the area.

1.2 - Other shows

No liquid or solid hydrocarbons shows were observed.

2 - Reservoirs -

2.1 - Tertiary

No reservoir development is present in this section, but a few,thin,shaly and water-bearing,sand stringers in the miocene circa 500 m.

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2.2 - Mesozoic

"Jurassic" sandstones (2.264 to 2.352) with a sandstone thickness of 68 m have medium to good porosities :

10 to 18 % : core analysis

15 to 20 % : log analysis

but poor permeabilities : generally a few millidarcies with an exceptional value of 90 md on 10 cm ,due to an extensive secondary calcareous cement.

Triassic sandstones : 87 m (Bunter) + 22 m (Bröckelschiefer) thick, possess the same porosities 15 to 20 % but may have higher permeabilities. All these sandstones are water-bearing.

2.3 - Zechstein and pre-Zechstein

A basinal tight and shaly facies prevails in the Zechstein section.

The conglomerates encountered below, are a very tight, quasi-unpenetrable formation.

A drop of resistivities observed between 3.967 and 3.979 m in a cleaner, but very tight bed, may be attributed to a salt water saturation (Ø = 3 %) but more likely to an increase in iron content.

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CONCLUSIONS

Exploratory well TOR investigated the sedimentary section down to the pre-zechstein but no economic accumulations of hydrocarbons were found.

The Jurassic and Triassic sand section was wet despite the proximity of an interesting source bed.

The cimmerian erosion had cut down the triassic structure to the sandstone level thus destroying any previous possible accumulation.

Afterwards, the region was situated in a deep basin position and probably lacking structural closure before oligocene times.

The potential permian objectives were tight, without reservoir developments as hoped.

The pre-zechstein conglomerates very close of a basement high may pass laterally, by sorting to a good sandstone reservoir, but nitrogen saturations are to be feared in the area.

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APPENDIX 1

CORING SUMMARY

1 - Conventional cores

Nr	Date	Interval	Rec.	Lithology
1	12.7	2.271 - 2.288 m = 17 m	100 %	Sandstone
2	10.8	3.881,5 - 3.884 = 2,5 m	100 %	Conglomerate

2 - Sidewall sampling

16 samples were recovered at the following depths :

3.860 - 3.487 - 3.476 - 2.895 - 2.815 - 2.730 - 2.720 - 2.635 - 2.585 - 2.485 - 2.397 - 2.534 - 2.350 - 2.260 - 2.245 - 2.313.

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APPENDIX 2

LOGGING SUMMARY

TOOLS	RUN	INTERVAL	DATE
SL BHC-GR	1	439 - 1205 (GR 140 - 1203)	24.6
	2	1150 - 1813	3.7
	3	1803 - 2897	20.7
	4	2840 - 3880,5	11.8
	5	3825 - 3993	23.8
IES - IL	1	439 - 1208	27.6
	2	1150 - 1813	3.7
	3	1803 - 2849	19.7
	4 (IL)	2800 - 3879	11.8
	5 (IL)	3825 - 3993	23.8
LL	1	1803 - 2897	21.7
MLL - ML	1	1803 - 2809	19.7
FDC	1	1150 - 1814	8.7
	2	1803 - 2900	20.7
	3	{ 3420 - 3800 { 3550 - 3994,5	24.8
SNP	1	1804 - 2900	21.7
CDM	1	1296 - 1805	4.7
	2	1803 - 2898,3	21.7
	3	{ 3420 - 3550 { 3800 - 3992	24.8

Lambert I X 03' 16' 15"E Zs -105 Y 58' 35' 47"N Zt +27 Origine des Profondeurs RT Appareil de Forage OCEAN VIKING Niveau d'Arret Rotliegend	Début de Sondage 15-6-68 Début du Forage 17-6-68 Fin du Forage 22-8-68 Fin de Sondage 30-8-68 Prof totale Sondeur 3997 Diagr 3996,5	**TOR 17-4-1 x**

OPERATEUR DU FORAGE **ELF NORGE**

PERMIS 17 _ 4 _ Lic : 007 TITULAIRE **PETRONORD**

OBJECTIFS
- Grès mésozoiques
- Dolomies zechstein
- Rotliegend

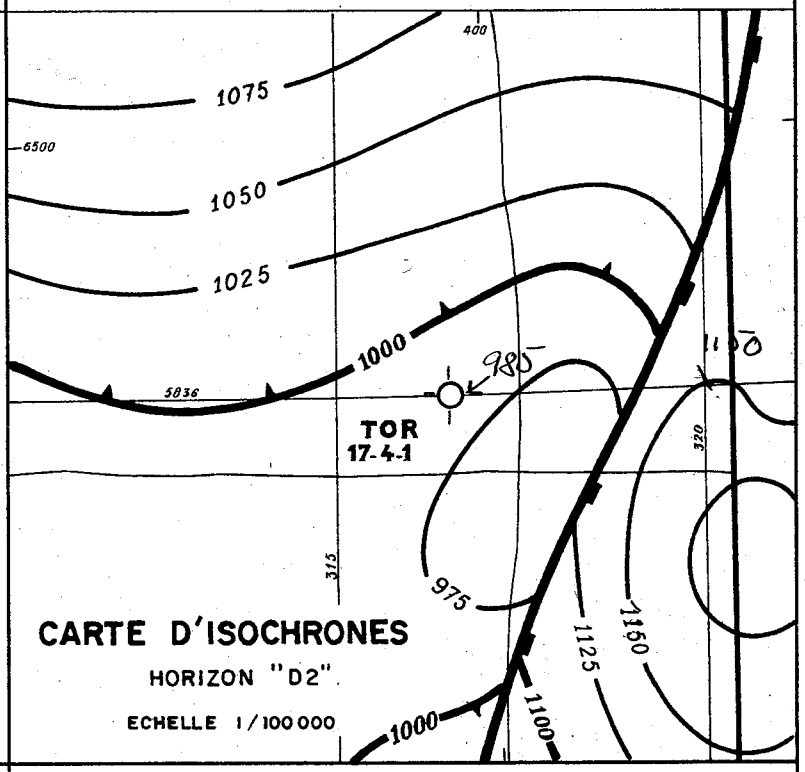
RESULTATS : Puits sec :
- Grès mésozoiques médiocres et aquifères
- Zechstein et Rotliegend compacts

D2 = lower part of the upper Cretaceous Chalk.

TUBAGES	CAROTTES		
20" à 439	1	2271 - 2288	100%
13"3,8 à 1803	2	3881,5 - 3884	100%

INDICES
- jusqu'à C_4 dans le Crétacé inf. argileux
- N_2 dans le Zechstein

IMPLANTATION



TESTS	DIAGRAPHIES	
	1	SLBHC GR 1
	1208	IES 1
	2	SLBHC GR 2
	1813	IES 2
		FDC 1
		CDM 1
	3	SLBHC GR 3
	2900	IES 3
		FDC 2
		ML-MLL 1
		SNP 1
		CDM 2
		LL 1
	4	SLBHC GR 4
	3884	IL 4
		Sismosondage
	5	SLBHC GR 5
	3997	FDC 3
		CDM 3
		IL 5
		CST

INTERPRETATION

Mise à jour le 25/11/68

Zs - 105 Fond sondeur 3997

Zt + 27 Fond diagraphie 3996,5

TOR 17-4-1 x

Profondeurs	Coupe Lithologique	Formations	Etages	Indices	Descriptions Remarques
					KB
					msl
100					fond mer (132)
200		?	PLEISTOCENE		
300					
400					445 retour de la circulation
500		Série à lignite	MIOCENE		Argile grise plastique sableuse - quelques passées de sables argileux
					544
600		A. à septaria - A. de Cilleborg	OLIGOCENE		Argile brune plastique glauconieuse carbonatée
700					
800					826
900		M. de Sovind	EOCENE Sup. OLIGOC.		Argile plastique grise à gris foncé à intercalations métriques de calcaires esquilleux brun-rouge.
					981
1000		A. de Roesnaes A de Mo	EOCENE Infér.		Argile feuilletée bariolée à intercalations de tufs volcaniques.
1100		M. de Karte-minde	PALEOC. DANIEN		1096 Argile gris beige carbonatée
					1161
1200		CS calc.	Maest.		Craie blanche tendre.

Profondeurs	Coupe Lithologique	Formations	Etages	Indices	Descriptions Remarques
1300		CRETACE Sup. Calcaire	CENOMANIEN à MAESTRICHTIEN		1250 Calcaire crayeux blanc-grisâtre pyriteux
					C. siliceux et glauconieux rose
					1369 Craie blanc-rosé tendre
1400					1390 Calcaire silicifié et glauconieux. C. gréseux et c. marneux, verts
					1444
1500		CRETACE Marneux	NEOCOMIEN à ALBIEN		Argile gris foncé à nombreuses intercalations et miches de calcaires sidéritiques beiges
1600					
1700					
1800					13" 3/8 17" 1/2 1812 12" 1/4
					Passage en boue saturée
1900					
					1974
2000					Alternance de calcaires marneux sidéritiques beige et de marnes gris-noir.
					2080
2100					Calcaire marneux bariolé
					2122
		Arg. R.A. C. argileux	NEOCOMIEN ?		Argile feuilletée gris-noir à débris charbonneux
2200					2217 C1 à C4
					2264
2300		K1	CRET. inf. à JURAS. sup.		Grès friables cycliques très carbonatés
					2352
2400		Bunter gréseux	TRIAS		Grès hétérométriques argileux et argiles sableuses, rouges.

Mise à jour le 25/11/62

Profondeurs	Coupe Lithologique	Formations	Etages	Indices	Descriptions Remarques
		Bunter gréseux	TRIAS		Grès hétérométriques F-6 et argiles rouges
2500				☼	C_1
					2531
		Bunter argileux			Argile rouge carbonatée
2600					2596
		Brockel Schiefer			Grès hétérométriques F-G et argiles rouges
					2665
		Z 4			Anhydrite Halite Anhydrite
2700					2716
					Argile rouge et grès fins à ciment salifère
					Halite
2800					Sels potassiques : carnallite et kainite
2900					(Passage en boue inverse)
					Halite
3000					
3100		Z 3	ZECHSTEIN		
3200					
3300				☼	N^2
3400					
					3446
					Anhydrite massive Dolomie argileuse beige
				N^2	3492
3500					Argile dolomitique gris-noir Anhydrite
		Z 2			
3600					Halite

Zs - 105 Fond sondeur 3997

Zt + 27 Fond diagraphie 3996,5

TOR 17-4-1 x

3700	Z 2	ZECHSTEIN		Halite
3800				3820 Anhydrite et argile 3829 dolomitique gris-noir 3834 Argile noire feuilletée
	K2	ROTLIEGEND		Conglomérat polygénique à galets (10 cm) de quartzites granite-r. volcaniques ciment argilo-siliceux ferrugineux rouge. Ensemble très dur et compact. 12"¼ 8"½
3900				
4000				3996,5 - P.F

Mise à jour le

PERFORMANCES DES OUTILS DE FORAGE ET CAROTTAGE

PUITS : TOR 1

N° Ordre	TYPE DE L'OUTIL		Ø	DE ..... A	POIDS (T)	ROTATION (t/mn.)	METRAGE (m)	TEMPS (H)	VITESSE (m/H)
1	Security	S3T	17½	132 à 157	6	80	25	4.00	6,25
2	Hughes	OSC3A	26	157 à 444	12	100	287	25,00	11,50
1R	Security	S3T	17½	444 à 881	18	150	437	18,00	24,30
3	"	S3T	"	881 à 1207	18	150	326	10,30	32,00
1R	"	"	"	1207 à 1316	18	100	109	3,00	31,00
4	SFAC	TS3	"	1316 à 1414	20	150	98	22.00	4,50
5	SFAC	TS3	"	Sur ferraille	/	/	/	/	/
1R	Security	S3T	"	1414 à 1427	20	80	13	3.00	3,50
6	Security	S6	12¼	1427 à 1691	20	120	264	23.30	11,20
7	"	S6	"	1691 à 1812	20	120	121	14.00	8,60
8	"	S3	"	1812 à 1967	15	130	155	20.30	7,40
9	"	S3	"	1967 à 2106	20	125	139	15 30	9,00
10	"	S3	"	2106 à 2235	20	125	129	19.30	6,00
11	"	S3	"	2235 à 2271	22	125	36	5.30	6,50
K1	Christensen	C22	8 7/16	2271 à 2288	8	80	17	4.30	3.80
12	Hugues	X1G	12¼	2288 à 2346	25	80	58	6.30	9,20
13	Security	M4N	"	2346 à 2395	25	80	108	8.10	6,10
14	SFAC	TS8	"	2395 à 2503	25	80	108	11°30	9.40
15	Security	S6	"	2503 à 2557	25	70	54	10.00	5;40
16	SFAC	TS8	"	2557 à 2604	25	85	47	12.30	3.80
17	Hugues	X1G	"	2604 à 2675	25	80	71	16.00	4.50
18	Security	M4N	"	2675 à 2749	25	80	74	12 00	6.20
19	Hugues	X1G	"	2749 à 2849	25	80	100	8.00	12.50
20	Security	S6	"	2849 à 2900	18	80	51	6.30	7,90
21	Security	S4T	"	2900 à 3158	20	150	258	16.00	16,10
22	Security	S4T	"	3158 à 3450	20	140	292	21.00	13,90
23	Security	M4N	"	3450 à 3471	25	150	21	19.30	1,70
24	Security	M4N	"	3471 à 3495	25	150	24	12.30	2.00
25	Security	M4N	"	3495 à 3549	30	80	54	10.00	5,40
26	Hugues	OWV	"	3549 à 3655	18	80	106	22.30	4,70
27	Hugues	OWV	"	3655 à 3665	18	80	10	1.00	10 00
28	Security	M4N	"	3665 à 3817	20	80	152	19.00	8 00
29	Security	M4L	"	3817 à 3830	25	80	13	17.00	0,70
30	Security	H7U	"	3830 à 3845	25	45	15	20.00	0,75
31	Security	H7U	"	3845 à 3861	30	45	16	21.00	0,75
32	Security	H7U	"	3861 à 3871	30	45	10	10.00	1.00
33	Security	H7U	"	3871 à 3881	30	80	10	11.30	0,85
K2	Christensen	C22	8 7/16	3881 à 3884	6	80	3	3.30	0,95
34	Security	H7U	12¼	3884 à 3884	30	80	/	11.00	/
35	Security	H7U	"	3884 à 3896	30	50	12	11.00	1,10
36	Security	H7U	"	3896 à 3907	30	50	11	10.30	1,05
37	Security	H7U	"	3907 à 3917	30	50	10	11.00	1,00
38	Security	M4LG	"	3917 à 3927	30	50	10	11.00	0,90
39	Security	H7UG	"	3927 à 3942	30	45	15	13.30	1.10
40	Security	H7UG	8½	3942 à 3947	10	40	5	6.00	0,90

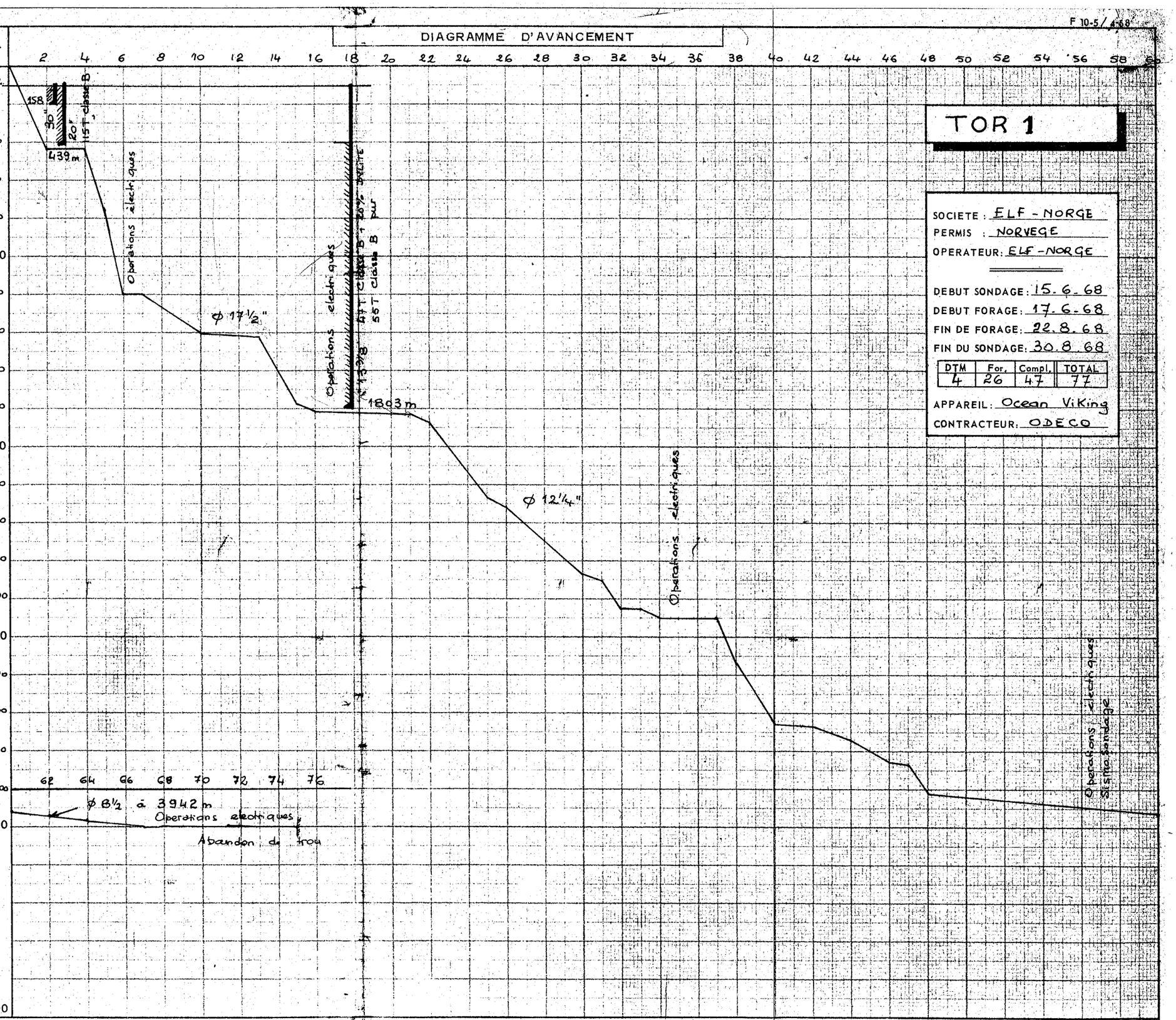
PERFORMANCES DES OUTILS DE FORAGE ET CAROTTAGE

PUITS : TOR 1

N° Ordre	TYPE DE L'OUTIL	Ø	DE ..... A	POIDS (T)	ROTATION (t/mn.)	METRAGE (m)	TEMPS (H)	VITESSE (m/H)
41	Security H7U	8 1/2"	3947 à 3956	10	40	9	10.00	0.90
42	" H7U	"	3956 à 3964	10	40	8	9.00	0,90
43	" H7U	"	3964 à 3969	10	40	5	6.30	0,85
44	" H7U	"	3969 à 3978	10	40	9	9.00	1,00
45	" H10	"	3978 à 3991	15	30	13	12.00	1,10
46	" H10	"	3991 à 3997	15	30	6	7,00	0,90

TOR 1

BOUE	OUTILS NUANCE	OUTILS DUREE (H)	GEOLOGIE
Circulation perdue à eau de mer	1 26" OSC3 J		Fond mer
			ARGILE GRISE
Boue eau de mer au LFC-LC	Φ 17½" 2 S3T J		
	2 TS3 J		
d = 1.35 V = 50 f = 8			CRAIE
			ARGILE GRISE
Boue au LFC. LC salée saturée	Φ 12¼" 4 S8 J		
	4 S3 J		SABLES
d = 1.40 V = 60 f = 8 à 10	3 X 16 J		ARGILE ET GRES ARGILEUX
	6 M4N J		
	2 TS8 J		
Boue à émulsion inverse	2 S4T J		SEL avec INTERCALATIONS ANHYDRITE
d = 1.50 V = 45 f = 2.5	2 OWV J		
	2 M4L J		
	9 H7U J		
	Φ 8½" ~~5 H7U~~ 2 H10		CONGLOMERAT FERRUGINEUX



SOCIETE : ELF - NORGE
PERMIS : NORVEGE
OPERATEUR : ELF - NORGE

DEBUT SONDAGE : 15. 6. 68
DEBUT FORAGE : 17. 6. 68
FIN DE FORAGE : 22. 8. 68
FIN DU SONDAGE : 30. 8. 68

DTM	For.	Compl.	TOTAL
4	26	47	77

APPAREIL : Ocean Viking
CONTRACTEUR : ODECO

PRINCIPALES CONSOMMATIONS SUR PUITS

PUITS : TOR 1

TUBAGES ET CIMENTATIONS

TUBES CASING CONSOMMES

Ø	DE ..... A	LONGUEUR	EPAISSEUR	GRADE	FILETAGE	TYPES ET TONNAGES DE CIMENTS UTILISES PAR TUBAGE
30"	129 à 158	29	1"	B	Squnch joints Vetco.	Ciment API Classe B 115 T (Tubages 30" et 20" descendus simultanement)
20"	129 à 218	89	133 #	J55	API - STC	
20"	218 à 425	207	94 #	J55	Joints Vetco	
20"	425 à 439	14	133 #	J55	"	
13 3/8	1803 à 1617	186	68 #	J55	Buttress	47 T API Classe B + 20 % DYLITE 55 T API Classe B
13 3/8	1617 à 1491	126	68 #	J55	API SC	
13 3/8	1491 à 521	971	68 #	J55	API LC	
13 3/8	521 à 131	390	68 #	N80	Buttress	

PRODUITS A BOUE

NOMS DES PRODUITS	QUANTITES
Bentonite	80 T
CMC	25 T
Lignosulfonate	20 T
Soude	10 T
FLOSAL	15 T
Sel	150 T
Baryte	600 T
Invermul	34 T
Duratone	18 T
Petrotone	14 T
	T
	T
	T
PERTES DE BOUE	M3
EAU	M3
HUILE OU GAS OIL	420 M3

AUTRES CIMENTATIONS

UTILISATION	TYPES OU CLASSES DES CIMENTS	TONNAGES
POUR COLMATAGE DE PERTES		
POUR AUTRES BOUCHONS	Abandon de puits Classe B	25 T
	" Classe A	20 T

TETE DE PUITS - SUSPENSION

DIMENSIONS - SERIES - TYPES DES ELEMENTS CONSTITUANT LA TETE DE PUITS

Tete de puits NATIONAL type "Sea King"

Ensemble 30" x 20" x 13 5/8"

Well head 13 5/8 Serie 10.000

FICHE STRATIGRAPHIQUE

Zone : OFFSHORE NORVEGE
Société : elf NORGE
Permis : 17.4
Concession : 007
Longitude : 03° 16' 15'' E
Latitude : 58° 35' 47'' N

Sondage : **TOR 1**
17 - 4 - 1
Appareil : OCEAN - VIKING

Commencé le : 15-6-1968
Terminé le : 30-8-1968

Z sol ou fond mer : pieds - 105 mètres
Z de référence des logs : Rt pieds + 27 mètres

ETAGE	FORMATION	Cotes Log Pieds Toit	Pieds Mur	Mètres Toit	Mètres Mur	EPAISSEUR	EPAISSEUR TOTALE	OBSERVATIONS
III IV	Pleistocène - Miocène			132	544	412		III + IV 132 - 1161
	A. de Cilleborg			544	618	74		
	A. à Septaria			618	826	208	964	
	M. de Sovind			826	981	155		
	A. de Roesnaes et Mo			981	1096	115		
	M. de Kerteminde			1096	1161	65	65	Danien de à
	DANIEN							Mur "Maestrichtien"
CRETACE	C. Supérieur calcaire			1161	1444	283		
	Crétacé marneux			1444	2122	678		
	Crétacé argileux			2122	2264	142	<1191	
	Crétacé sableux			2264				Ep : grès utiles 68 m médiocres
	"Wealdien"				?			
JURASSIQUE	Jurassique sup.				2352	88		
	Dogger						> 88	
	Lias							Mur Rhétien gréseux :
TRIAS	Trias argilo-évaporit.							Toit Sels D
								C
								(Röt) A
	Trias gréseux			2352	2531	179		Grès médiocres 87 m
							313	
	Trias argileux inf.			2531	2596	65		
	Zone oolithique							Absente
	Bröckelschiefer			2596	2665	69		Grès médiocres 22 m
PERMIEN	Zechstein total			2665	3834	1169		Ep. totale des dolomies
	Zechstein 4 (Aller)			2665	2716	51		Toit pegmatit anhydrit :
	Zechstein 3 (Leine)			2716	3492	776		
	Rotersalzton			2716	2735	19		
	Leinesteinsalz			2735	3446	711		Sels de potasse 2783 - 2897
	Hauptanhydrit			3446	3474	28		
	Plattendolomit			3474	3485	11		Faciès schistes fétides
	Grauersalzton			3485	3492	7		
	Zechstein 2 (Stassfurt)			3492	3829	337	1169	
	Deckanhydrit			3492	3500	8		
	Stassfurtsteinsalz			3500	3820	320		
	Basalanhydrit			3820	3822	2		
	Hauptdolomit			3822	3829	7		Faciès bassin
	Zechstein 1 (Werra)			3829	3834	5		
	Werraanhydrit			3829	3832	3		
	Zechsteinkalk							
	Kupferschiefer			3832	3834	2		
	Weissliegend							
	Rotliegend							
	R. argileux ou a. salif.							Conglomérat polygénique
	R. détritique			3834	> 3996,5	> 162,5		Epaiss. grès utiles : 0
PRIMAIRE PRE PERMIEN	Stephanien							
	Westphalien D							
	C							
	B							
	A							
	Namurien							
	Dinantien							
	Devonien							
SOCLE CRIST.								

Fond sondeur correspondant à 3997 m — Profondeur finale SPE : 3996,5 m — Mis à jour le : 31.11.1968

FICHE TECHNIQUE DE FIN DE PUITS

PUITS : TOR 1

PAYS :	OPERATEUR :	ENTREPRENEUR :	APPAREIL :	PROFONDEUR FINALE :
NORVEGE	ELF-NORGE	ODECO	Ocean-Viking	3997 m

GENERALITES

- Puits d'Exploration [X]
- Puits d'Extension [ ]
- Puits de Développement [ ]
- Puits de Service (Injection ...) [ ]
  - Puits à terre [ ]
  - Puits en off-shore (Profondeur d'eau 105 m) [X]
- Producteur d'huile [ ]
- Producteur de Gaz [ ]
- Indices d'huile [ ]
- Indices de Gaz [ ]
- Sec [X]
  - Mis en production [ ]
  - Tubé en vue complétion [ ]
  - Abandonné [X]

DECOUVERTS		TUBAGE DES DECOUVERTS		
Ø	JUSQU'A	Ø	SABOT	CIMENTE DE ..... A .....
36"	158 m	30"	158 m	Totalité
26"	444 m	20"	439 m	Totalité
17½	1812 m	13⅜	1803 m	Sabot à 450 m
12¼	3942 m			
8½	3997 m			

Les cotes seront indiquées par rapport à la table de rotation

METRAGES REALISES

Ø SUCC. du TROU	METR. REAL. par DIAMETRE	FORAGE TOTAL Ø	FORAGE TOTAL Métrage	CAROTTAGE Ø	CAROTTAGE Métrage	METRAGE ELARGI	TURBO FORAGE	FORAGE DIRIGE	FORAGE A L'AIR	METRAGE ABANDONNE
36"	26	36"	26							
26"	286	26"	286							
17½	1368	17½"	1368							
12¼	2130	12¼	2107	8½	23	23				
8½	55	8½	55							
TOTAL	3865		3842		23					

TESTS

NOMBRE DE TESTS	REALISES	" dont " MANQUES
EN OPEN HOLE	0	
EN CASING	0	
TOTAL		

CAUSES D'ECHEC	Nombre
FUITE AU PACKER	
COLMATAGE	
NON OUVERTURE	

INSTRUMENTATIONS

DUREE ↓ / CAUSES →	Chute d'objet dans le puits	Coincement garniture	Rupture garniture	Incident sur outil	Incident sur carottier	Incident tubage	Incident diagraphies	TOTAL
Moins de 24 h.								
De 1 à 5 jours	1							
Plus de 5 jours								
Non résolues								
NOMBRE TOTAL	1							1

REPARTITION DES TEMPS

17 POSTES DICA	HEURES	%
1 Montage-Transfert	83	4,5
2 Forage	612	33,55
3 Carottage	8	0,05
4 Man. Forage	346.30	18,90
5 Man. Carottage	24 30	1,30
6 Reforage	97	5,30
7 Elargissage	/	/
8 Test	/	/
9 Diagrap. Mesures div.	217.30	11,70
10 Mise en production	/	/
11 Tubage-Cimentation	178	9,80
12 Circ. cond. boue	70	3,80
13 Instrumentation	52	2,90
14 Fermeture puits	58 30	3,20
15 Réparat. entretien	35	1,90
16 Attentes diverses	56	3,10
17 Congés	/	/
TOTAL	1838 H	100 %
Utilisation appareil	2,501 mois/app	

MOYENS MIS EN OEUVRE - ETAT FINAL DU PUITS

PUITS : TOR 1

APPAREIL

TREUIL : CONTINENTAL EMSCO A 1500

CAPACITE DU DERRICK OU MAT : 1.400.000 #

PUISSANCE TOTALE INSTALLEE : 5400 CV

PUISSANCE HYDRAULIQUE DISPONIBLE : 2800 CV

HAUTEUR TABLE AU-DESSUS DU SOL OU DU FOND DE MER : 132m

POMPES

NB.	MARQUE	TYPE
2	EMSCO	D1350
1	GARDNER-DENVER	7 x 16"

GARNITURES

DE ..... A	TIGES DE FORAGE (Ø, grade, épaisseur, "TJ".....)	MASSE - TIGES (Ø, longueur maxi.....)
132 à 3997	Tiges 5" XH TJ 4 1/2 IF Grade E et P 105	DC 7 3/4 OD - 220 m " 6 1/2 OD 75 m

OBTURATEURS

DE ..... A	MARQUE - TYPE - SERIE
129 à 444 m	HYDRIL GK 20" Serie 2000
444 à 3997 m	3 Obturateurs SHAFFER type U 13 5/8 serie 10.000 1 HYDRIL GK 13 5/8 serie 5000

MATERIEL SPECIAL

(TURBINE, SHOCKSUB, INSTALLATION D'AIR .....)

CONTRAT

(TYPES DE CONTRAT)

- Régie -

OPERATIONS DE FIN DE PUITS

(DONNER UN RESUME DES OPERATIONS DE COMPLETION , D'ESSAIS OU D'ABANDON :
Tubing, bouchons, récupération tubages ou tête de puits, les cotes importantes .....)

Puits sec - Casing 13 3/8" coupé à 50 m sous le fond de mer

Casings 30" et 20" coupé à 3 m sous le fond de mer

Tête de puits récuperée en totalité réutilisable

Bouchons de ciment A 2300 m 25 T Classe B

A 1850 m 16 T Classe A

En surface 4 T Classe A

FLUIDE LAISSE EN PLACE DANS LE PUITS Boue à émulsion inverse INVERMUL

CONA
FILE No.

TOR.1

孔口標高	37.7
孔底標高	37.7
孔深	1.0
傾斜	90°
方位	
掘進方向	鉛直
孔径	φ66mm
掘進機	
掘進者	
掘進日	2004.10.12
完了日	2004.10.12

BORING