esco
european salt company
Frisia Zout B.V.

Frisia Zout B.V., Lange Lijnbaan 15, 8861 NW Harlingen, Nederland

Staatstoezicht op de Mijnen
Inspecteur-generaal der Mijnen
T.a.v. de
Henri Faasdreef 312
2492 JP 's-Gravenhage

Harlingen, 2 september 2008

Betreft: Eindrapport BAS-4 End of Well Report

Geachte ,

Hierbij ontvangt u het eindrapport betreffende BAS-4 boring die in juni 2004 is uitgevoerd.

Hoogachtend,

Frisia Zout B.V.

Hoofd Mijnbouw

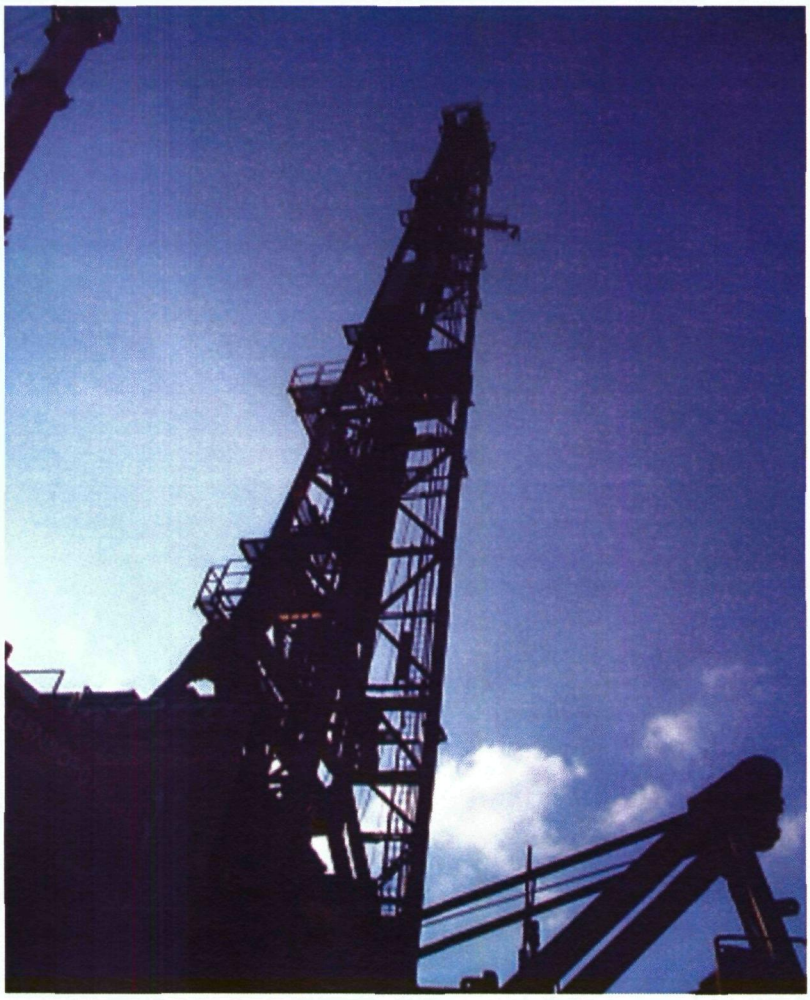
Cc:

esco
european salt company
Frisia Zout B.V.

END of WELL REPORT

BAS 4

NOTE: **DATE: Aug 2004**



Summary:

Well Details Barradeel # 4

- Rigmove started 23/02/2004 @ 07:00 hrs
- Operations started 02/03/2003 @ 02:00 hrs
- Released 16/04/2004 @ 08:00 hrs

Time Details	Total days	Operating Days
Planned (Original AFE)	54.00	42.00
Actual	48,00	45,25 days

Cost Details (€)	Total Expenditure
Planned (Original AFE)	€ 4,800,000
Actual (Rig Estimate)	€ 5,336,000

Execution Summary

Tophole was drilled previously as per program by Grondboorbedrijf Haitjema B.V.
The 22"hole was drilled without delay to top Chalk. Unfortunately, a 9 ½" drill collar washed through on the top connection area and had to be fished which caused the instable lower North Sea clay's to be exposed to WBM with bad hole conditions as a result. The 18 5/8" casing stood up in the top section of the hole due to bridging. At a second attempt, pipe ran differentially stuck but could be made free. It was run to bottom and cemented as per program.
The 16" section showed some vibration in the Ommelanden Clay due to chert and bad performance of a PDC bit. No hole cleaning problems were seen in this vertical hole at (maximum) pump-rate of some 4500 LPM. Casing (13 3/8"- 14") was run and cemented with no problem. An 18 m spot core was taken in the ZEZ2 Halite close below the 14"shoe. Core head ran stuck on pulling the core free from bottom what accounted for some minor delay. The cavern was subsequently drilled and opened, leaching strings were run and Xmas tree was installed as per program.

HSE performance

- Four safety related incidents were reported, only one of these involving a minor injury, that could be treated on site. There were no LTI's.
- Two OBM spills occurred, both contained. No liquid got beyond the location boundaries.
- Several complaints concerning noise hindrance were received from residents living nearby.

Contractors:

• Well design:	BECi, Vries, NL
• Top hole drilling:	Grondboorbedrijf Haitjema b.v. Dedemsvaart, NL
• Drilling contractor:	KCA DEUTAG Drilling GmbH Bad Bentheim , BRD
• Directional Drilling	Schlumberger Drilling and Measurements Den Haag, NL
• Drilling data system:	Bohr Instrument services, Veenoord NL
• Mud company:	M-I Drilling Fluids B.V., Heerhugowaard, NL
• Mud logging:	Petrolog, Amsterdam NL
• Solids Removal:	Task Environmental Services, Heerhugowaard, NL
• Cementing:	Schlumberger Offshore Services Ltd. Coevorden, NL
• Casing running:	Weatherford Oil Tool B.V., Den Helder, NL
• Logging:	Schlumberger Oilfield Services, IJmuiden, NL
• Cranes	L. Kielstra Kraanverhuur BV, Leeuwarden, NL
• Transport:	L. Kielstra BV, Leeuwarden, NL
• Tanker Transport:	A. Lootsma B.V. Transportbedrijf Bolsward, NL Fokke Noppert, Joure, NL Reym, Veendam, NL
• Cutting transport	Fokke Noppert , Joure, NL
• Cleaning	Reym, Veendam, NL
• Casing cutting	BUKOM Service B.V. Heerhugowaard
• General assistance	Van der Zee Services, Lutjelollum, NL

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1 Conclusions and Recommendations

1.1 Major Highlights and Lowlights

Highlights

+ Smooth and undisturbed drilling of top hole without clay balls / bit-balling and overload of cuttings in annular space by drilling at low WOB and limiting ROP to some 15 to 20 m/Hr.
+ The 18 5/8" casing was run to bottom in spite of hole problems at second attempt.
+ OBM easy to keep within specifications. Sufficient hole cleaning in 16" hole.
+ Bottom part of intermediate string, 14" 106 lbs/ft VM-80 VAM TOP casing was successfully run to setting depth with no problem at all.

Lowlights

– Communications by telephone / Fax / E mail & Internet not readily available.
– Information regarding third party service-contracts incomplete.
– Insufficient off set data of nearby wells available on site.
– A few minor flaws in the drilling contract that obviously had been overlooked during the negotiations, came to light with the project ongoing, viz. disagreeable items concerning guaranteed flowrate and shaker screens.
– Wash out/through of 9 ½" drill collar resulting in a fishing job.
– Instability of lower North Sea Clays, resulting from delay caused by wash through of 9 ½" drill collar.
– Dissatisfying bit performance in 16" intermediate hole section.
– Disappointing progress in opening 12 ¼" hole to 17 ½".
– Some delay and irritation caused by late procurement of pipe.

1.2 Key Learning Points and Recommendations

- The KCA-DEUTAG T 46 rig is to be considered for future drilling.
- A proper communications plan should be available before start of operations.
- String dynamics should be verified for top hole drilling and motor drilling should be considered to eliminate drill collar failures
- Shaker screens should not be included in the rig-day rate without further conditions. Either state in the contract that only new screens are to be used or do not have screens included in the day rate.
- Apart from number of mud-pumps in the equipment list, the correct figure of required minimum flow rate needs to be mentioned and guaranteed in the contract.
- Selection of a combination of Fresh Water Bentonite mud for the Upper North Sea and salt saturated brine for the Middle and Lower North Sea proved to be a good choice.
- Lower North Sea Clays, the Landen and, to a lesser extend, the Ieper Clay as well, have again proven to be stable for a very short period of time only and are to be cased off soon after drilling them.
- Proper hole cleaning in a vertical 16" hole can be achieved with OBM at a flow rate of ~4500 lpm which presents a contrast with experiences in the comparable, high angle (67°) 14 ¾" // 16" section of well BAS#3 drilled one year before.
- After top-hole drilling only one mud engineer is required on site. For intermediate and production hole one engineer should be under contract with a possibility to call in assistance whenever needed.
- Pay zone (ZEZ2H) should be drilled with a steerable assembly by preference.
- Hole opening form bottom up, as practiced for BAS 3, should be considered for future wells.
- Thoroughly check term of delivery of material and attune the procurement process to it.
- Concurrent operations (e.g. building the pump-house along with drilling the well) do not contribute to safety performance and should be avoided if at least possible.
- Security cabin and barrier at location entrance to be present as from the first day of operation.

2 Health, Safety and Environment Overview

2.1 Health

Only one incident was reported viz. one of a sub-contractor's employee's injured his wrist while handling a drift for 13 3/8" casing. The person involved was treated first aid on location and continued work, performing light duties only.

2.2 Safety

An noticeable incident took place when the 13 3/8" casing was cut to remove the wear bushing from the HARTMANN wellhead and install the next casing head housing after hanging off the pipe in a slip&seal assembly. The inside of the casing was thoroughly cleaned from OBM by flushing with water. Nevertheless, as soon as the welder cut through the pipe with the torch, fluid from inside came out and caught fire instantly. The situation was controlled immediately by a crew member standing by with a fire extinguisher. No further casualty occurred. The casing was then cut by means of a grinding machine.

A chicksan elbow broke away from the swivel when the 11 ¾" test shoe was sheared from the casing at a pressure of 292 Bar. The sudden relief of pressurized fluid into the closed system of the cavern, created a shock-wave that bounced back, up into the casing, creating a pressure shock at the narrowing connection between the 11 ¾" circulating head and the 2" chicksan that were at right angles to one another. Obviously, for a very short period of time, the 700 Bar pressure rating of the elbow was exceeded what made the elbow blast apart, with great noise and hubbub from the fluid rushing out.

A 7" casing pup-joint of 6.55 m long was lifted on the PULD machine and came down right away on the other side. The kickers are 5.20 m apart but there is 6.20 m in between the stoppers. The pup joint was not exactly centered on the machine, so one end of it missed the end-stop. The joint went over then edge on the other side of the machine and fell to the ground.

2.3 Environment

Two spills were reported; both contained ones that did not extend to beyond location boundaries.
A 9 m^3 OBM spill occurred during drilling when a Bauer coupling on the hose between the charge pump and the mud-cooler gave way. The coupling appeared not to have been sealed. The OBM was transferred back into the active system.
When fluid was discharged from the active tank into a REYM truck, one switched on the pump when the valve on the truck was still closed. Some 900 litres of mud flowed onto the location as a consequence of a burst of the discharge hose. The area was cleaned.

Several complaints concerning sound embarrassment and noise hindrance of traffic driving past were received from residents living nearby.
In future drilling, one should see to it that the distance between location and surrounding residences is as large as possible.
It was already planned to not allow any all transportation between 23:00 and 07:00 hours, except for emergencies. In addition to that all transportation between 19:00 and 23:00 hours too was stopped..
Appropriate measures were taken to slow down the traffic to and from the location. Notice was given to all truck drivers to drive past nearby housing at reduced speed.
A sound monitoring system was installed that continuously measured the sound production of the rig and monitored a theoretical, calculated value of the volume at a distance of 300 m from the rig.
Sound producing activities were avoided in so far as possible during night hours.

3 Well Design (Planned & Actual)

3.1 Hole Sections

Planned Hole Size	Actual Hole Size	Planned hole Depth (AHORT)	Actual hole Depth (AHORT)	Comments
22"	22"	1130	1144	
16"	16"	2460	2440	
12 ¼"	12 ¼"	2905	2819	Opened to 17 ½"

3.2 Casing/Liners

Planned Casing Size	Actual Casing Size	Planned Casing/Liner Depth	Actual Casing/Liner Depth	Planned TOC	Actual TOC	Comments
28"	28"	15	15	N.A.	N.A.	Driven
24"	24"	226	228	N.A.	212	Spot-cemented shoe
18 5/8"	18 5/8"	0 – 1115	0 – 1135,3	Surface	Surface	Returns seen on surface
13 3/8"/ 14"	13 3/8" / 14"	0 – 2050 2050 - 2425	0 – 1989,65 1989,7 – 2419,5	935	-	TOC f/ ΔP ~925 m. No clear ind. on CBL.
11 ¾" 7"	11 ¾" 7"	0 – 2770 0 -2850	0 – 2739,14 0 – 2789,31	N.A. N.A.		

3.3 Well Profile

Hole Size	Planned Deviation	Actual Deviation	Comments
22"	Straight hole.	Angle below 1°. Max angle 0,82° @ 590 m.	Successfully drilled straight hole at low WOB with a rotary-pendulum assy with no MWD.
16"	Straight hole.	Max angle 1,38° @ 2427 m.	Drilled straight hole to bottom chalk with non-steerable assy. Ran MM-MWD-GR from top Texel chalk.
12 ¼"	Straight hole.	Max angle 2,30° @ 2484 m at azimuth of ~120°.	Corrected angle once because of formation dip. Tendency to build angle again, now at ~70° azimuth, in bottom part of hole.

3.4 Formation Tops

Formation	Prognosed Depth M TV NAP	Actual Depth Cutt/MWD GR M TV NAP	Actual Depth (Wireline GR) M TV NAP	Uncertainty	
				Prognosed M TV	Actual M TV
Upper North Sea (NU)	0	0		0	
Breda Sand (NUBAS)	575	563		10	- 12
Boom clay (NMRF)	603	585		-	- 18
Asse Clay (NLFFB)	618	645		10	27
Brussels Sand (NLFFS)	645	725		10	80
Ieper Clay (NLFFY)	818	833		10	15
Dongen tuffite (NLFFT)	1051	1075		10	24
Landen claystone (NLLF)	1063	1087		10	24
Ommelanden Chalk (CKGR)	1105	1127		10	22
Texel Chalk (CKTX)	1396	1385		25	- 11
Lower Holland marl (KNGLL)	1459	1561		25	102
Vlieland Shale (KNNC)	1533	1625		25	92
Vlieland SST (KNNS)	1854	1896		25	42
Coevorden (SKCF)	1901	1920		25	19
Lower Buntsandstein (RBSH)	1987	2005		25	18
Zerchstein 4 (ZEZ4)	2090	2066		50	- 24
Zechstein 3 Halite (ZEZ3H)	2113	2086		50	- 27
Zechstein 3 AnhydriteZEZ3A	2285	2282		70	- 3
Zechstein 3 Grey salt clay (ZEZ3G)	2355	2337		70	- 18
Zechstein 2 Roof Anhydrite (ZEZ2T)	2360	2342		70	- 18
Zechstein 2 Carnallite	2365	2345		70	- 20
Zechstein 2 Halite (ZEZ2H)	2400	2389		70	- 11
Zechstein 2 Anhydrite (ZEZ2A)	2879	2805		70	- 74

4 Operations Review

- Depth reference is Along Hole Original Rotary Table (AHORT), unless indicated differently.
- More detailed technical information on the well can be found in the Daily Drilling Reports, Daily Mud Reports and in the Composite Log.

4.1 26"hole / 24"casing

Started : 19/01/2004 07:00 hrs
Finished : 26/01/2004 17:00 hrs
Planned : 5.0 days
Actual : 5.5 days
NPT : 0 hrs

Planned Programme:

To drill tophole in one go to the first competent clay layer, which could be at ~60 mtr but more likely will turn out to be the Oosterhout Clay at 216 mtr (expected) and set the 24" pipe.
Equipment will be a water well drilling installation. A reamer like bit on DP will make hole. Mud circulates into the open hole annulus and out of the casing/drill pipe annulus. Cuttings will be removed by injecting air at about 100 m out of slots in the DP joints at that depth and thus air lifting the fluid to surface.
Pre-welded sections of some 30 meters of 24" pipe will be lowered and welded together. Pipe will be cemented.

Operations Review/Summary:

Hardly any competent clay was seen at ~60 m, so hole was successfully washed out to 212 m where top of Oosterhout was encountered. TD was called at 218 m. On one occasion, some sandy slurry influxed into the well bore due to mudweight falling below specific gravity of seawater (~1.03 SG), which accounted for some 24 hours of delay. Pipe was run in and fixed by spotting cement with no problem. Annulus was filled up by dumping grout, gravel and clay as programmed. The top 25 m of pipe was fixed and fastened using concrete.

Highlights

+ Good performance of custom made expendable bit / reamer.
+ Good cutting removal by air lifting the fluid in the 24" casing.

Lowlights

– Sandy slurry entered the well bore due to low hydrostatic head.

Learning Points and Recommendations

- Mud weight must be no less than 1.03 SG as specific gravity of groundwater so close to the sea, equals that of seawater.

4.2 Rig move

Started : 23/02/2004 08:00 hrs
Finished : 02/03/2003 02:00 hrs
Planned : 9.0 days
Actual : 8,083 days
NPT : 0 hrs

Planned Programme:

To move the T-46 drilling rig safely from the (Grijpskerk) GRK-21, install and rig it up on the Bethanië location to drill the BAS#4 development well.

Operations Review/Summary:

Activities on NAM well GRK-21 were finished 9 days ahead of schedule. As FRISIA' s not ready yet to receive the rig, the equipment was dismantled and stored at Grijpskerk after rig-release on January 24, 2004. Moving and installing the rig started February 23 and went as planned with no HSE incidences.
Preparation for installing communications (telephone-fax-e mail-internet) proved to be lousy which led to a good deal of inconvenience and irritation and necessitated intensive use of mobile phones.

Highlights

+ Considering dismantling was already done, the move from Grijpskerk to Tzummarum was estimated to take 9 days instead of 12 as usual for a full move. The actual duration of the move is so considered good performance.

Lowlights

– Laborious communication due to lack of a fax-line and shortage of telephone and e mail connections.

Learning Points and Recommendations

• A proper communications plan should be available before start of operations.

4.3 22" Hole

Started : 02/03/2004 @ 02:00 hrs
Finished : 09/03/2004 @ 20:00 hrs
Planned : 5.5 days
Actual : 7.8 days
NPT : 66.50 hrs

Planned Programme:

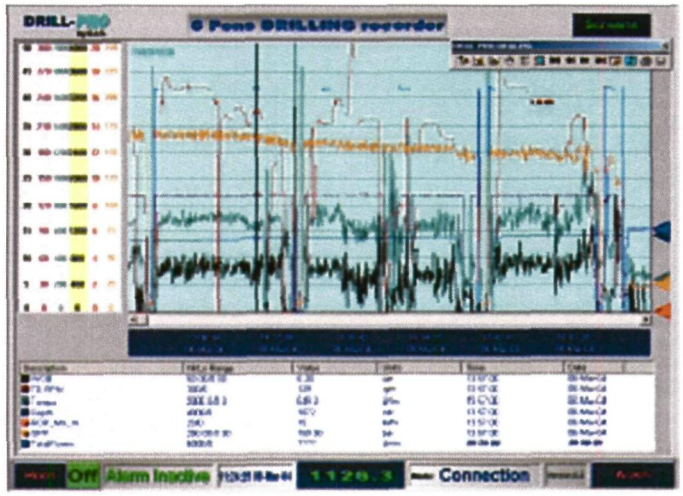
To drill 22" top hole through the North Sea (NS) with TD at approximately 1130 mRT, +/- 10 to 15 m TV into the Ommelanden Chalk formation (CKGR), to case off the reactive NS shales. The well is intended to be vertical with an angle that will not exceed 5°. A fresh water Bentonite mud will be used to the first reactive clays at an expected depth of 550 m approximately. It will be kept in spec by dumping and diluting. Mud will then slowly be changed into a salt saturated system by adding salt saturated brine.

Operations Review/Summary:

Section : 218 – 1144 m
Mud : Fresh water Bentonite, 1.06 – 1.10 sg.
: Viscous Salt (NaCl) saturated brine, 1.25 – 1.46 sg.
Deviation : Max inclination = 0.82° @ 589.61 mAH with an azimuth of 198,09°.

Well was drilled at low WOB and modest ROP by a 40 ft pendulum rotary assembly which proved to be a good choice. Hole appeared to be vertical indeed afterwards. Drilling fluid was fresh water based mud in the top part and salt saturated brine in the lower North Sea.

Drilling the lower North Sea (Landen) clay, SPP started to drop slowly and gradually, which wasn't noticed right away. Unfortunately, a remark from the driller who came on shift at 18:00 hours of the day and who pointed out that SPP was some 8 Bars lower than then day before in spite of the fact that well depth had increased by some 150 m which counted for an increase of SPP by some 4 or 5 Bars, was not paid the right attention to. As absolute value of circulating pressure was within the limits set by the hydraulics calculation, drilling was continued until at 1126 m pressure surges were seen, SPP suddenly dropped two times by 10 Bars with bit on bottom and ROP went to zero. At pick – up, SPP again appeared to have lost another ~20 Bars so string was pulled. Top ten centimeters of the fully washed through connection of the lowest 9 ½"drill collar was brought to surface, still firmly made up around the pin of the pony drill collar above with 1 or 2 cm of this pin sticking out. Left in hole was the remainder of the collar and the bit with bitsub.



Fish was recovered by a basket grapple in one run. History and test-certificates of subject drill collar were checked and found to be in order.
Equipment was used in Spain and checked by an government recognized testing facility. Further investigation to shed light on the backgrounds of this equipment failure will be carried out.

On running in again, resistance was encountered in the lower part of the hole with a fair amount of caving from the Ieper and Landen Clay coming over the shakers. Mud weight was increased to 1,42 SG. Bottom of hole appeared to be top Chalk so the 9 ½" drill collar obviously broke away from the washed out connection under torque and stick/slip at the formation change. Drilling continued while increasing mud weight to 1.46 SG, until TD was called at 1144 m. A wiper trip indicated good hole, coming out. Running in resistance was encountered and removed, at the bottom four meters.

Highlights

+ Selection of drilling parameters viz. low WOB and modest ROP.
+ No clay balls and no cutting overload and pack off's in annulus, indicating sufficient hole cleaning.

Lowlights

– 9 ½" drill collar wash-through and fish as result.
– Instability of Landen and Ieper clay, due to extended exposure to water based salt saturated mud , caused by fishing job, resulting from above drill collar wash through.
– Communication still not up to the mark.

Learning Points and Recommendations

- Variations of SPP, pressure drop in particular, that cannot be explained by (variations of) drilling parameters and clearly do not find a reason in the system of surface lines, are reason to pull pipe.
- Remarks of driller and crew are to be rated at true value.
- Viscous salt (NaCl) saturated brine for drilling fluid proved top be a reasonably good and economic choice, but again it is clear that both Ieper and Landen clay, the Landen in particular, maintain stability for a short period of time only in this mud system.
- String dynamics should be verified for top hole drilling and motor drilling should be considered to eliminate drill collar failures.

4.4 18 5/8" Casing

Started : 09/03/2004 @ 20:00 hrs
Finished : 17/03/2004 @ 01:00 hrs
Planned : 4.0 days
Actual : 7.2 days
NPT : 66.75 hrs

Planned Programme:

The objective is to set the 18 5/8" casing across the North Sea and 5 to 10 mTV into the Ommelanden Chalk formations. The shoe will be set at an estimated 1125 mAH RT. The objectives are:

1. Case off the North Sea group including unstable clays in the lower part.
2. Provide support for the BOP for the next section.
3. Provide sufficient shoe strength to drill the next section, based upon the maximum anticipated ECD in the next section.

Required TOC is at surface: stab-in technique will be used to ensure cement to surface with a minimum waste.

Operations Summary:

Mud weight was increased to 1.5 SG. Backreamed out of hole with no resistance, but circulated out massive amounts of solids.
Casing met with resistance and stood up solid soon after entering open hole. Pipe was pulled and a bit run removed resistance on that spot. A consequent full trip to bottom removed resistance in two places and went to hole TD, heavily reaming from top Chalk to bottom. On second attempt to run casing, the string became differentially stuck in the Upper North Sea sands. Pipe was freed by reducing hydrostatic head by 16,5 Bar (Equivalent MW ~1,10 SG from casing shoe upwards). Mud was re-conditioned to a weight of 1,39 SG and casing was run, maintaining mud weight at 1.4 SG, to planned setting depth without further serious problems, washing and working through tight spots as required.
Pipe was subsequently cemented and hung off as per program. Wellhead was installed and tested as per Hartmann standard procedures and BOP's were nippled up.

Highlights

+ In spite of severe hole problems, casing was successfully run to setting depth and cemented, as planned.
+ Lower part of the hole, the Landen clay in particular remained stable and did not collapse as a consequence of the reduced hydrostatic head, which was applied to the hole to cure differentially stuck-pipe.

Lowlights

– Obvious bridging below the shoe of the surface pipe, causing the casing to stand up solid at 295 m.
– Casing, running differentially stuck due to high mud weight (1,5 SG) which was compelled however by hole conditions.
– Inconvenient communication. Though fax line installed still low on E mail connections.

Learning Points and Recommendations

- Usual wash out right below a shoe needs to be cleaned thoroughly as it invites cuttings and cavings to deposit themselves when pipe is pulled / back reamed out, thus creating an increased danger of hole bridging by packets of solids sinking / sliding down into the hole below the washed-out area.
- Mud weight in case of a hole caving in, is a trade-of between the risk of getting stuck and the risk of creating continued caving.
- Even an instable hole is able to take the fright of a reduction of hydrostatic head for a short period of time. Obviously, it has been a good decision to quickly restore hydrostatic head by weighing up the mud to 1.39 SG after curing the differentially stuck-pipe.
- In a vertical hole it may pay to try to get a casing down in spite of severe wash-outs and the resulting down hole caverns, where a casing very well may stand up in case of a deviated hole.

4.5 16" Hole

Started : 17/03/2004 @ 01:00 hrs
Finished : 29/03/2004 @ 06:45 hrs
Planned : 7.00 days
Actual : 12.24 days
NPT : 39.75 hrs

Planned Program:

To drill the 16" section vertically, to section TD, some 50 m below the ZEZ2 squeezing salts. The Ommelanden Chalk will be drilled with a rock bit because of the presence of chert. Salt saturated WBM will be changed out for OBM at Top Texel Chalk. A PDC bit with motor and MWD-GR is supposed to drill to section TD in one go. It will penetrate the Texel Chalk, the Rijnland, the Germanic Triassic and the top of the Zechstein. The GR will clearly indicate the squeezing Z2 salts, thus enabling an accurate determination of casing setting depth.

Operations Review/Summary:

Section : 1144 – 2440 m
Mud : WBM (Viscous Salt (NaCl) saturated Brine), 1.30 SG
: OBM (MI Drilling Fluids - Versaclean), 1.32 – 1.50 SG
Deviation : Max inclination = 1.38° @ 2427.22 mAH with an azimuth of 103.63°.

Top of the 16 "section was drilled with a 30 Ft pendulum rotary assembly. Chert layers in the Ommelanden chalk made the bit jump and rattle, resulting in rough drilling, severe string vibration, reduced ROP's and an relatively high sound production, unacceptable to the environment, especially at night. BHA was changed out for a motor assembly and the opportunity was used to change out the WBM for Versaclean OBM. Only 40 m deeper down the formation became chert free and BHA was changed out for a steerable assembly with a PDC bit. Drilling continued as per program, however at ROP's lower than expected, especially from top Vlieland onwards. In the lower part of the Buntsandstein the bit was pulled because of low and decreasing ROP. The outer rows of the bit were most heavily damaged; the body was under gauge by 32/16 with the hard facing totally gone. The sleeve stabilizer on the motor at approx. 1 mtr above the bit was worn to about 1 inch under gauge for half of its length. Analysis of ROP and drilling parameters, indicated high and varying torque in the Holland Marl which may have led to heavy wear and tear suffered by the bit, resulting in a relatively low ROP's after that. A lithological explanation for high torque and excessive wear could not be derived from cutting description though.
The back-up bit was run and drilled to TD at 2440 m. Unfortunately the signal from the MWD-GR suddenly was lost well above the ZEZ2 salts, so section TD had to be determined on the basis of minimum directions, going by comparison with off set wells, extrapolation of GR data and (small) variations of drilling parameters, ROP in particular, only.

Highlights

+ No hole-problems experienced.
+ Hole cleaning proved to be satisfying.
+ TD called at the right depth on the basis of minimum directions only.

Lowlights

– String vibration and rough drilling of rotary assembly in top of Chalk due to chert layers.
– Bad performance and failure of DS40H PDC bit to drill from top Texel Chalk to section TD.
– Failure of MWD-GR signal.

Learning Points and Recommendations

- It should be considered to drill the Ommelanden Chalk with a motor to reduce string vibration and sound production. In case a rotary assembly is used, at least a shock sub should be inserted in the BHA.
-
-

- Choice of the Reed Hycalog DS 40 bit for this section may be questioned. Both DSV / CO-REP and Directional Driller on site should be consulted in the matter of bit selection. Final decision about bit to be run must be made on the spot, on site.
- Schedule of mud weight, viz. 1,32 SG in Chalk, 1.4 SG from top Vlieland to maintain stability of the Vlieland shale and slowly increasing to 1.5 SG at top Lower Buntsandstein to control squeezing Zechstein-3 salt clays and Zechstein-2 Potassium / Magnesium salt, lived up to expected performance /hole conditions.
- Hole cleaning is less of a problem in a vertical well.
  Mud system in use (PV/YP ~30/21, Gels 10/10 ~ 20/30) provided satisfying hole cleaning capability at flow rates between 3800 and 4200 lpm., which contrasts favourably with performance of a mud system with similar characteristics at flowrate of 4500 lpm approx. in a 70° deviated, 14 ¾" hole in recently drilled well BAS#3.

4.6 13 3/8" – 14" Casing

Started : 29/03/2004 @ 06:45 hrs
Finished : 01/04/2004 @ 14:00 hrs
Planned : 6.0 days
Actual : 3,3 days
NPT : 0.00 hrs

Planned Programme:

To run and set 13 3/8" 68 lbs/ft P-110 VAM TOP / 14" 106 lbs/ft N-80 VAM TOP casing string in the ZEZ2H, which is expected to provide a formation strength of 2.1 bar/10m or more. This will be sufficient to accommodate a kick from the ZEZ2A/C, which formation may be touched but is not meant to be drilled though. The casing is to case off potentially unstable formations such as the Vlieland shale. The 14" thick wall casing will be run over the squeezing Potassium / Magnesium salts in the Zechstein-3 and Zechstein 2 formations and the squeezing salt clay in the Zechstein-3.

The objectives are:
1. Secure the previous section
2. Isolate the pay zone in the Zechstein-2 Halite
3. Allow the mud weight to be lowered to drill the reservoir section

Operations Review / Summary:

MWD-GR tool itself proved to have properly monitored and recorded all data to section TD. The signal was lost due to failure of the pulse generator which according to tool log, obviously had been blocked someway by something, had been trying to restart itself for about one day and finally gave up. Memory content was downloaded and data appeared to be of sufficient quality, so Schlumberger wireline logging was cancelled.
GR showed the bottom of squeezing salt intervals and as such casing setting depth derived from it, exactly there where project management and on site engineering staff determined it to be.
Casing was run and cemented. Attempt to cut casing above hanger with the torch failed due to a film of OBM left on the pipe although riser and the stack were circulated to sweet water. Remnants of OBM nevertheless caught fire and generated nasty smelling fumes. Casing was cut with a grinding machine, which provided a very neat cut that did not require further polishing. Slip&seal assy was set and tested. Next casing head housing / BOP's were nippled up and tested as per program.

NB: TOC behind 13 3/8" casing was estimated to be at 925 m from differential pressure. GR-CBL was run when TD logging was done. Bad bond was indicated all the way up with good bond in just one or two spots over a distance of a couple of meters only. No clear indication of a TOC could be derived from the log.

Highlights

+ MWD-GR memory contained all data required.
+ No problems encountered in running the 13 3/8"- 14" string into 16" hole.
+ Smooth cement job.

Lowlights

– CBL indicates bad cement bond and provides no indication of TOC
– Delay due to waiting on grinder for casing cut.

Learning Points and Recommendations

- Obviously 14" VAM TOP pipe with 15 ¼" OD connections can be run into 16" Hole with no problems.
- Preventing solid particles to enter mud system requires continued and continuous attention.
- A drill pipe screen may render good services when a MWD tool is in the hole.
- Pre-cement spacer system may be re-designed to improve removal of mud cake and OBM film on pipe.
- Casing cut by grinding is preferred as it provides a neat cut at the right slope, with a smooth surface that does not need further de-edging and polishing.

4.7 12 ¼" Cavern Hole and underreaming to 17 ½"

Started : 01/04/2004 @ 14:00 hrs
Logging : 06/04/2004 @ 08:00 – 18:00 hrs
Finished : 11/04/2004 @ 11:00 hrs
Planned : 11.0 days (incl. 1.0 days logging)
Actual : 9.875 days (incl. 10 hrs logging)
NPT : 46.75 hrs

Planned Programme:

To drill 12 ¼" hole to such depth that sufficient pocket is available to evaluate the entire ZEZ2H. One 18 m core is planned to be taken some 20 m below 16" hole TD.
The section will be drilled vertical until ZEZ2A is clearly indicated by drill cuttings. At TD, a GR-Density-Sonic log will be taken over the open hole and a GR-CBL from 14" casing shoe to TOC or 200 m into previous casing. Setting depth of leaching strings will then be determined and hole will be opened to 17 ½" to required depth.

Operations Summary:

Section : 2440 -- 2815 m
Mud : OBM (MI Drilling Fluids - Versaclean) 1.35 sg
Deviation : Max inclination = 2.30° @ 2483,55 mAH with an azimuth of 119,16°.

Shoe track and ZEZ2H salt formation were drilled to coring depth with a DS-49 PDC bit on a rotary assembly. A Limited Leak-Off Test (LLOT) indicated a formation strength of at least 1.96 Bar/10 m (Equivalent mud density 2.00 SG). Coring passed off as per program with 96 % recovery. Coring assembly ran stuck while pulling at 4 m above bottom. Jarring didn't help so pipe was made free by spotting sweet water around the core head.
On the basis of bad experiences in drilling of well BAS # 3, BHA original programmed was deviated from. Instead of a pendulum rotary assembly, a steerable assembly was run with the same PDC bit and a drill pipe screen installed in the top DP joint. Section was drilled to well TD in 30 hours, (BOB). Angle had to be corrected once as the well showed a tendency to build angle at a constant azimuth indicating the bit to be following a formation dip. Both a negative drilling break and anhydrite cuttings indicated top ZEZ2A at 2805 m so TD was called with the bit at 2819 m. At bottoms-up carbonate cuttings were seen on the shakers.
Logging was carried out as per program, with good recovery. The 12 ¼" DS-49 drilling bit was rerun as a pilot for the under reamer with a 9 ½" pony drill collar in between. This set up generated unacceptable high variations of WOB and torque values, indicating lack of stabilization of the under reamer. The pony drill collar was changed out for a full 8" drill collar and a full gauge stabilizer was added to the assembly right below the under reamer. Some 110 m of hole was opened at dissatisfying ROP. The string was pulled when ROP dropped to 2 m/hr. No excessive wear of cutters could be noticed so the equipment was redressed and rerun. After another good 100 m of progress, a pressure loss of 10 Bar in 45 minutes was noticed by the driller on duty. String was pulled and a connection between the top sub and the main body of the under reamer was found to be washed out. A back-up hope-opener was collected and run in. Hole was reamed to setting depth of 7'inner leaching string at 2790 m.

Highlights

+ Good ROP in drilling 12 ¼"hole.
+ Running an MWD in the 12 ¼" proved to be the right selection, worth the extra cost.
+ Smooth E-line logging job.
+ Cured stuck core head quickly

Lowlights

– Stabilization problem of hole opener.
– ROP of underreamer lower than expected.
– Wash-out of pin of connection between main body and top sub of hole opener.

Learning Points and Recommendations

- Zechstein-2 Salt (ZEZ2H) should be drilled with a steerable assembly by preference as formation dip may cause the hole to deviate from the desired vertical line.
- Stabilization of a under reamer, especially when the hole could be washed out to a greater diameter than the pilot bit, is worth considering.
- Under reaming from bottom up, as practiced in BAS 3, should be considered for future wells.

4.8 11 ¾" and 7"Production strings

Started : 11/04/2004 @ 11:00 hrs
Finished : 16/04/2004 @ 08:00 hrs
Planned : 6.5 days
Actual : 4,875 days
NPT : 1.0 hrs

Planned Programme:

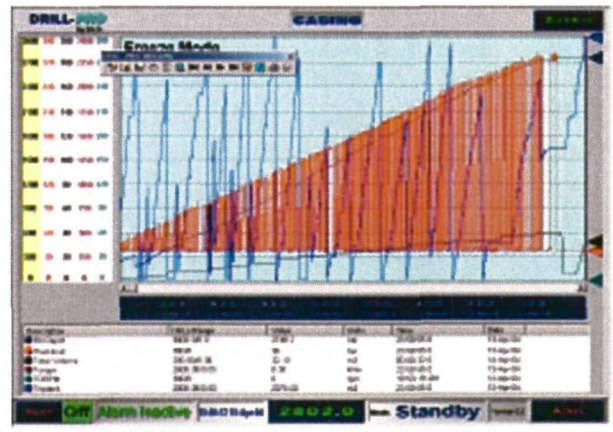
To change out the OBM for slightly under-saturated salt (NaCl) brine and run leaching strings as follows:

- Outer production string: 11 ¾" 65 lbs/ft VM-80 VAM FJL to be run to 2740 m AHRT or 50 m TVD above shoe of 7" inner production string.
- Inner production: 7" 26 lbs/ft L-80 VAM TOP to be run to 2790 m AHRT or ~15 m TVD above bottom of cavern..

Operations Summary:

OBM was changed out for under-saturated brine using a "liquid stopper" pill as a separation between OBM and brine. Base fluid for this "Liquid stopper" is magnesium ($MgCl_2$) brine, which is incompatible with VCM. A 5 m^3 Base oil spacer was pumped in advance of this pill but unfortunately it mixed up with base oil and mud, thus creating a 45 m^3 transition zone of Mg contaminated VCM with lumps of gelled-up mud, that had to be disposed of. Secondly, 3.5 m3 of this "liquid stopper" was required whilst mixing was done in batches of some 2 m3 only. After having pumped the base oil spacer and the first batch of liquid stopper, operation had so to be interrupted for about an hour.
With an eye to existing legal / permitting problems concerning the construction of supply and discharge lines to Harlingen plant, and the uncertainty about the duration of the juridical process involved, it was decided to wash out the cavern to such extend that enough space would be available to have the cavern squeeze in for several months at pace as expected with no danger to arise from it for a shear-off of the 11 ¾" and 7" pipe.
In spite of short term decision making as compelled by unforeseen circumstances and the logistical haste brought about it was managed to collect and circulate around some 75 m^3 of sweet water after the liquid stopper pill, with the bit at bottom cavern, followed by under-saturated brine of 1,15 SG, until all OBM was circulated out and spacer and pill had returned to surface. This treatment proved to be quite successful as the water returned to surface as over-saturated brine with 1.22 SG. Pipe was pulled by 200 m and again 75 m^3 of sweet water was circulated in and spotted in the annulus right above the bit. Treatment was repeated close below the 14" casing shoe with another 25 m^3 sweet water.
Drill string and BHA were then singled out and laid down.

Both the 11 ¾" outer production string and the 7" inner production string were run to planned setting depth without problems. The picture of hook-load increasing with depth versus time as it appears on the BIS screen illustrates very well the proceeding of an undisturbed casing running job in a vertical hole that is in excellent condition. The 11 ¾" diagram is inserted next to this as an example.



The 11 ¾" pipe was pressure tested at 200 Bar against the pump-off shoe that is constructed to shear at 240 Bar. Surface pressure went up to 290 Bar though when at surface a chicksan connection sheared off in a knee. The 7" string was run out of the 11 ¾" without any sign of resistance, so from that it became clear that the pump-off shoe was sheared indeed. Obviously, the sudden release of 290 Bar of pressure into the limited and fluid filled

space of the hole / cavern at no more than some 30 m above bottom created a shock wave that bounced back into the pipe to surface and hit the 2" chicksan in the 90° bend, where probably, due to inertia and the narrowing from 11 ¾" to 2", the chicksan's pressure rating of 700 Bar was exceeded for a split second what made it blast apart. The two parts of the chicksan knee were checked on site and taken to KCA DEUTAG's workshop for further investigation.

As a precaution to salt settling out, the narrow annulus between the 13 3/8"-14" casing and the 11 ¾" outer leaching string was reversed to sweet water. After landing the 7", both this string and the 11 ¾" to 7"annulus were circulated to sweet water too. Rig release followed, April 16, 2004 at 08:00 hours.

Highlights

+ Both strings were run to planned setting depth.

Lowlights

- Disorderly pump-job to change out VCM for brine.
- Contamination of Base oil and OBM by Magnesium Chloride ($MgCl_2$) containing carrier of "Liquid stopper" pill.
- Chicksan connection blasted apart by pressure shock from shear off of pump-off shoe.

Learning Points and Recommendations

- Logistics of a three component pump job (OBM – Brine – Sweet water) to change out drilling fluid necessitate proper planning, done well in advance if possible, to organize and rig-up sufficient transport and storage capacity. Excess capacity should be available to accommodate an unexpected large volume of transition fluid that has to be disposed of.
- Use of "Liquid stopper" spacer is not advisable if the carrier fluid contains Magnesium Chloride, which is not compatible with VCM.
- Open the annulus between leaching string and previous pipe before shearing the pump-off shoe to let the pressurized fluid have an opening to release itself into and go out.

5 Time and Cost Review

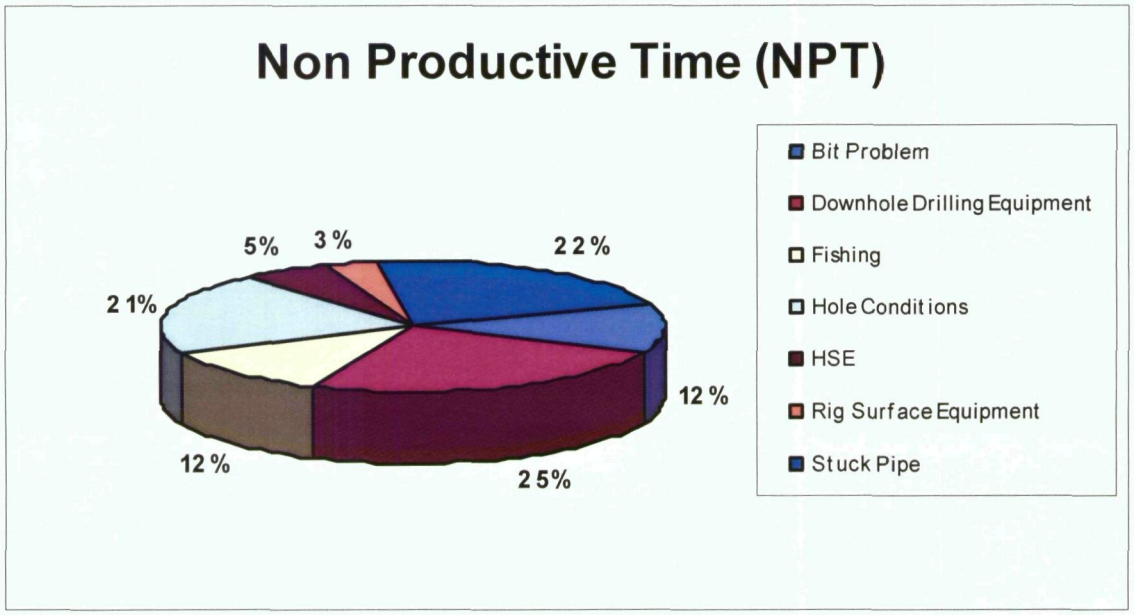
5.1 Time Overview

Operation (planned)	Operation (Actual)	Planned Time (days)	Actual Time (days)	Differ-ence (days)	NPT (hrs)
26"hl/24"pipe	26"hl/24"pipe	5,0	5,5	+ 0,500	00,00
Rig Move	Rig Move	9,0	8,1	- 0,900	00,00
----------	----------	----------	----------	----------	----------
22" hole	22" hole	5,5	7,80	+ 2,300	66.50
18 5/8" Csg.	18 5/8" Csg	4,0	7,19	+ 3,200	66.75
16" Hole	16" hole	7,0	12,24	+ 5,240	39.75
13 3/8" /14"Cs	13 3/8"/ 14"	6,0	3,27	- 2,700	0.00
12 ¼" hole.	12 ¼" /17 ½"	11,0	9,875	- 1,125	46.75
11 ¾" / 7" Csg	11 ¾"/7"Csg	6,5	4,875	- 1,625	1.00
Total		**40,0**	**45,25**	**5,25**	**220,75**

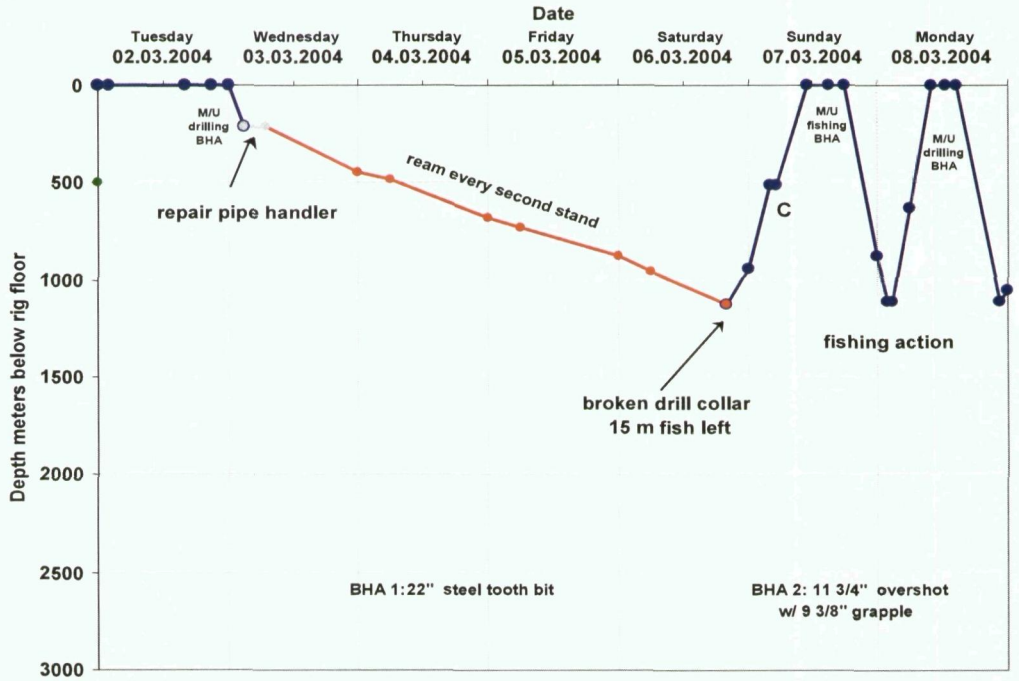
5.2 NPT Events

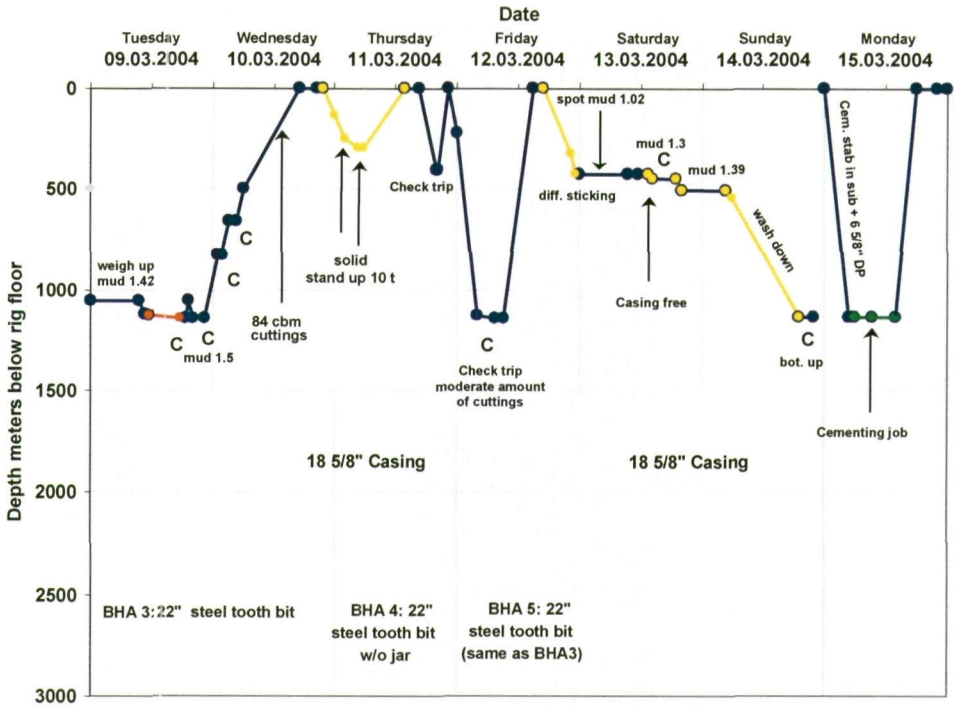
EAR #	DATE	NPT (HRS)	DESCRIPTION
	03-03-2004	4.00	Repair pipe handler on TDS.
	06-03-2004	2.00	Check surface piping because of drop of SPP.
	06-03-2004	2,00	Trip for washed-out 9 ½" drill collar.
	07-03-2004	9.75	Trip for washed-out 9 ½" drill collar.
	07-03-2004	1.25	Circulating out cutting
	07-03-2004	13.00	Fishing washed through 9 ½"drill collar and bit.
	08-03-2004	13.50	Fishing washed through 9 ½"drill collar and bit.
	08-03-2004	10.00	Trip for washed-out 9 ½" drill collar.
	08-03-2004	1.50	Hole caving. Circulated to weigh up and condition mud
	09-03-2004	9.50	Circulated to weigh up and condition mud.
	11-03-2004	12.00	Pull out 18 5/8" casing because of stand-up @ 295 m.
	11-03-2004	7.50	Trip to condition hole.
	12-03-2004	15.00	Trip to condition hole.
	12-03-2004	7.25	Run / wash casing to 295 m.
	12-03-2004	0.75	Work casing, differentially stuck @ 421 m.
	13-03-2004	14.50	Free casing. Circulate. Condition mud.
	13-03-2004	4.00	Weigh up and condition mud as consequence of stuck pipe.
	14-03-2004	4.75	Weigh up and condition mud as consequence of stuck pipe.
	16-03-2004	1.00	Repair hydraulic hose TDS
	19-03-2004	7.50	Extra trip to change BHA to motor assy for noise / vibration.
	20-03-2004	4.50	Extra trip to change BHA to motor assy for noise / vibration.
	24-03-2004	1.00	Pump repair.
	25-03-2004	4.00	Extra trip for bit problem.
	26-03-2004	11.00	Extra trip for bit problem.
	26-03-2004	0.50	Change out wash pipe
	26-03-2004	11.00	Extra trip for bit problem.
	27-03-2004	0.25	Extra trip for bit problem.
	03-04-2004	4.50	Stuck with core head. Spot water. Circulate.
	07-04-2004	13.75	Extra trip for stabilisation of hole opener.
	08-04-2004	4.50	Extra trip for low ROP of hole opener. Formation problem.
	09-04-2004	6,50	Extra trip for low ROP of hole opener. Formation problem.
	09-04-2004	0,50	Check surface lines cause of drop of SPP.
	09-04-2004	0.50	Extra trip for washed-out hole connection of hole-opener.
	10-04-2004	16,50	Extra trip for washed-out hole connection of hole-opener.
	12-04-2004	1,00	Repair iron roughneck.
Total NPT		220,75	

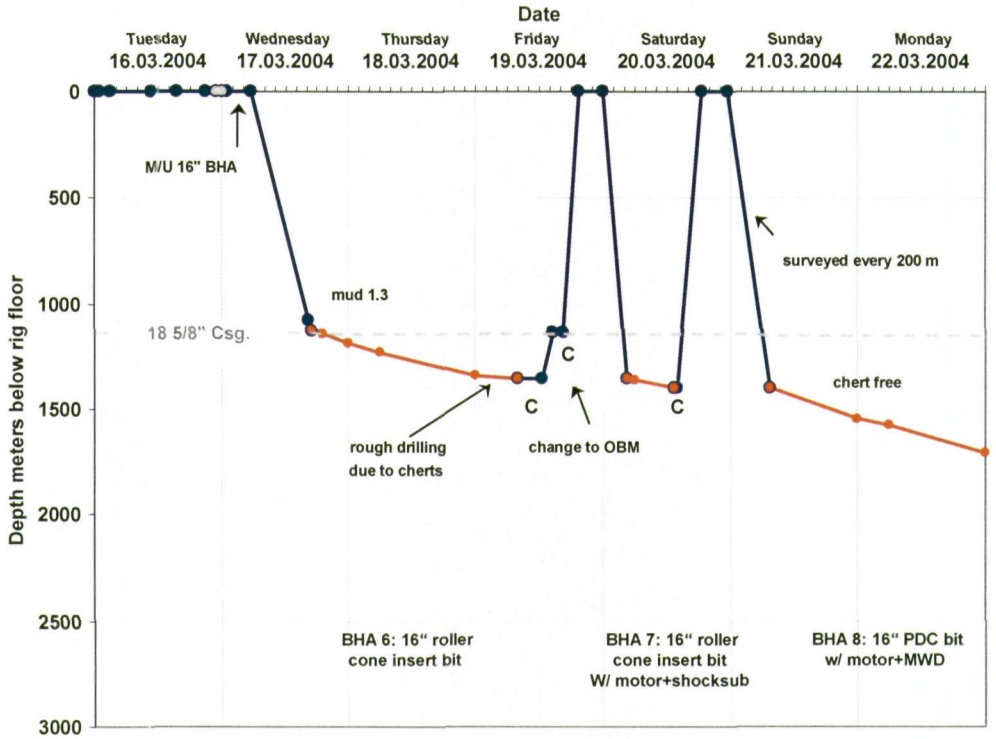
5.3 Non Productive Time (NPT)

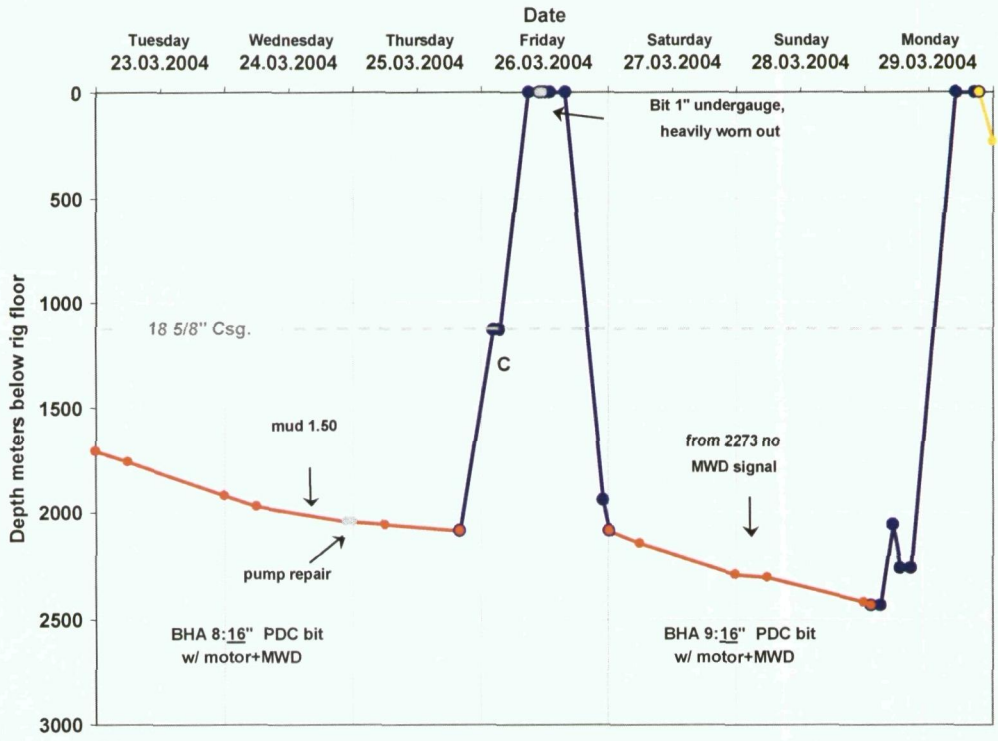


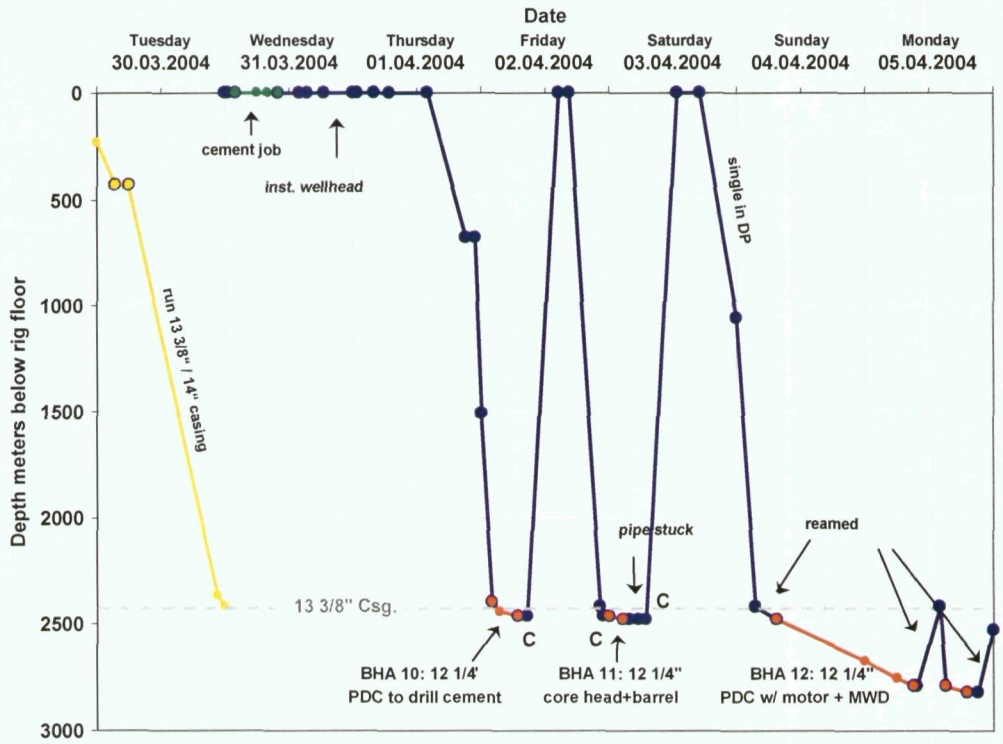
5.4 Drilling Time-Events / Depth Diagram

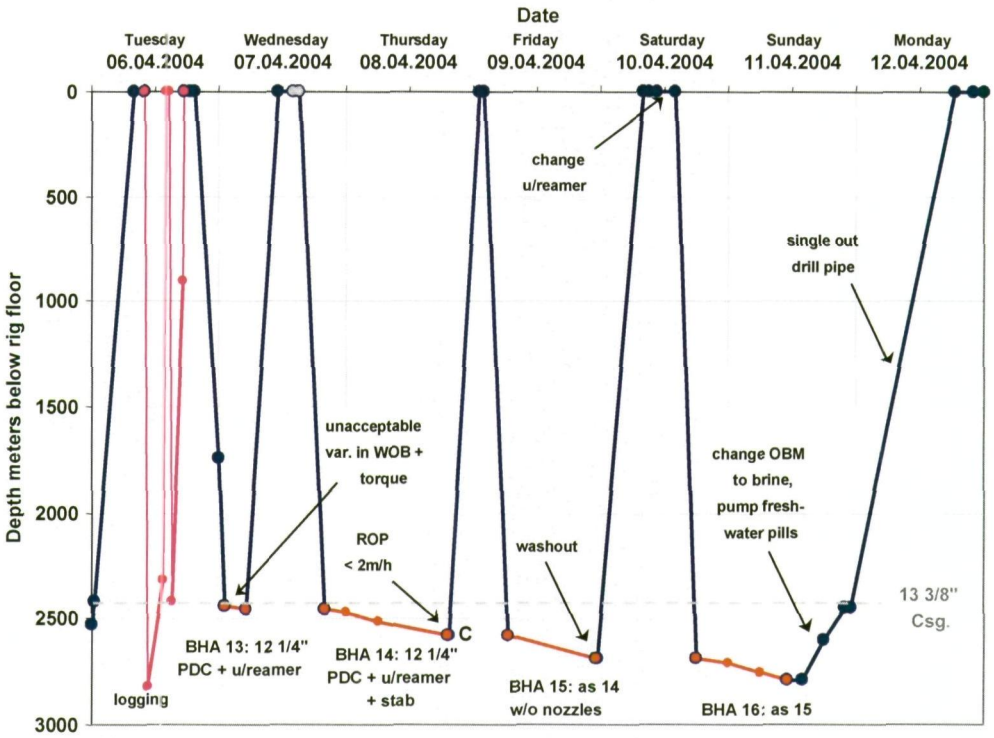


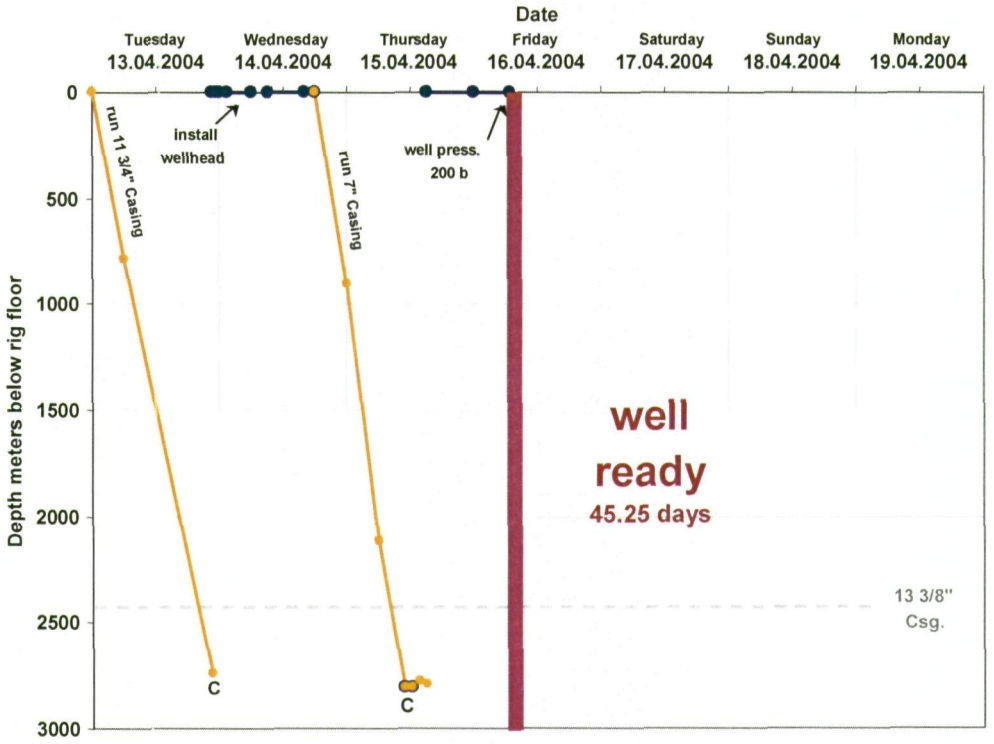

Date
Tuesday 09.03.2004
Wednesday 10.03.2004
Thursday 11.03.2004
Friday 12.03.2004
Saturday 13.03.2004
Sunday 14.03.2004
Monday 15.03.2004
Depth meters below rig floor
0
500
1000
1500
2000
2500
3000
weigh up mud 1.42
C
C
mud 1.5
C
C
84 cbm cuttings
solid stand up 10 t
Check trip
C
Check trip moderate amount of cuttings
spot mud 1.02
diff. sticking
mud 1.3
C
mud 1.39
Casing free
wash down
C
bot. up
Cem. stab in sub + 6 5/8" DP
Cementing job
18 5/8" Casing
18 5/8" Casing
BHA 3:22" steel tooth bit
BHA 4: 22" steel tooth bit w/o jar
BHA 5: 22" steel tooth bit (same as BHA3)


Date
Tuesday 16.03.2004
Wednesday 17.03.2004
Thursday 18.03.2004
Friday 19.03.2004
Saturday 20.03.2004
Sunday 21.03.2004
Monday 22.03.2004
Depth meters below rig floor
0
500
1000
1500
2000
2500
3000
M/U 16" BHA
mud 1.3
18 5/8" Csg.
C
C
C
rough drilling due to cherts
change to OBM
surveyed every 200 m
chert free
BHA 6: 16" roller cone insert bit
BHA 7: 16" roller cone insert bit W/ motor+shocksub
BHA 8: 16" PDC bit w/ motor+MWD


Date
Tuesday 23.03.2004
Wednesday 24.03.2004
Thursday 25.03.2004
Friday 26.03.2004
Saturday 27.03.2004
Sunday 28.03.2004
Monday 29.03.2004
Depth meters below rig floor
0
500
1000
1500
2000
2500
3000
Bit 1" undergauge, heavily worn out
18 5/8" Csg.
C
mud 1.50
pump repair
from 2273 no MWD signal
BHA 8:16" PDC bit w/ motor+MWD
BHA 9:16" PDC bit w/ motor+MWD


Date
Tuesday 30.03.2004
Wednesday 31.03.2004
Thursday 01.04.2004
Friday 02.04.2004
Saturday 03.04.2004
Sunday 04.04.2004
Monday 05.04.2004
Depth meters below rig floor
0
500
1000
1500
2000
2500
3000
cement job
inst. wellhead
run 13 3/8" / 14" casing
single in DP
pipe stuck
reamed
13 3/8" Csg.
C
C
C
BHA 10: 12 1/4' PDC to drill cement
BHA 11: 12 1/4" core head+barrel
BHA 12: 12 1/4" PDC w/ motor + MWD


Date
Tuesday 06.04.2004
Wednesday 07.04.2004
Thursday 08.04.2004
Friday 09.04.2004
Saturday 10.04.2004
Sunday 11.04.2004
Monday 12.04.2004
Depth meters below rig floor
0
500
1000
1500
2000
2500
3000
change u/reamer
single out drill pipe
unacceptable var. in WOB + torque
ROP < 2m/h
washout
change OBM to brine, pump fresh-water pills
13 3/8" Csg.
C
logging
BHA 13: 12 1/4" PDC + u/reamer
BHA 14: 12 1/4" PDC + u/reamer + stab
BHA 15: as 14 w/o nozzles
BHA 16: as 15


Date
Tuesday 13.04.2004
Wednesday 14.04.2004
Thursday 15.04.2004
Friday 16.04.2004
Saturday 17.04.2004
Sunday 18.04.2004
Monday 19.04.2004
Depth meters below rig floor
0
500
1000
1500
2000
2500
3000
run 11 3/4" Casing
install wellhead
run 7" Casing
well press. 200 b
well ready
45.25 days
13 3/8" Csg.
C
C

6 Data Acquisition

6.1 Mud Logging

Planned				
Hole Size	**Type of Mud Logging.**	**Depth Logged From – To (AH)**	**Logging Company**	**Comments**
22"	Cutting description/litholog	0 - 1130	Petrolog	
16"	Cutting description/litholog	1130 – 2460	Petrolog	
12 ¼"	Cutting description/litholog	2460 – 2905	Petrolog	

Actual				
Hole Size	**Type of Mud Logging.**	**Depth Logged From – To (AH)**	**Logging Company**	**Comments**
22"	Cutting description/litholog	218 - 1144	Petrolog	
16"	Cutting description/litholog	1144 – 2440	Petrolog	
12 ¼"	Cutting description/litholog	2440 – 2819	Petrolog	

6.2 Wireline Logging

Planned					
Run No	**Hole/Casing/Liner Size**	**Logging Tools Run**	**Depth Logged From – To**	**Logging Company**	**Comments**
1	18 5/8 '' Csg	GR	1115 – 218	Schlumberger	Optional / at 16" TD
2	16" hole	MWD – GR GR-Dens-Resis.	2460 – 1350 2460 - 1115	Schlumberger Schlumberger	Canc. if no gas shows
3	12 ¼"	GR-Dens-Resis. CBL-VDL-GR	2905 – 2460 2460 - 915	Schlumberger Schlumberger	

Actual					
Run No	**Hole/Casing/Liner Size**	**Logging Tools Run**	**Depth Logged From – To (AH)**	**Logging Company**	**Comments**
1	16" Hole	MWD - GR	1375 - 2440	Schlumberger	
2	12 ¼" hole	MWD - GR	2817 - 2440	Schlumberger	
3	13 3/8"/14" csg	GR-CBL-VDL	2419 - 900	Schlumberger	Bad bond. No TOC
4	12 ¼" hole	GR-LDT-Sonic	2819 - 2319	Schlumberger	
5					

6.3 Coring

Planned					
Hole Size	**Type of Coring**	**Depth Core From – To**	**% Recovered**	**Coring Company**	**Comments**
12 ¼"	Conventional	2460 - 2478	100	Security-DBS	

Actual					
Hole Size	**Type of Coring**	**Depth Core From – To**	**% Recovered**	**Coring Company**	**Comments**
12 ¼"	Conventional – fibre glass inner barrel.	2460 - 2478	96	Security - DBS	

6.4 Deviational Surveys, Gyro / EMS

Hole Size	Type of Survey	Survey Depth From – To	Survey Company	Comments
12 ¼"	MWD	2795 - 0	Schlumberger	Measured while POOH 12 ¼" hole

6.5 MWD

Hole Size	Type MWD	Depth Used From – To (AH)	Logging Company	Comments
16"	Slimpulse	1395 – 2440	Schlumberger	Signal failure @ 2273 m
12 ¼"	Slimpulse	2440 – 2819	Schlumberger	

6.6 Gas Detection

Hole Size	Type of Gas Detection.	Depth Used From – To	Logging Company	Comments
22"	Bohr sensors	218 - 1144	BIS BV	No gas detected. Max. 1300 ppm @ 577 m
16"	Bohr sensors	1144 – 2440	BIS BV	No gas detected. Max. 1800 ppm @ 2071 m
12 ¼"	Bohr sensors	2440 - 2819	BIS BV	No gas detected. Max. 700 ppm @ 2777 m

7 Abbreviations

AH	Along Hole
AHORT	Along Hole Original Rotary Table
AHRT	Along Hole Rotary Table
AHTVD	Along Hole True Vertical Depth
BG	Back Ground
BHA	Bottom Hole Assembly
BIS	Bohr Instrument Services
BOP	Blow Out Preventer
B/U	Build Up
CBL	Cement Bond Log
CLST	CLaySTone
DC	Drill Collar
DP	Drill Pipe
ECD	Equivalent Circulating density
EMW	Equivalent Mud Weight
EZSV	Easy-Drill Subsurface valve (Drillable bridge plug)
GR	Gamma Ray
HSE	Health, Safety & Environment
HWDP	Heavy Weight Drill Pipe
K	Kalium (= Pottasium)
KOP	Kick Off Point
LDT	Litho-Density Tool
LPM	Litres Per Minute
M	Meter
Mg	Magnesium
$MgCl_2$	Magnesium Chloride
MWD	Measure While drilling
NaCl	Natrium Chloride (Sodium Chloride = kitchen salt)
NAP	Nieuw Amsterdams Peil (Standard level in NL)
NPT	Non Productive Time
OBM	Oil Based Mud
PDC	Polycrystalline Diamond Composites
SG	Specific Gravity
SPP	Stand Pipe Pressure
SST	SandSTone
ST	Side Track
TD	Total Depth
TDS	Top Drive System
TOC	Top Of Cement
TV	True Vertical
TVD	True Vertical Depth
VAM	Vallourec Mannesmann
VCM	Versaclean Mud
VDL	Variable Density Log
XO	Cross Over

8 Attachments

8.1 Final Well Status Diagram

BAS-4 WELLSTATUS DIAGRAM

Date updated: 19 May 2004
Well Spuded 02/03/2004 02:00 hrs
Well released 16/04/2004 08:00 hrs

Depth reference: RT-NAP = ~ 9,49m
RT-Top Cellar = 9,44 m
RT-TRF = 10,20 m
NOTE: TRF = Top Reference Flange (20 3/4" bottom flange)

Description	Depth AH RT (m)	Depth TVD RT (m)	Well sketch	Remarks
Driven 28" x 1" X52E Conductor Shoe	14,5	14,5		24" line pipe, t ~0,5"
24" Csg. Shoe	228,5	228,5		Spot cement around shoe
				Lead slurry 18 5/8", 137 m^3 Pozzo Chemoil 1.55 SG
				18.625", 87,5#, K 55 BOM casing
Theor.(calc.) TOC 13 3/8"/18 5/8" csg/csg annulus	~ 925	925		
Theor. Top of tail cement behind 18 5/8" csg	1073	1073		Tail slurry, 18 5/8": 16 m3 Pozzo Chemoil, 1.67 sg
18.625", 87,5#, K 55 BOM Casing shoe.	1135	1135		
				Lead slurry 13 3/8" - 14": 54 m3 Pozzo Chemoil, 1.60 sg
				13 3/8" 68 lbs/ft P110 VAM TOP
Top of 14" 106# VM 80 VAM TOP	1989	1989		14" 106 lbs/ft N 80 VAM TOP
Calc. Top of tail cement in 14"/18 5/8" csg/csg annulus	~2318	2318		
TOP Carnallite	2345	2345		Tail slurry 13 3/8"-14": 6,1m3 G cement ,1.92 sg
BOTTOM Carnallite	2389	2389		
14" 106.00 lbs/ft VM-80 VAM TOP Shoe	2419	2419		LLOT: Grad. 1,96 / EMW 2,00 SG
11 3/4" 65 lbs/ft VM 80 VAM FLJ outer production string	2739	2739		
7" 26 lbs/ft L 80 VAM TOP inner production string	2789	2789		
12 1/4" (-> 17 1/2") Section TD / Well TD	2819	2819		drilled (pipe tally depth.) (logging TD 2824 m)
				hole opened, 12 1/4" to 17 1/2" cavern area washed out with ~175 m^3 sweet water.

8.2 Daily reports

See separate volume / well file.

8.3 Mud Recap

See separate volume: "M-I Drilling Fluids final well report"

8.4 Directional Report

See separate volume: "Schlumberger final well report"

8.5 Geological Report

See separate volume: "Petrolog" Final Well Report Barradeel Salt well nr. 4 (BAS – 4,)