

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

Staatstoezicht op de Mijnen
T.a.v.
Postbus 24037
2490 AA 's-Gravenhage

Harlingen, 19 februari 2015

Betreft: FRISIA BAS-3 abandonment eindrapport (EOWR)

Geachte heer

Hierbij ontvangt u de BAS-3 abandonment eindrapportage, die op 6 september 2014 is afgerond op de BAS-3 caverne van Frisia Zout B.V.

Wij stellen uw mogelijk commentaar op prijs.

Er vanuit gaande u voldoende geïnformeerd te hebben.

Met vriendelijke groet,

Frisia Zout B.V.



Hoofd mijnbouw

CC



Staatstoezicht op de Mijnen			
Nr.			
23 FEB 2015			
CL 3 / Boren / Land / Bas-3			
Boren		02	



End of Well Report Abandonment BAS-3

FRISIA Zout BV

Prepared by Well Engineering Partners

Version 1

Publication Date 30 January 2015

Reviewed

Approved

Agreed

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Revision no.	Version	Date	Change Items	Initials
0	1.0	02 Feb. 15	Initial version	YP

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1. GENERAL PROJECT DATA

1.1 PROJECT MANAGEMENT:

<u>Title</u>	<u>Name</u>	<u>Company</u>	<u>Period from</u>	<u>to</u>
Project Manager		Frisia	21-06-2014	06-09-2014
Drilling Advisor		Well Engineering Partners	21-06-2014	06-09-2014
Drilling Manager		Well Engineering Partners	21-06-2014	06-09-2014
Lead ops Engineer		Well Engineering Partners	21-06-2014	06-09-2014
HSE Manager		Advisea	21-06-2014	06-09-2014
Drilling Engineer		Well Engineering Partners	21-06-2014	06-09-2014

Drilling Supervisors on 2 week rotational scheme:

<u>Title</u>	<u>Name</u>	<u>Company</u>	<u>Period from</u>	<u>to</u>
Drilling Supervisor		Well Engineering Partners	01-07-2014	15-07-2014
Drilling Supervisor		Well Engineering Partners	21-06-2014	01-07-2014
			15-07-2014	25-07-2014
			18-08-2014	01-09-2014
Drilling Supervisor		Well Engineering Partners	29-07-2014	12-08-2014
			01-09-2014	06-09-2014
Drilling Supervisor		Well Engineering Partners	25-07-2014	29-07-2014
Drilling Supervisor		Well Engineering Partners	12-08-2014	18-08-2014
Night DSV		Well Engineering Partners	27-06-2014	07-07-2014
			21-07-2014	31-07-2014
			14-08-2014	28-08-2014
Night DSV		Well Engineering Partners	07-07-2014	21-07-2014
Night DSV		Well Engineering Partners	21-06-2014	27-06-2014
			31-07-2014	14-08-2014
			28-08-2014	06-09-2014

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1.2 WELL DATA

Field	Barradeel II		
Well Number	3		
Well Name	BAS-3		
Well Type	Sodium Chloride Brine Producer		
Operator	Frisia Zout B.V.		
Surface Location	Latitude & Longitude	Geographical	
	N 53° 12' 27.66041"	X: 160 552.00m E	
	E 5° 28' 14.68320"	Y: 579 996.00m N	
Grid Coordinate System	Rijksdriehoeksmeting / Netherlands New		
Primary objective	Abandonment BAS-3 current well		
Start date	21-06-2014		
End Date	06-09-2014		
Days Operational	78		
Drilling Contactor	KCA Deutag		
Drilling Rig	T-207		

2. WELL SUMMARY

Elevation	RT – GL	9.35 m	
	GL – NAP	+0.9 m	
	NAP – RT	10.25 m	
Total Depth	RT	3330m MD	1888m TVD

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2.1 DIRECTIONAL PLOTS

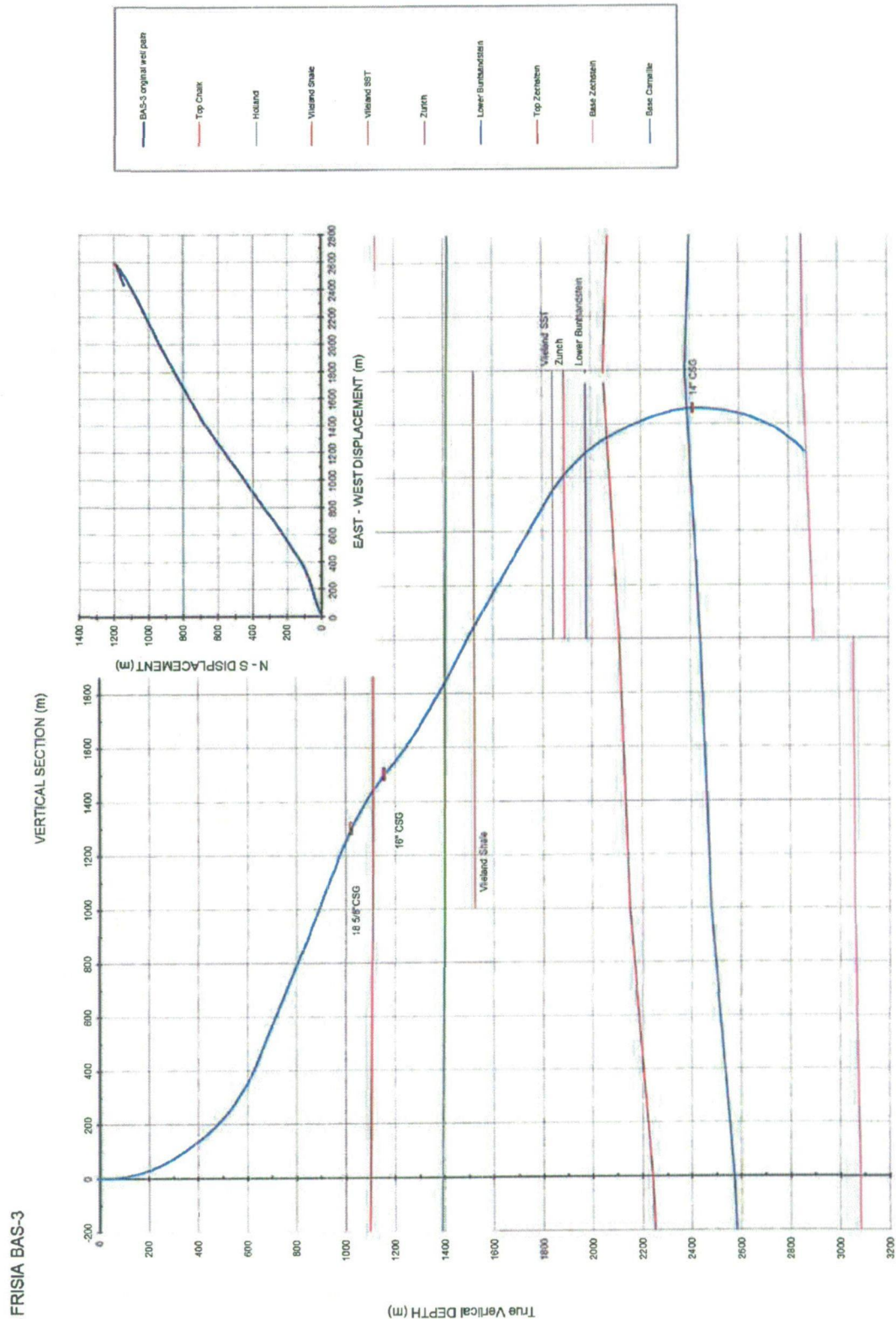


Figure 1: Vertical Section plot and plan view plot

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2.2 TECHNICAL SUMMARY

2.2.1 Casing

Table 1: Tubular summary

Item	Top MD (m)	Bottom MD (m)	Weight (ppf)	Grade	Connection
36"	0	39	½" WT		Welded
24"	0	409	½" WT		Welded
18 5/8"	0	1762	87.5	K55	Big Omega
16"	0	2000	84.5	C85	Hydril
13 3/8"	0	3669	68	P110	VAM TOP
14"	3660	3940	106	N80	Hydril Mac II

2.2.2 Cement

Table 2: Cement summary

Item	TOC (MD)	Lead Slurry Volume (m³)	Lead Slurry Weight (s.g.)	Tail Slurry Volume (m³)	Tail Slurry Weight (s.g.)	Type
Pre-abandonment BAS-3 Current	Please refer to the well diagram					
Abandonment plug	3330m	9	1.88	--	--	Class G

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2.3 SUMMARY OF OPERATIONS

BAS-3 has been a brine producer for FRISIA in the period 2004 to 2010. During this period it has been intensively leached. During drilling BAS-3 the well path in the cavern section was not drilled vertical as planned. It deviated from vertical at the top to a maximum deviation of 50 degrees at the bottom. This deviation combined with small (vertical) leaching intervals and the intensive leaching caused the cavern to move rapidly through the salt interval available for mining.

At the end of January 2010 production was stopped. Before starting to drill BAS-3 Original well, a final abandonment of the cavern will be made, these operations are a combined rig operation.

Objectives

- Place a minimum 50m wall-wall abandonment plug below the top Zurich Fm. depending on feedback during above operations:
 - 13 3/8" bridge plug with minimal 50m cement.
 - 11 3/4" bridge plug with minimal 50m cement.
 - 50m section mill and 50m cement inside 13 3/8".

In order to do so the following sub-objectives needed to be reached:

- Clean out the 11 3/4" till 50m below top Zurich Fm from TOC (~3356m GL, WL depth) to 3397m GL, without damaging the 11 3/4".
- Assess cement bonding in annular space 11 3/4" x 13 3/8" from 3300m to 3397m. Identifying from which point the 11 3/4" can be retrieved and how the well needs to be abandoned.
- Retrieve 11 3/4" from well to be able to drill 12 1/4" side track.
 - Primary objective: retrieve 2969m 11 3/4" casing, i.e. from HUD (3397m GL).
 - Fall-back 1: retrieve 2872m 11 3/4" casing, i.e. from side-track point (3290m GL).
 - Fall-back 2: retrieve 2572m 11 3/4" casing. Sidetrack point will be moved to 3000m GL, inside Vlieland Shales.
 -

Situation prior to abandonment

The well diagram 2.4 shows the situation prior to abandonment.

The 11 3/4" casing dropped back on the 11 3/4" stump at 3825 m RT during the Phase 1a activity in Q1 2013. The bottom of the inside of the 11 3/4" casing has been cemented in. After cementation 2 with the HWO (jan-mar2013), 455 m cemented in DP was left behind in the bottom of the 11 3/4" casing. Above this point, the DP string was freed with a severing shot inside a connection and successfully recovered.

An annular top down cementation was performed in July 2013, during which 10m3 cement was pumped through a suspension string, above a wiper into the 13 3/8", down the 11 3/4" x 13 3/8". Based on displacement the TOC cement is at 3566 m RT. A long term pressure observation followed the operation, showing a decreasing pressure build up, the well was opened via a small control line, which showed an inflow of ~5ltr/day.

In November 2013 an additional snubbing operation was performed with the attempt to abandon the well prior to rig operations. During operations the coil got stuck inside 455m 5" DP fish. Making an abandonment more difficult, the well was secured with a gravitational cement job, 5m3 cement placed around the 455m 5" fish. At the end of operations a segmented bond log was made of the 11 3/4" casing, indicating an almost free 11 3/4" (patches cement at 1974.4 – 2209.4 m & 3009.4 – 3234.4 m RT).

The well was observed for more than three months, showing no pressure build up. In February the BOP was changed out for the WH, two pressure tests (240bar WH) were performed during this operation showing no leak-off.

- 18 5/8", closed in, pressure stable, diesel/OBM in annulus hydrostatic driven pressure.
- 13 3/8", closed in, no pressure build up, 1.15sg NaCl brine
- 11 3/4", top not in well head.

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- Inside 11 3/4" x 13 3/8" 1.40sg K-formate, brine to prevent solids drop-out and protect 1 1/2 joint 13 3/8" in top Salt against collapse.

Rig T-207 abandonment operation summary

Six runs were made to mill out the 5" DP, with low ROP, the last run had only 90cm progress. Milling was suspended (total milled from 3360m to 3395m) to retrieve 11 3/4" casing, cut and fish sections, had to be performed in smaller section than anticipated (total retrieved 438m to 1446m). In the meantime a review was made of the abandonment objective. Four more runs were made in attempt to mill out the 5" DP to planned depth, with even slower ROP (total milled from 3395m to 3400m).

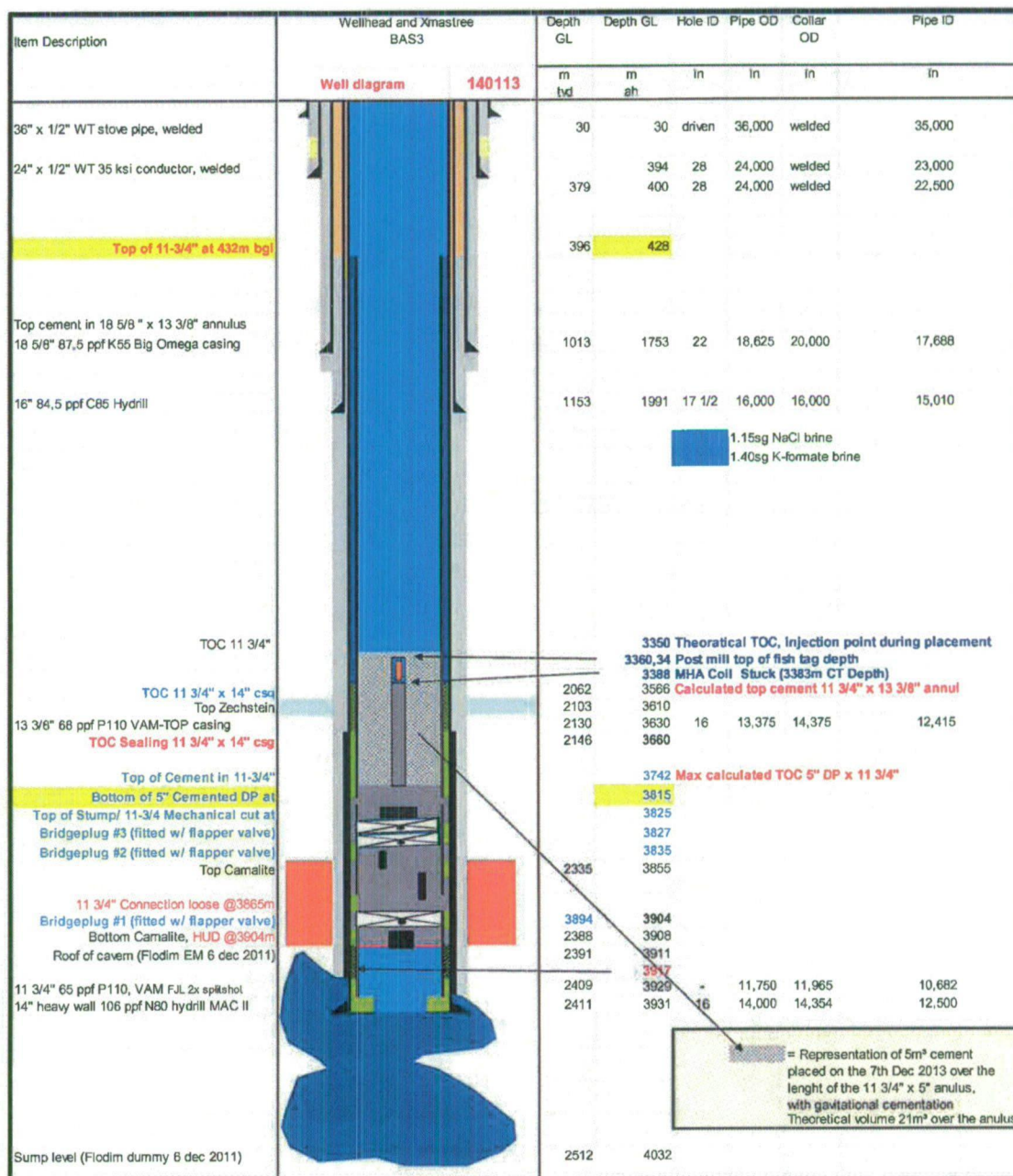
The exposure to damaging the 13 3/8" casing with the mills, setback in milling progress and difficult 11 3/4" casing removal triggered the alteration of the abandonment objective (MOC2 v2), placing the abandonment plug 44m below top Zurich, instead of 50m.

First a bridge plug was set to act as cement retainer straight on top of the 5" DP. A cut out was made short above the cement retainer (3396-3397.5m) to create a pocket for a squeeze cementation of the 11 3/4" x 13 3/8" annulus to fixate the 11 3/4" casing. A bridge plug was placed 1m above the cut out, to act as squeeze packer, however no circulation was achieved over the 11 3/4" x 13 3/8" annulus. A split shot was made at 3330m to give a circulation path, however again no circulation possible, indicating the 11 3/4" was already fixated.

A section mill was run to mill away 11 3/4" from 3346-3393m, in two runs. A full bore balanced cement plug (1.88sg) was placed, after 40hr the cement was dressed with milled tooth to 3330m. The abandonment cement plug was tested with a 10T solid tag and a pressure test from above of 170bar. Refer to section 5.1 for the well schematic after operations.

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2.4 WELL DIAGRAM



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3. DRILLING FLUID SUMMARY

During operations the following drilling fluid types have been used:

Table 3: Fluid summary

Section	Type	Density Min – Max
Start of operation	Brine	1.15 s.g.
All operations during abandonment	WBM Salt saturated	1.37-1.40 s.g.

The figure below shows the mud weight versus depth at the start of operation and during all abandonment operations. No contact to the formations, all operations performed in cased hole.

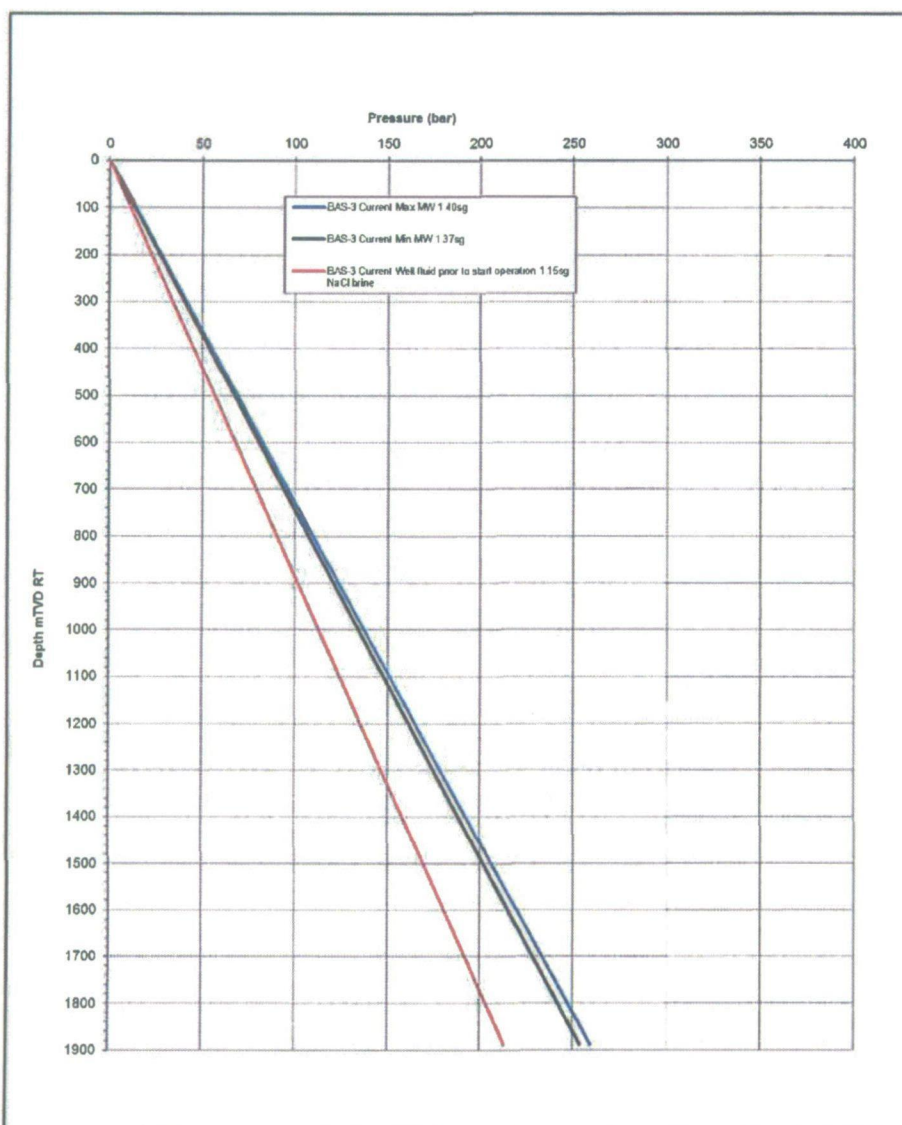


Figure 2: Mud weight vs. depth

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4. GEOLOGY

Below the geological column with vertical and along hole depths below RT.

Stratigraphic Column BAS-03 'Original'						BAS-03 Current		
Era	Group	Period	Formation	Epoch (Age)	Member	TV Depth (m) GL	AH Depth (m) GL	
Cenozoicum	Upper North Sea NU	Quat.	"Diverse"	Holocene-Pleistocene		0	0	
			Oosterhout NUOT	Pliocene		216	220	
			Breda NUBA	Miocene		673	680	
	Middle North Sea MU	Tertiary	Rupel NURF	Oligocene (Rupelian - Early Chadian)	Rupel Clay NURFC	600	730	
	Lower North Sea HL		Dongen NLFF	Middle - Late Eocene (Lutetian to Bartonian)	Asse NLFFB	614	760	
				Early to Middle Eocene (Ypresian to Lutetian)	Brussels Sand NLFFS	640	820	
				Early Eocene (Ypresian)	Ieper NLFFI	818	1260	
					Basal Dongen Tuffite NLFFT	1064	1850	
	Landen NLFF		Late Paleocene (Thanetian)	Landen Clay NLFFC	1076	1870		
Mesozoicum	Chalk CK	Cretaceous	Ommelanden CKOR	Upper Cretaceous (Turonian to Maastrichtian)		1108	1926	
	Texel CKTX		Upper Cretaceous (Cenomanian)	Texel Marlstone CKTX	1409	2440		
	Rijnland KN		Holland KNGL	Lower Cretaceous (Early Aptian)	Upper Holland Marl KNGLU	1479	2580	
				latest Ryazanian/ Valanginian to Barremian/ Early Aptian	Middle Holland Claystone KNGLM	1511	2644	
					Lower Holland Marl KNGLL	1523	2666	
			Vlieland Claystone KNHC	(Ryazanian/ Barremian)		1533	2687	
			Vlieland Sandstone KNHS	(Ryazanian)	Friesland KNHSF	1854	3284	
	Schieland SL	Jurassic	Zurich SLDZ	Upper Jurassic to Lower Cretaceous	Upper Zurich SLDZU	1900	3356	
	Lower Germanic Trias RB			Late Kimmeridgian to Ryazanian	Wadden Volcanoclastics SLDZY	1955	3431	
					Lower Zurich SLDZL	1980	3463	
Paleozoicum		Triassic	Lower Buntsandstein RBSS	Triassic (latest Permian - early Scythian)	Main Claystone RBSSM	1987	3472	
	Zechstein ZE	Permian	Zechstein Upper Claystone ZEUC	Upper Permian (Thuringian)		2090	3594	
					Zechstein 4 (Aller) ZEZ4	Z4 Pegmatite Anhydrite ZEZ4A	2105	3611
						Red Salt Clay ZEZ4R	2108	3614
					Zechstein 3 (Leine) ZEZ3	Z3 Salt ZEZ3H	2113	3619
						Z3 Main Anhydrite ZEZ3A	2285	3803
						Grey Salt Clay ZEZ3G	2330	3850
					Zechstein 2 (Stassfurt) ZEZ2	Z2 Roof Anhydrite ZEZ2T	2333	3853
						Z2 Salt ZEZ2H	2339	3858
						Upper section: Halite	2339	3858
						Middle section: Carnallite	2342	3861
					Target	Lower section: Halite	2393	3913
						Z2 Basal Anhydrite ZEZ2A		
TD						2877	4444	

Table 4: Geological summary

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5. WELL STATUS

5.1 SCHEMATIC AFTER OPERATIONS

A detailed well schematic summarizing all casing sizes is shown below.

Note: well depth is not to scale.

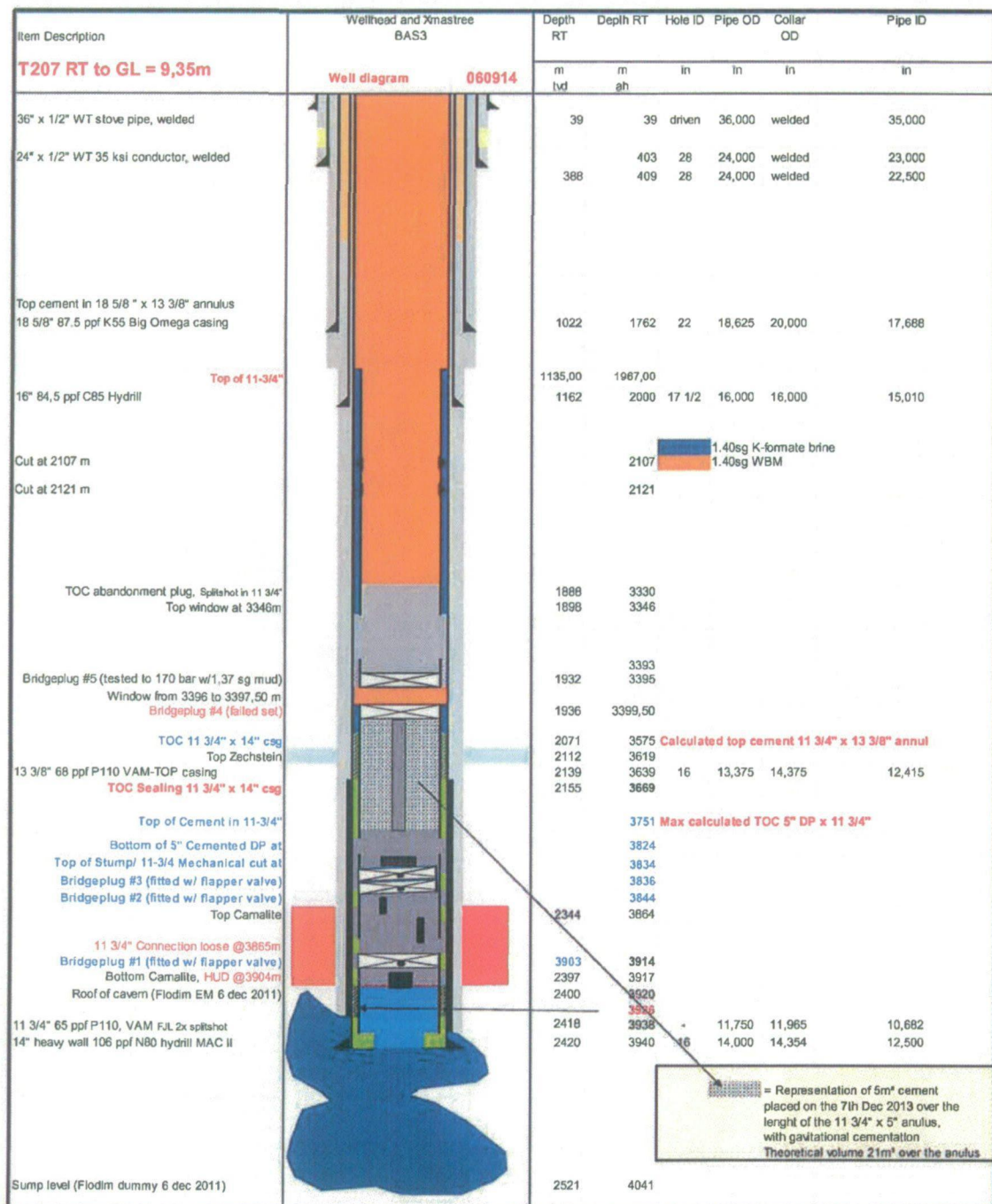


Figure 3: Well schematic

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5.2 WELLHEAD

Wellhead at end of operations.

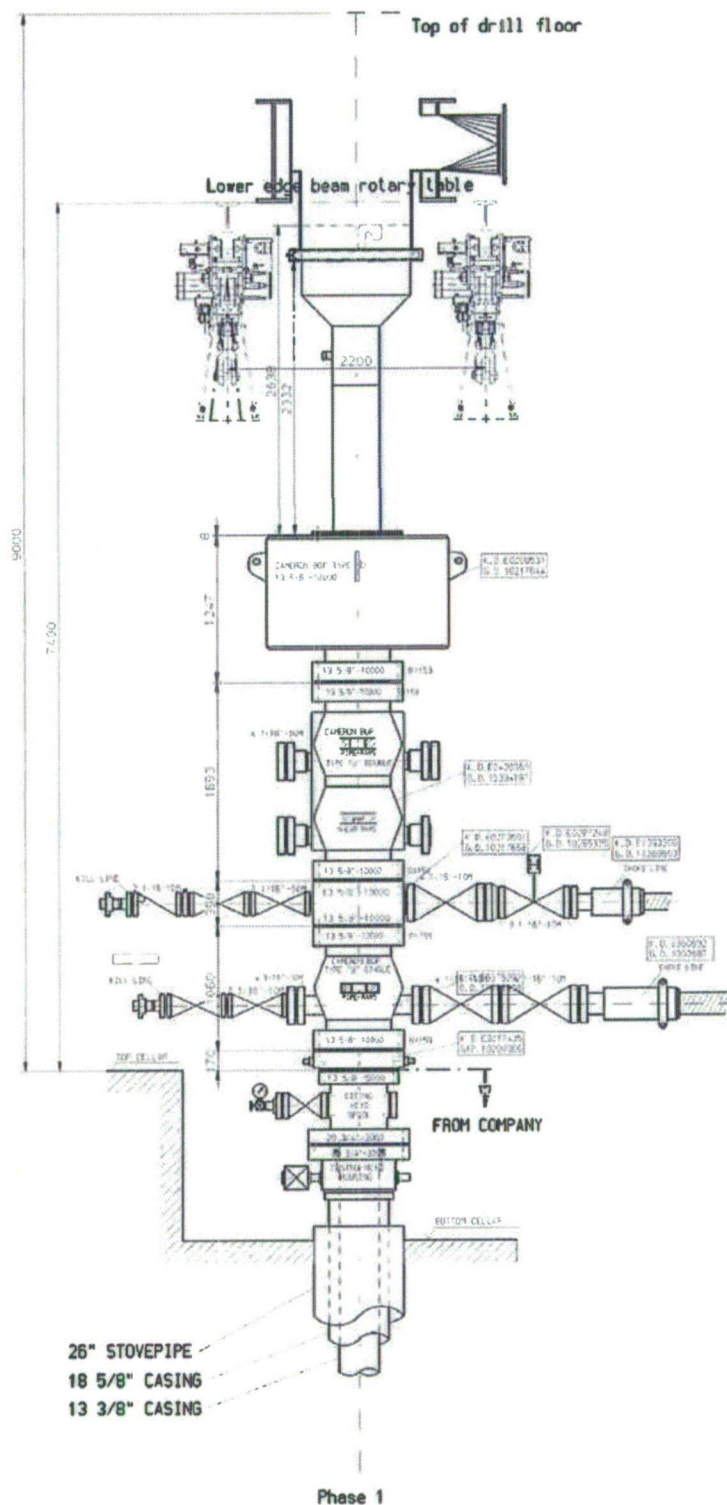
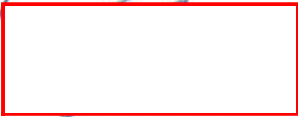


Figure 4: Wellhead

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6. SIGN SHEET

	Name & Function	Signature	Date
Prepared by	 Drilling Engineer		9 Feb 15
Reviewed by	 Lead ops Engineer		2 Feb 15
Reviewed by	 Drilling Advisor		9 12/2015
Approved by	 Drilling Manager		03 Feb. 15
Approved by	 Project manager		09/02/15
Approved by	 Managing Director		03.02.15.

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