End of Well Report
PNA-GT-05 / PNA-GT-05-S1

Ammerlaan Geothermie B.V.

Operator: Ammerlaan Geothermie B.V.
Nootdorpseweg 15
2641 BK Pijnacker

Prepared by: Well Engineering Partners
Toldijk 17-19
7900 AP Hoogeveen (NL)
Tel: +31 (0)528 227710
www.wellengineeringpartners.com

Version: 1.0

Publication date: 0 Oct 2019

Document signature sheet:

	Name	Function	Signature	Date
Prepared by	[redacted]	Sr. Drilling Engineer	[redacted]	Digitaal ondertekend door [redacted] Datum: 2019.10.01 13:40:08 +02'00'
Checked by	[redacted]	Drilling Manager	[redacted]	Digitaal ondertekend door [redacted] Datum: 2019.10.01 14:06:25 +02'00'
Approved by	[redacted]	Operator	[redacted]	1-10-2019

Document Revision Control:

Revision no.	Chapter	Changed Items
0.3		Draft issued for internal reviews
1.0		Final version

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GLOSSARY

AH	Along hole
AKO	Adjustable Kick-Off
BGL	Below ground level
BHA	Bottom hole assembly
BOP	Blowout preventer
CBL	Cement bond log
CHH	Casing head housing
C/O	Change Out
CP	Conductor Pipe
CRT	Casing running Tool
DC	Drill Collar
DP	Drill pipe
DSV	Drilling supervisor
EMW	Equivalent mud weight
ESP	Electric submersible pump
FMS	Flush Mounted Spider
FIT	Formation integrity test
FOSV	Full opening safety valve
GL	Ground level
GR	Gamma-Ray
HSE	Health, Safety & Environment
HWDP	Heavyweight drillpipe
IR	Iron Roughneck
LCM	Lost circulation material
LOT	Leak Of Test
LTI	Lost Time Incident
MD	Measured Depth
MW	Mud Weight
MWD	Measurement while drilling
NAP	Normaal Amsterdams Peil
NDSV	Night Drilling Supervisor
NPT	Non-productive time
OH	Open hole
PBL	Circulation sub
PBR	Polished Bore Receptacle
PDC	Polycrystalline diamond compact
PDM	Positive displacement (mud) motor
PJSM	Pre-job safety meeting
POA	Plan of action
POOH	Pull out of hole
ppf	pounds per foot
P/U	Pick Up
PUW	Pick up weight
PV	Plastic viscosity
R/D	Rig Down
RF	Rig Floor
RIH	Run in hole
ROP	Rate of penetration
RSS	Rotary steerable system
RT	Rotary table
RTTS	Retrievable Test-Treat-Squeeze (packer)
R/U	Rig Up
s.g.	Specific gravity
SodM	Staatstoezicht op de Mijnen
SOW	Slack off weight
Spm	Strokes per minute
SPP	Stand pipe pressure
TD	Total depth
TDS	Top Drive Swivel
TOC	Top of cement
TOL	Top of liner
TRS	Tubular Running Services
TP	Toolpusher
TSP	Top Set Packer
TVD	True vertical depth
TWCV	Two Way Check Valve
WBM	Water Based Mud
WOB	Weight on bit
WOC	Wait on cement
WWS	Wire-wrapped screen
YP	Yield point

1. Project Details

1.1 *Organisation*

Project Management:

Project Director	
Project Manager	
Drilling Manager	
Sr. Drilling Engineer	
Drilling Engineer	
Sr. Well Site Geologist	
HSE Manager	

Drilling Supervisors on 2 week rotational scheme:

Drilling Supervisor		17-08-2018 / 28-08-2018 11-09-2018 / 25-09-2018 09-10-2018 / 24-10-2018
Drilling Supervisor		25-09-2018 / 09-10-2018 29-10-2018 / 31-10-2018
Drilling Supervisor		28-08-2018 / 11-09-2018
Drilling Supervisor		24-10-2018 / 29-10-2018
Night Drilling Supervisor		21-08-2018 / 04-09-2018 18-09-2018 / 3-10-2018 11-10-2018 / 13-10-2018
Night Driling Supervisor		13-10-2018 / 31-10-2018
Night Drilling Supervisor		17-08-2018 / 21-08-2018 04-09-2018 / 18-09-2018 03-10-2018 / 11-10-2018
S-1		
Drilling Supervisor		01-07-2019 / 21-07-2019
Night Drilling Supervisor		01-07-2019 / 22-07-2019
ESP installation and Clean out		
Drilling Supervisor		02-08-2019 / 13-08-2019

1.2 *Operational summary*

Field	Pijnacker-Nootdorp 4
Well Number:	PNA-GT-05
Well Name	Pijnacker-GT-05
Well Type	Geothermal Production
Start operations	18-08-2018; 18:00 hr
Spud date	21-08-2018; 04:00 hr
Start demobilization (end of well)	28-10-2018; 11:30 hr
Days Operational	68.3 days

Well Number:	PNA-GT-05-S1
Well Name	Pijnacker-GT-05-S1
Well Type	Geothermal Production
Start operations	01-07-2019; 07:00 hr
Sidetrack date	04-07-2019; 10:00 hr
Start demobilization (end of well)	22-07-2019; 21:00 hr
Days Operational	21.6 days
ESP installation and Clean out	
Start operations	09-08-2019; 13:00 hr
End operations	13-08-2019; 17:00 hr

Operator	Ammerlaan Geothermie B.V.	
	Latitude & Longitude (ETSR89)	Geographical
Surface Location	52° 01’ 18,454”N 4° 25’ 22,105”E	X: 88784,890m (RD) Y: 448491,976m (RD)
Grid Coordinate System	Rijksdriehoeksmeting / Netherlands New	
Depth reference	Rotary Table (RT)	

1.3 *Drilling rig*

Drilling Contractor	Innodrill
Drilling Rig	LOC400 – “Heracles”

2. Well summary

The table below gives a summary of the drilling operation per hole section.

Table 1: Well summary

Item	MD (m)	TVD (m)	Comments
24" Conductor	100	100	Pre-installed.
20" Hole	928	926	Drilled vertical to KOP at 717m. Drilled directionally to 928m.
16" Casing	924	922	Ran casing, tag bottom at 928m, pull up and position casing shoe at 924m. Cemented casing to surface.
12 ¼" Hole	2871	2150	Drilled 3m of new formation. Performed FIT to 1,51sg EMW. Drilled directionally to 1647m. Drilled tangent to section TD at 2871m in de Rodenrijs Claystone. Circulated clean and increased MW from 1.25 to 1.30 SG. POOH.
9 ⅝" Liner	(TOL) 730 (Shoe) 2730	(TOL) 730 (Shoe) 2076	Ran liner to 2003 m, made up liner hanger and RIH to 2732m, stood up. Set liner hanger with shoe at 2730m (141m off bottom). Cemented liner. Set packer. Pulled the liner setting tool above the top liner and circulated clean. No spacer/cement returns at surface.
8 ½" x 9 ½" Hole	2383	3308	Drilled hole directional with RSS and Rhino-reamer to TD at 3308m.
7 ⅝" Liner	2306	3164	Ran WWS liner till 2726m. Washed and worked down liner to 2787m, unable to work past. POOH liner. Ran Rhino reamer, moderate reaming needed to get to bottom (reamer closed). The under reamer was activated and the open hole section was back reamed to the shoe. POOH. RIH 8 ½" rotary BHA, several times washed/reamed till the hole was smooth. Ran WWS liner (with 8 ½" bit NB-stab and motor below) till 2666m, washed down liner to 2740m. Washed and worked down liner to 3164 m. Unable to work deeper. Set liner hanger and packer. Pulled the liner hanger running tool with difficulty out of the liner. POOH, part of liner hanger running tool and 2⅞" inner string left in hole.
Fishing			Attempted to fish the RSM pack-off without success. On final run lost grapple in the hole. Halted fishing operations and demob.
Suspend well			Installed tubing hanger with TWCV. Installed tubing head adapter and blind flange.
Fishing with slickline			Attempted to fish grapple. After total of 60 runs grapple not retrieved. Operations suspended for 1 week to fabricate new tools. Another 26 runs were made with no success, lost wire grab in the hole. Operations suspended. Installed tubing hanger with TWCV. Installed tubing head adapter and blind flange.
Fishing with slickline and rig			Made several attempts to fish lost wire line tool at 2579,80 m without success. Circulated well to 1,08 sg brine. Rig up wire line and RIH with camera to fish position. No visibility. On 2nd run camera tool string stuck @ 2577m. Sheared weak point at cable socket. Recovered full e-line cable. RIH with slick line and recover camera tool string. Engaged 5 ¾" grapple on lost wireline tools. Recovered wire line tool string.

			Slick line fishing operation with magnet and LIB run. Suspended fishing operations after no success, set plug type tester in wellhead. Closed all side outlets, kill and choke line valves. Closed mechanical locks on shear rams. Suspended all operation.
8 ½" hole sidetrack	2377	3211	A scraper run was made to 2574m. Fluid changed out to drill-in fluid. Set whipstock, milled window at 2539 m. Ran a 2nd Tri Mill BHA to mill and polish the window. Ran directional BHA with PDC bit, drilled directionally to TD at 3211 m.
6 ⅝" x 7" Liner	2894	3205	Ran 6 ⅝" WWS x 7" blank pipe liner string with a 2 ⅞" inner string. Install liner hanger and ran liner to 3205 m. Set hanger and packer and POOH.
Suspend well			Removed BOP and installed blind flange.
ESP installation and Clean out			Run inhibitor line in hole, connect to ESP bullnose. RIH ESP with dual inhibitor line and ESP cable on 8 ⅝" casing. Land hanger and install tubing head adaptor and X-mas tree. Produce water to clean up well.

2.1 *Depths and trajectory*

Primary Objective		Delft Sandstone	
PNA-GT-05			
Primary Objective Depth		2882 m MD	2156 m TVD
Total Depth		3308 m MD	2383 m TVD
PNA-GT-05-S1			
Primary Objective Depth		2894 m MD	2160 m TVD
Total Depth		3211 m MD	2377 m TVD
Elevation	RT – GL	8.10 m	
	GL – NAP	-1.47 m (NAP is 1.47m above ground level)	

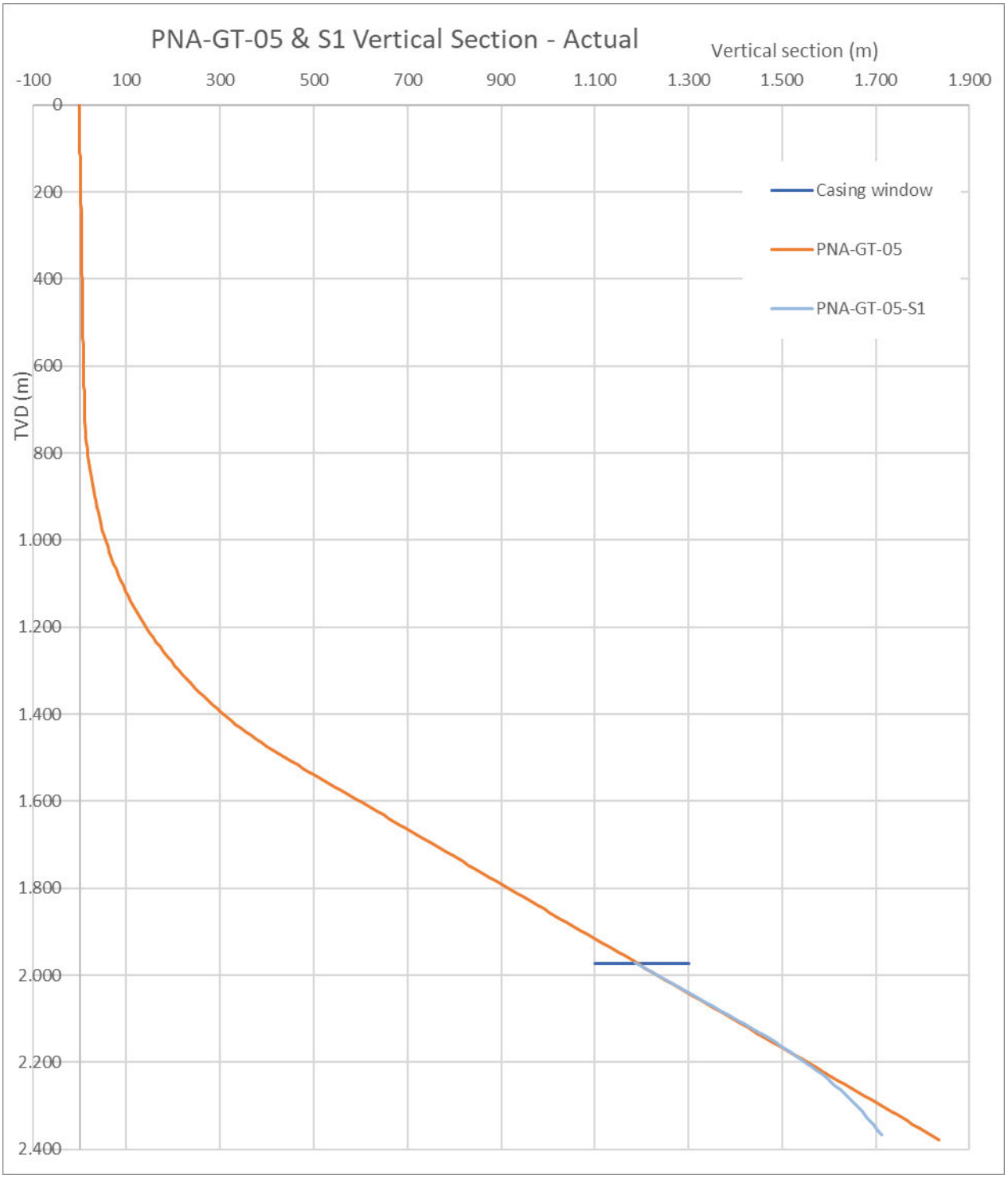


Figure 1. Vertical section

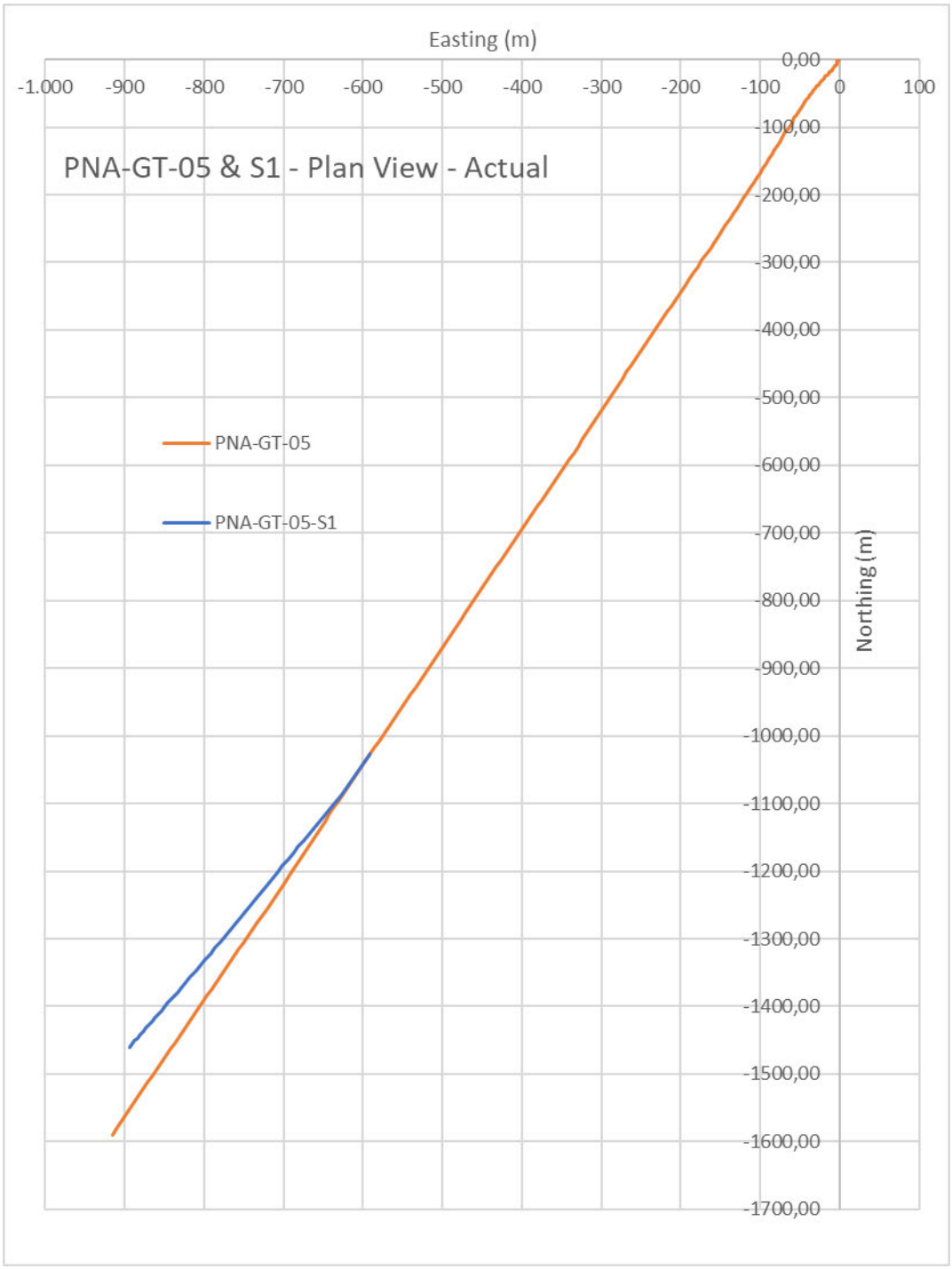


Figure 2. Plan view

2.2 *Technical summary*

2.2.1 Casing

Table 2: PNA-GT-05 tubular summary

Item	Top (m MD)	Bottom (m MD)	Weight	Grade	Connection
24" Conductor	0	100	0.5" WT		Welded
16" Casing	0	924	84 ppf	J55	BTC
13 ⅜" Tieback Casing	0	730	72 ppf	L80	VAM TOP (SC)
9 ⅝" Liner	730	2730	53.5 ppf	L80	VAM TOP
7 ⅝" Liner / 8.23" OD WWS	2573	3164	26.4 ppf	L80	HC Polseal-1 SC
Note: Whipstock placed in 9 ⅝" liner above 7 ⅝" liner hanger.					

Table 3: PNA-GT-05-S1 tubular summary

Item	Top (m MD)	Bottom (m MD)	Weight	Grade	Connection
7" Liner	2405	2464	29 ppf	C95	VAM TOP HT
7" Liner	2465	2894	23 ppf	L80	VAGT
6 ⅝" WWS Liner	2894	3205	24 ppf	L80	VAGT

Table 4: PNA-GT-05-S1 ESP and production string (ref. mBGL)

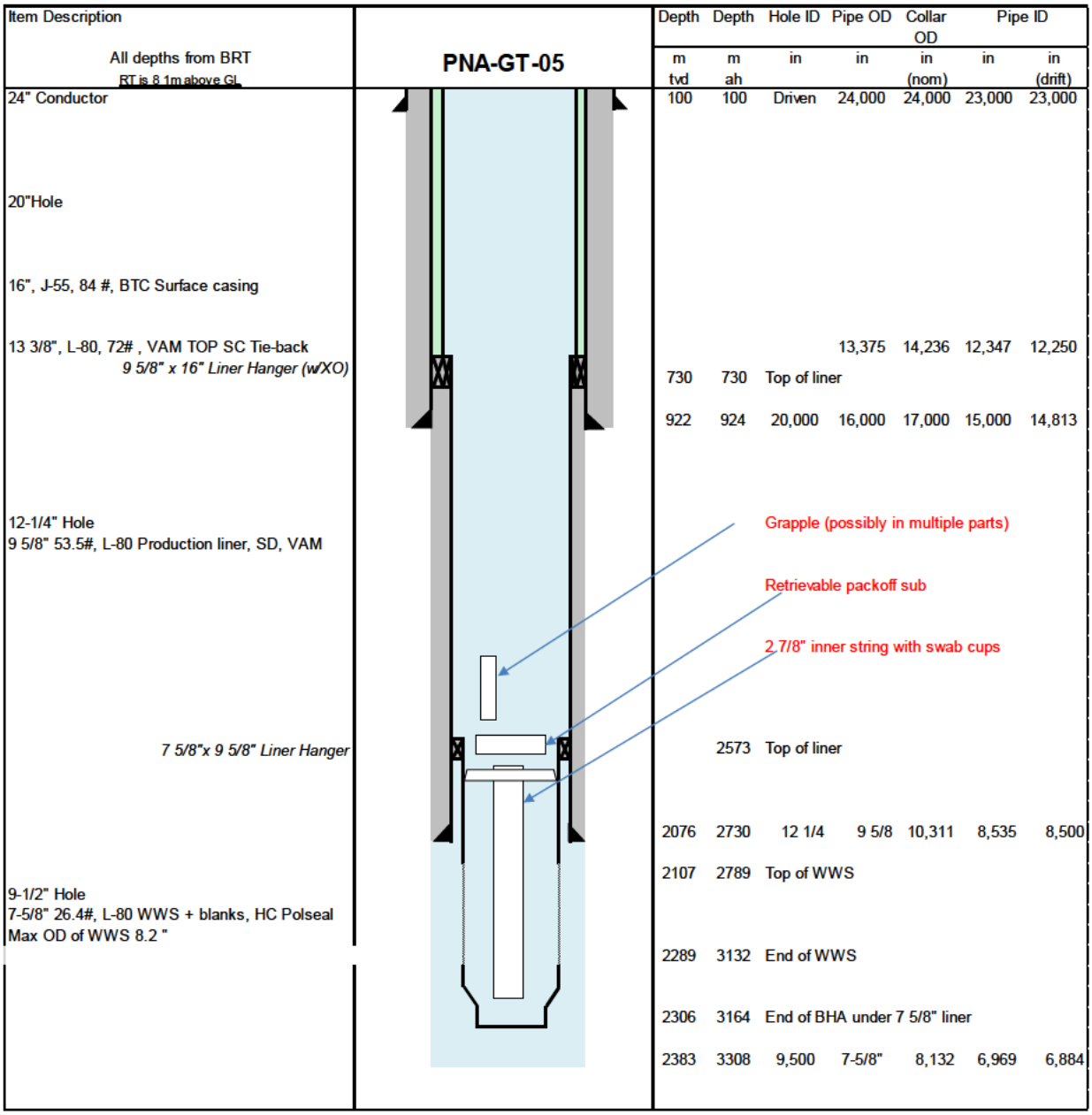
Item	Top (m MD)	Bottom (m MD)	Weight	Grade	Connection
8 ⅝" Production string	0	667,62	32 ppf	L80	HC Polseal-1
ESP	667,62	688.32			
⅜" Inhibitor line	688.32	2363.32			

2.2.2 Cement

Table 5: PNA-GT-05 cement summary

Item	TOC (m MD)	Lead Slurry Volume (m^3)	Lead Slurry Weight (s.g.)	Tail Slurry Volume (m^3)	Tail Slurry Weight (s.g.)	Type
16" Casing	Surface	135	1.58	17.6	1.67	PozzoCemoil
9 ⅝" Liner	@ 100 m below TOL based on calculations	101.6	1.60	14.5	1.67	PozzoCemoil

2.2.3 Well schematic



Item Description	Depth m tvd	Depth m ah	Hole ID in	Pipe OD in	Collar OD in (nom)	Pipe ID in	Pipe ID in (drift)
All depths from BRT RT is 8.1m above GL							
24" Conductor	100	100	Driven	24,000	24,000	23,000	23,000
20"Hole							
16", J-55, 84 #, BTC Surface casing							
13 3/8", L-80, 72# , VAM TOP SC Tie-back				13,375	14,236	12,347	12,250
9 5/8" x 16" Liner Hanger (w/XO)	730	730	Top of liner				
	922	924	20,000	16,000	17,000	15,000	14,813
12-1/4" Hole 9 5/8" 53.5#, L-80 Production liner, SD, VAM							
7 5/8"x 9 5/8" Liner Hanger		2573	Top of liner				
	2076	2730	12 1/4	9 5/8	10,311	8,535	8,500
9-1/2" Hole 7-5/8" 26.4#, L-80 WWS + blanks, HC Polseal Max OD of WWS 8.2 "	2107	2789	Top of WWS				
	2289	3132	End of WWS				
	2306	3164	End of BHA under 7 5/8" liner				
	2383	3308	9,500	7-5/8"	8,132	6,969	6,884

Figure 3: PNA-GT-05 well schematic

tem Description All depths from BRT RT is 8.1m above GL	PNA-GT-05-S1	Depth m tvd	Depth m ah	Hole ID in	Pipe OD in	Collar OD in (nom)	Pipe ID in	Pipe ID in (drift)
24" Conductor		100	100	Driven	24,000	24,000	23,000	23,000
20"Hole								
16", J-55, 84 #, BTC Surface casing								
13 3/8", L-80, 72# , VAM TOP SC Tie-back					13,375	14,236	12,347	12,250
9 5/8" x 16" Liner Hanger (wXO)		730	730	Top of liner				
		922	924	20,000	16,000	17,000	15,000	14,813
12-1/4" Hole 9 5/8" 53.5#, L-80 Production liner, SD, VAM								
				12 1/4	9 5/8	10,311	8,535	8,500
7" x 9 5/8" Liner Hanger			2405	Top of liner				
7" 29#, C-95 Blank joints, VAMTOP HT Crossover VAMTOP to VAGT			2464					
			2540	Window in 9 5/8" casing				
7" 23#, L-80 Blank joints, VAGT								
Crossover 6 5/8" to 7"			2894	Top of WWS				
6-5/8" WWS on 24#, L-80, VAGT								
8-1/2" Hole			3190	End of WWS				
			3205	End of liner				
			3211	8,500				

Figure 4: PNA-GT-05-S1 well schematic

Item Description	PNA-GT-05-S1	Depth m tvd	Depth m ah	Hole ID in	Pipe OD in	Collar OD in (nom)	Pipe ID in	Pipe ID in (drift)
All depths from Ground Level RT was 8.1m above GL								
24" Conductor		92	92	Driven	24,000	24,000	23,000	23,000
20"Hole								
				ESP on 8 5/8" Polseal				
16", J-55, 84 #, BTC Surface casing								
		668	668	Bottom bull nose				
13 3/8", L-80, 72# , VAM TOP SC Tie-back					13,375	14,236	12,347	12,250
9 5/8" x 16" Liner Hanger (w/XO)		722	722	Top of liner				
		914	916		20,000	16,000	17,000	15,000	14,813
12-1/4" Hole								
9 5/8" 53.5#, L-80 Production liner, SD,								
			2363	Inh bitor line				
				12 1/4	9 5/8	10,311	8,535	8,500
7" x 9 5/8" Liner Hanger			2397	Top of liner				
7" 29#, C-95 Blank joints, VAMTOP HT			2456					
Crossover VAMTOP to VAGT								
			2532	Window in 9 5/8" casing				
7" 23#, L-80 Blank joints, VAGT								
Crossover 6 5/8" to 7"			2886	Top of WWS				
6-5/8" WWS on 24#, L-80, VAGT								
8-1/2" Hole			3182	End of WWS				
			3197	End of liner				
			3203	8,500				

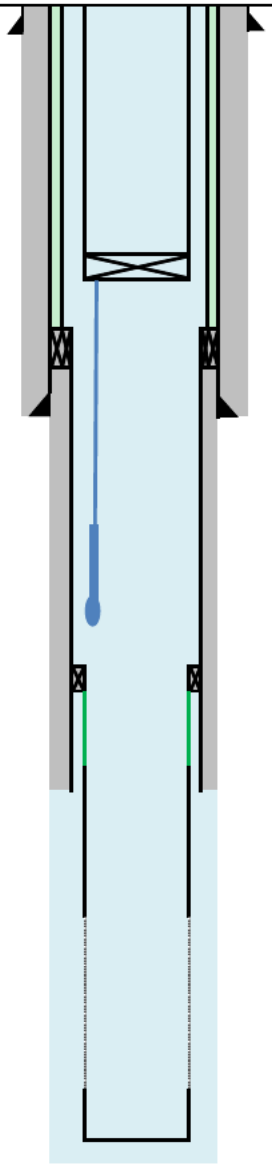


Figure 5: PNA-GT-05-S1 wellschematic after Completion

3. Drilling fluid summary

Per section the following drilling fluid types have been used:

Table 6: PNA-GT-05 drilling fluid summary

Section	Type	Density (s.g.) Min – Max	PV (cP) Min – Max	YP (lbf/100ft2) Min – Max
20"	TriGuard – Pure bore WBM	1.08 – 1.22	6 – 17	10 – 29
12 ¼"	TriGuard – Pure bore WBM	1.16 – 1.27	12 – 32	14 – 28
8 ½" x 9 ½"	Pure-Bore Drill-in Fluid	1.21 – 1.26	10 – 24	18 – 25

Table 7: PNA-GT-05-S1 drilling fluid summary

Section	Type	Density (s.g.) Min – Max	PV (cP) Min – Max	YP (lbf/100ft2) Min – Max
8 ½"	Pure-Bore Drill-in Fluid	1.20 – 1.27	4 – 15	18 – 27

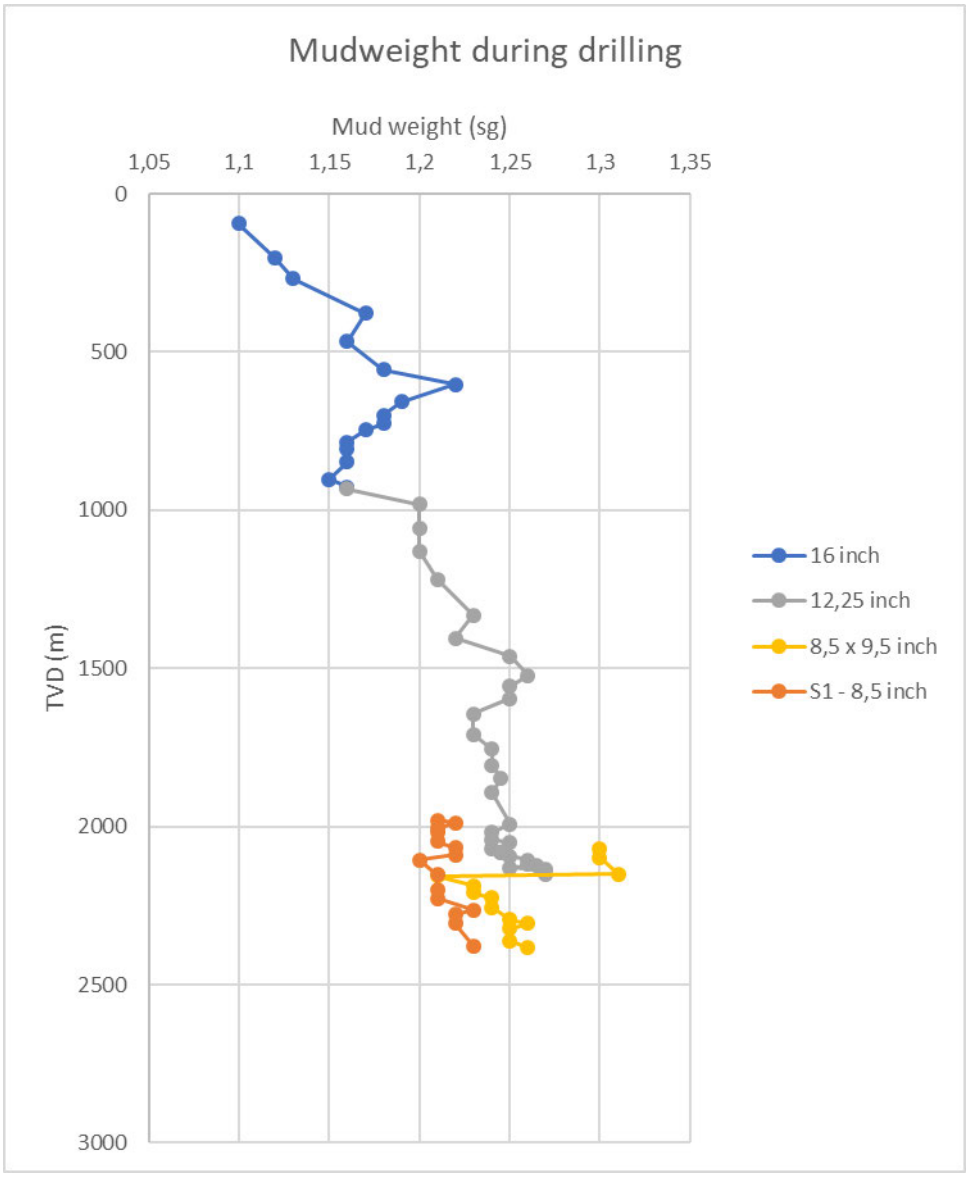


Figure 6: Mud weight vs. TVD

4. Geology

4.1 *Lithostratigraphic column*

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

Lithostratigraphic Column PNA-GT-05 Julien Smeulders							Expected		Actual	
Era	Group	Period	Formation	Epoch (Age)	Member	Lithology	TV-RT	AH-RT	TV-RT	AH-RT
Cenozoic	Upper North Sea NU	Quaternary	"Diverse"	Holocene-Pleistocene		Diverse continental deposits, mostly fluvial sands and clits interoalated by some thin layers of grey or greenish grey, silty olays.	8,7	8,7	8,7	8,7
			Maassluis NUMS	Early Pleistocene		Deposits of coastal sands, very fine to medium coarse, calcareous, shell and wood bearing, mica rich. Silty to sandy, grey to dark grey olay containing shells and	109	109	no gamma	
		Tertiary	Oosterhout NUOT	Pliocene		Succession of sands, sandy olays, and grey and greenish olays. The lower part of the formation often consists of sands that are extremely rich in shells and bryozoans.	241	241	243	243
			Breda NUBA	Miocene		Sequence of marine, glauconitic sands, sandy olays and olays. In places a glauconite-rich layer occurs at the base.	388	388	385,5	385,5
	Middle North Sea NM		Rupel NMRF	Oligocene/Eocene Rupelian to Chattian	Rupel Clay NMRFC	Clays that become more silty towards basis and top. It is rich in pyrite, contains hardly any glauconite and calcium carbonate tends to be concentrated in the septaria layers.	426	426	430	430
					Vessem NMRFV	Silty to olayey sands with a low glauconite content, flint pebbles or phosphorite nodules commonly occur at the base.	445	445	448	448
	Lower North Sea NL		Landen NLLF	Late Paleocene Thanetian	Landen Clay NLLFC	Generally dark-green, hard, flaky olay, somewhat silty, containing glauconite, pyrite and mica. The basal part of the member can be marly and of a lighter colour.	450	450	454	454
Mesozoicum	Chalk CK	Cretaceous	Ommelanden CKGR	Upper Cretaceous Turonian to Maastrichtian		Succession of white, yellowish-white or light-grey, fine grained limestones, in places argillaceous. Layers of chert nodules can be very common over thick intervals. Along the basin edge coarse, bioclastic limestones and tongues of sandstone occur.	469	469	471	471
			Texel CKTX	Cenomanian	Plenus Marl CKTXP	Dark-grey, partly black, calcareous, laminated claystone.	756	756	760	760
					Texel Marlstone CKTXM	White to light-grey (locally pinkish) limestones, marls and marly chalks.	762	762	767	767
	Rijnland KN		Holland KNGL	Lower Cretaceous Late Albian	Upper Holland Marl KNGLU	Light-grey and red-brown marls, characterised by a carbonate content which gradually increases towards the top.	792	792	786	786,5 20° section TD @ 928m
				Late Aptian to Early Albian	Middle Holland Claystone KNGLM	Grey and/or red-brown calcareous chaly claystone with a distinctly lower lime content than the under- and overlying members.	961	964	1011,5	1016
				Early Albian	Holland Greensand KNGLG	Alternation of greenish grey, very glauconitic, very fine- to fine-grained, argillaceous sandstones, locally silt-stones with calcareous or sideritic cement, and olive-grey claystones or grey marlstones.	986	990	1090	1100
				Early Aptian	Lower Holland Marl KNGLL	Grey and red-brown marl or calcareous, fissile claystone, frequently with interoalated bituminous claystone beds and sandstone beds.	1042	1050	1201	1224
			Vlieland Sandstone KNNS	Late Barremian to Early Aptian	De Lier Sandstone KNNSL	Alternation of thin-bedded, very fine- to fine-grained argillaceous sandstones, generally glauconitic and lignitic, and sandy claystones, commonly glauconitic and with shell fragments and frequent bioturbation.	1341	1402	1362,5	1429
				Late Barremian	Vlieland Clay KNNCM	Dark brownish-grey to grey claystone. Mica and very fine lignitic matter are common. The formation can be very silty to sandy with many interoalated siltstone and very fine sandstone beds. Slightly calcareous.	1408	1482	1444	1551
				Late Hauterivian to Mid Barremian	Berkel Sandstone KNNSB	Sandstone, light-grey, very fine- to fine- and medium- to coarse-grained, locally gravelly, lignitic, locally glauconitic or with sideritic concretions. Especially in the upper part calcareous cemented beds are common.	1959	2512	1969	2529,5
				Late Hauterivian to Early Barremian	Berkel Sand-Claystone KNNSB	Alternation of fine-grained, argillaceous sandstones and brown-grey silty to sandy claystones. Locally sideritic concretions are present.	1994	2578	1981	2552,5
				Hauterivian	Rijswijk Sandstone KNNSR	Light- to medium-grey sandstones with a very fine to medium and locally gravelly grain size; mica, lignitic matter and siderite concretions are common.	1998	2586	1987,5	2565
	Schieland SL		Nieuwerkerk SLDN	Late Valanginian to Early Hauterivian	Rodenrijs Claystone SLDNR	Medium- to dark-grey and dark brown, silty to sandy lignitic claystones with laminated or contorted bedding, and lignite/coal beds. Traces of mollusc shells, pyrite and siderite.	2007	2603	2029	2642,5
				Valanginian	Delft Sandstone SLDND	Light-grey massive sandstone sequence, very fine to coarse-gravelly. Shale/claystone interoalations and coal/lignite beds are common. Siderite is also common.	2171	2912	2156	2882
				Lower Cretaceous to Upper Jurassic Ryazanian to Valanginian	Alblasserdam SLDNA	Variegated claystones (grey, red, oker yellow, brown) and siltstones, fine to medium grained sandstone beds and massive, thick-bedded, coarse grained sandstones. Coal, lignite beds, shells and siderite are common.	2365	3278	2356	3258
RT - NAP = 7,23m; NAP - GL = 1,47m above GL; RT - GL = 8,7m						TD	2372	3293	2383	3308

12 1/4" section TD @ 2871m MD; 9 5/8" shoe depth @ 2730m MD

Table 8: PNA-GT-05 geological lithostratigraphic column

Lithostratigraphic Column PNA-GT-05-S1 Julien Smeulders							Expected		Actual	
Era	Group	Period	Formation	Epoch (Age)	Member	Lithology	TV-RT	AH-RT	TV-RT	AH-RT
Cenozoic	Upper North Sea NU	Quaternary	"Diverse"	*Holocene-Pleistocene*		Diverse continental deposits, mostly fluvial sands and silts intercalated by some thin layers of grey or greenish grey, silty clays.	8,7	**8,7**	8,7	**8,7**
			Maassluis NUMS	*Early Pleistocene*		Deposits of coastal sands, very fine to medium coarse, calcareous, shell and wood bearing, mica rich. Silty to sandy, grey to dark grey clay containing shells and	109	**109**	no gamma	
		Tertiary	Oosterhout NUOT	*Pliocene*		Succession of sands, sandy clays, and grey and greenish clays. The lower part of the formation often consists of sands that are extremely rich in shells and bryozoans.	241	**241**	243	**243**
			Breda NUBA	*Miocene*		Sequence of marine, glauconitic sands, sandy clays and clays. In places a glauconite-rich layer occurs at the base.	388	**388**	385,5	**385,5**
	Middle North Sea NM		Rupel NMRF	*Oligocene/Eocene Rupelian to Chattian*	Rupel Clay NMRFC	Clays that become more silty towards basis and top. It is rich in pyrite, contains hardly any glauconite and calcium carbonate tends to be concentrated in the septaria layers.	426	**426**	430	**430**
					Vessem NMRFV	Silty to clayey sands with a low glauconite content, flint pebbles or phosphorite nodules commonly occur at the base.	445	**445**	448	**448**
	Lower North Sea NL		Landen NLLF	*Late Paleocene Thanetian*	Landen Clay NLLFC	Generally dark-green, hard, flaky clay, somewhat silty, containing glauconite, pyrite and mica. The basal part of the member can be marly and of a lighter colour.	450	**450**	454	**454**
Mesozoicum	Chalk CK	Cretaceous	Ommelanden CKGR	*Upper Cretaceous Turonian to Maastrichtian*		Succession of white, yellowish-white or light-grey, fine grained limestones, in places argillaceous. Layers of chert nodules can be very common over thick intervals. Along the basin edge coarse, bioclastic limestones and tongues of sandstone occur.	469	**469**	471	**471**
			Texel CKTX	*Cenomanian*	Plenus Marl CKTXP	Dark-grey, partly black, calcareous, laminated claystone.	756	**756**	760	**760**
					Texel Marlstone CKTXM	White to light-grey (locally pinkish) limestones, marls and marly chalks.	762	**762**	767	**767**
	Rijnland KN		Holland KNGL	*Lower Cretaceous Late Albian*	Upper Holland Marl KNGLU	Light-grey and red-brown marls, characterised by a carbonate content which gradually increases towards the top.	792	**792**	786	**786,5** 20" section TD @ 928m
				Late Aptian to Early Albian	Middle Holland Claystone KNGLM	Grey and/or red-brown calcareous shaly claystone with a distinctly lower lime content than the under- and overlying members.	961	**964**	1011,5	**1016**
				Early Albian	Holland Greensand KNGLG	Alternation of greenish grey, very glauconitic, very fine- to fine-grained, argillaceous sandstones, locally silt-stones with calcareous or sideritic cement, and olive-grey claystones or grey marlstones.	986	**990**	1090	**1100**
				Early Aptian	Lower Holland Marl KNGLL	Grey and red-brown marl or calcareous, fissile claystone, frequently with intercalated bituminous claystone beds and sandstone beds.	1042	**1050**	1201	**1224**
			Vlieland Sandstone KNNS	*Late Barremian to Early Aptian*	De Lier Sandstone KNNSL	Alternation of thin-bedded, very fine- to fine-grained argillaceous sandstones, generally glauconitic and lignitic, and sandy claystones, commonly glauconitic and with shell fragments and frequent bioturbation.	1341	**1402**	1362,5	**1429**
				Late Barremian	Vlieland Clay KNNCM	Dark brownish-grey to grey claystone. Mica and very fine lignitic matter are common. The formation can be very silty to sandy with many intercalated siltstone and very fine sandstone beds. Slightly calcareous.	1408	**1482**	1444	**1551**
				Late Hauterivian to Mid Barremian	Berkel Sandstone KNNSB	Sandstone, light-grey, very fine- to fine- and medium- to coarse-grained, locally gravelly, lignitic, locally glauconitic or with sideritic concretions. Especially in the upper part calcareous cemented beds are common.	1959	**2512**	1969	**2529,5**
						Sidetrack (Tie-in) PNA-GT-05-S1 from 2540m AHD (Whipstock)				
				Late Hauterivian to Early Barremian	Berkel Sand-Claystone KNNSB	Alternation of fine-grained, argillaceous sandstones and brown-grey silty to sandy claystones. Locally sideritic concretions are present.	1994	**2578**	1982,5	**2555,5**
				Hauterivian	Rijswijk Sandstone KNNSR	Light- to medium-grey sandstones with a very fine to medium and locally gravelly grain size; mica, lignitic matter and siderite concretions are common.	1998	**2586**	1989,5	**2568,5**
	Schieland SL		Nieuwerkerk SLDN	*Late Valanginian to Early Hauterivian*	Rodenrijs Claystone SLDNR	Medium- to dark-grey and dark brown, silty to sandy lignitic claystones with laminated or contorted bedding, and lignite/coal beds. Traces of mollusc shells, pyrite and siderite.	2007	**2603**	2031	**2649,5**
				Valanginian	Delft Sandstone SLDND	Light-grey massive sandstone sequence, very fine to coarse-gravelly. Shale/claystone intercalations and coal/lignite beds are common. Siderite is also common.	2156	**2912**	2160	**2894**
				Lower Cretaceous to Upper Jurassic Ryazanian to Valanginian	Alblasserdam SLDNA	Variegated claystones (grey, red, oker yellow, brown) and siltstones, fine to medium grained sandstone beds and massive, thick-bedded, coarse grained sandstones. Coal, lignite beds, shells and siderite are common.	2360	**3233**	2350	**3177**
RT - NAP = 7,23m; NAP - GL = 1,47m above GL; RT - GL = 8,7m								**TD**	2377	**3211**

Table 9: PNA-GT-05-S1 geological lithostratigraphic column

4.2 *Hydrocarbons*

No hydrocarbons were seen in the well

5. Wellhead and X-mas tree

5.1 *Well status before completion*

After drilling the well was suspended with a crossover joint from 7 ⅝ to 8 ⅝" below the tubing hanger at 14 m. Seals were pressure tested 25 bar / 5 min and 70 bar / 10 min. TWCV was installed and pressure tested 25 bar / 5 min and 70 bar / 10 min. BOP stack was nippled down. Directly after this the tubing head adapter flange and blind top flange was installed, and pressure tested with 25 bar / 5 min and 70 bar / 10 min.

After slickline fishing operation the well was suspended as above.

After fishing with slickline and rig the well was left with the BOP installed, BOP test plug in the wellhead, and shear rams closed and locked. Pressure tested 25 bar / 5 min and 205 bar / 10 min.

After drilling S1 suspended the well with a blind flange on the 13 ⅝" 3K wellhead housing.

5.2 *Well suspension schematic*

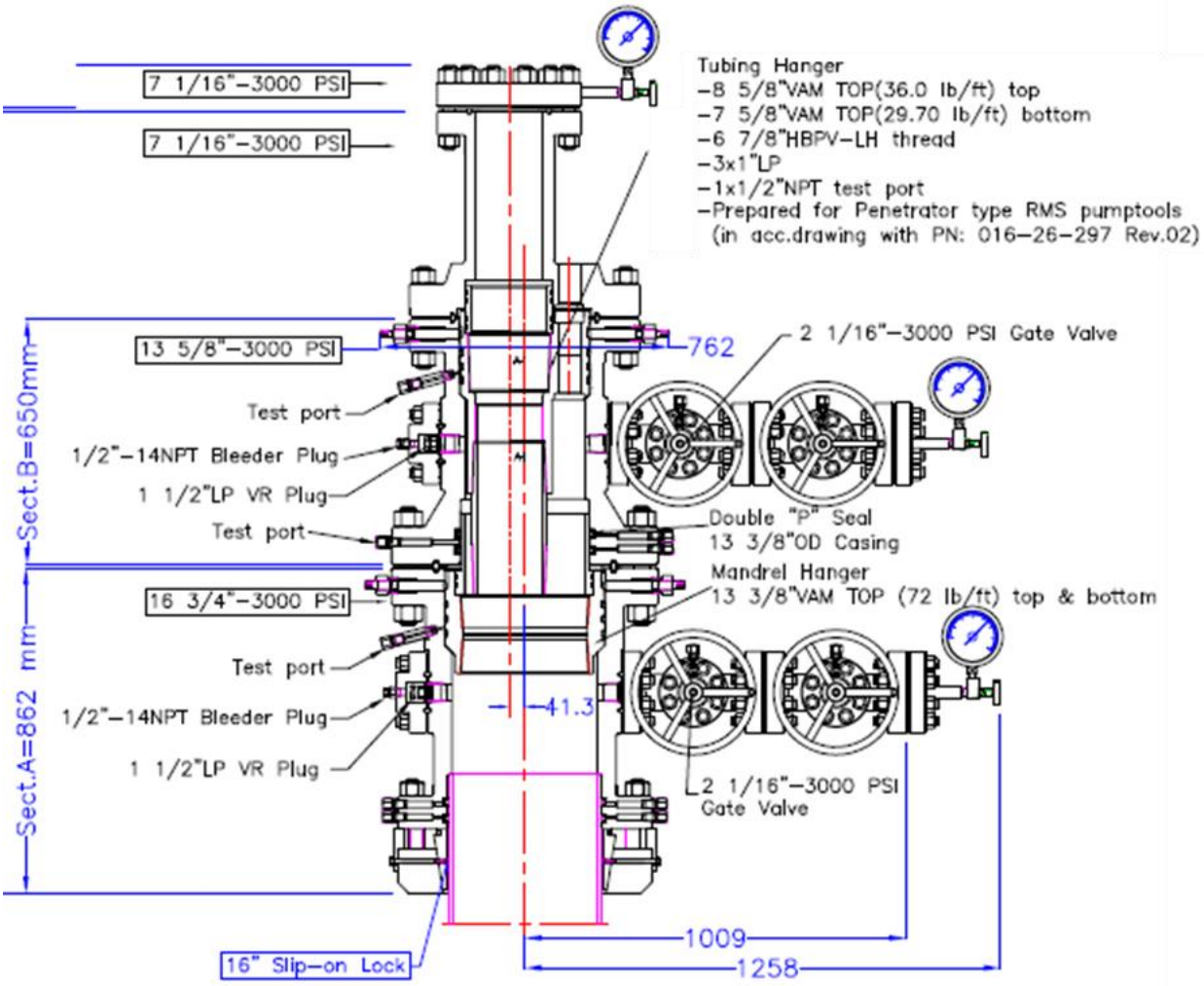


Figure 7: PNA-GT-05 well suspension

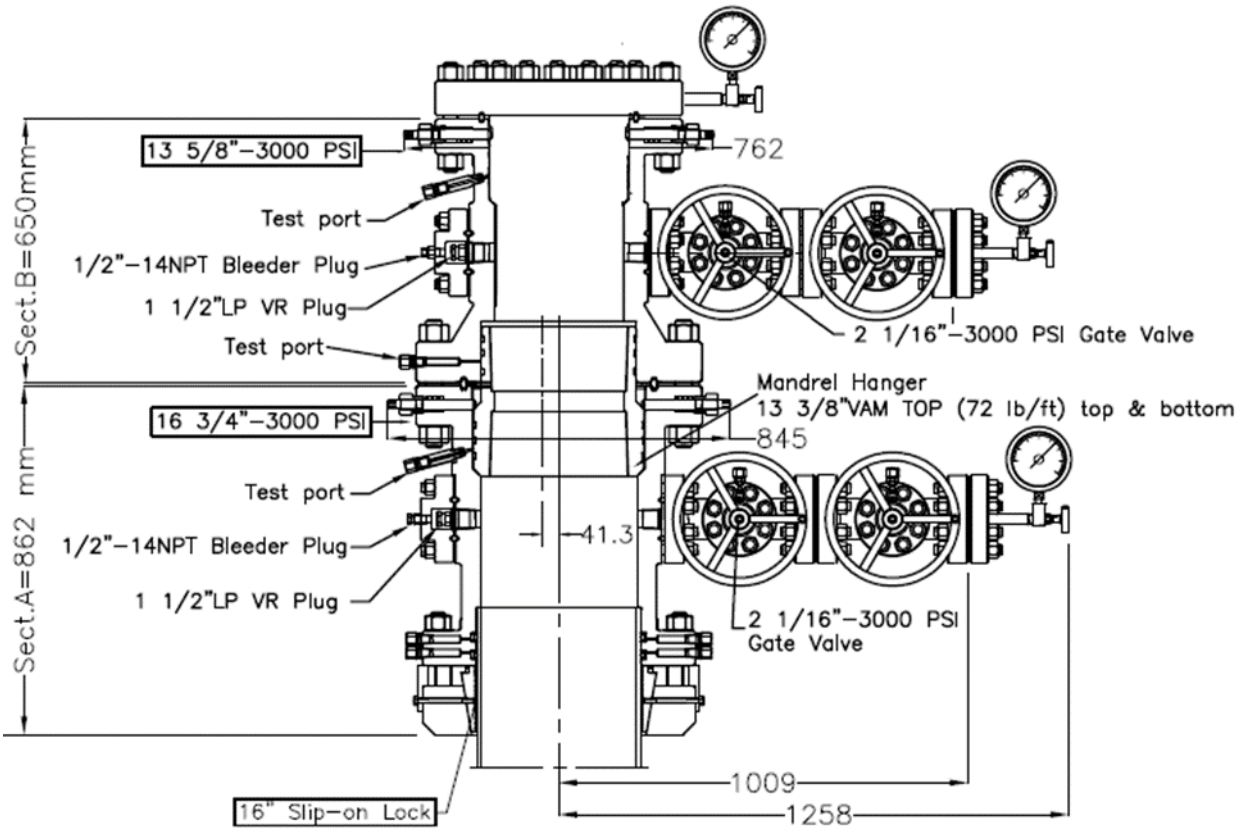


Figure 8: PNA-GT-05-S1 well suspension

5.3 *Well status after completion*

After installation of the ESP in PNA-GT-05-S1 the well was completed with the tubing head adapter and two 7 1/16" gate valves.

5.4 *Wellhead and Christmas tree drawing*

Below is drawing of the final installation.

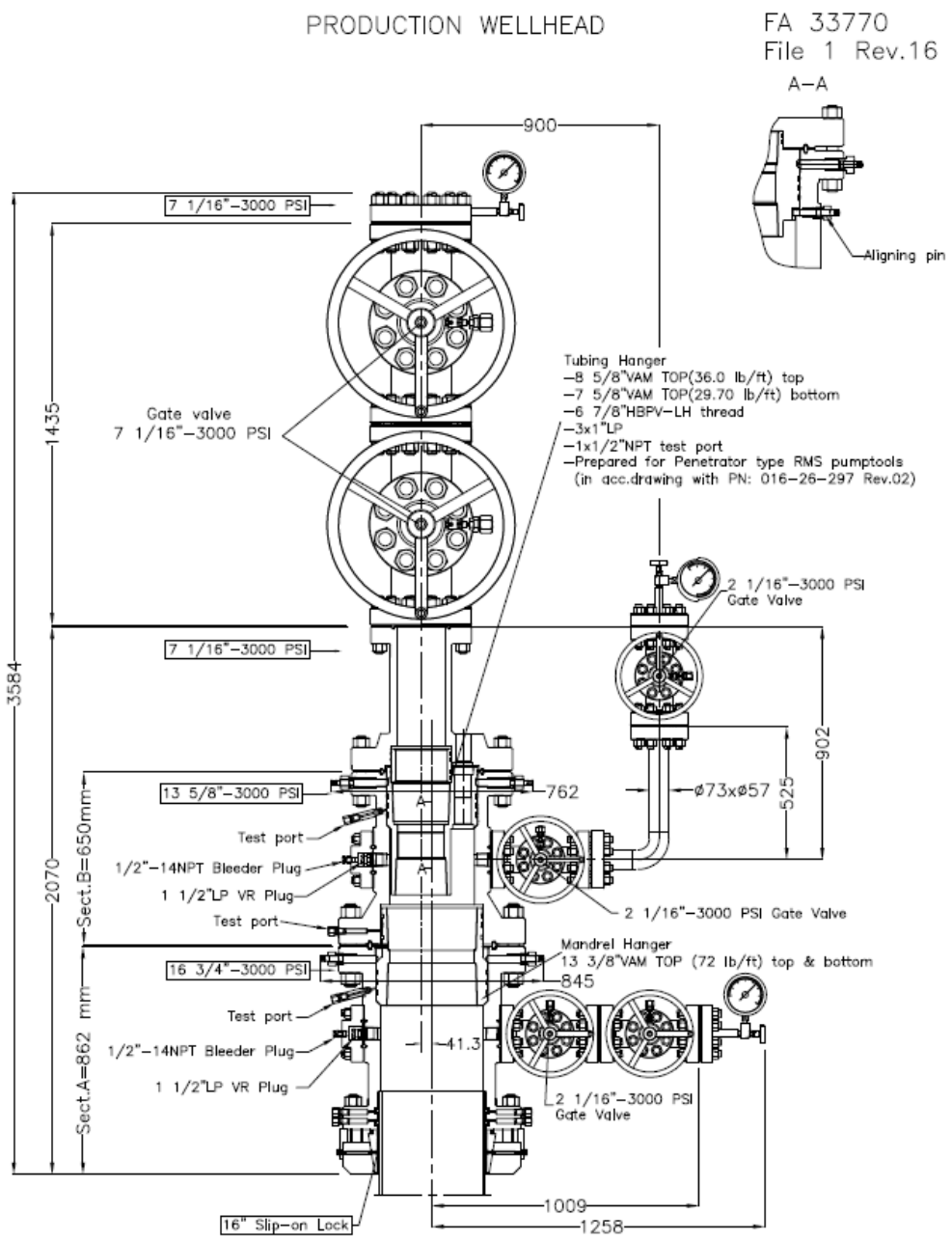


Figure 9: PNA-GT-05 well head and Christmas tree drawing

6. HSE performance

6.1 *General*

To ensure that the operation is carried out in a safe manner, several HSE tools have been implemented both by Ammerlaan Geothermie B.V. and Innodrill during the drilling of PNA-GT-05(-S1).

Innodrill's Permit to Work system was a tool used in order to perform additional activities outside regular drilling activities that carry a potential risk. Both the Toolpusher's and DSV's approval were required for a Permit to Work to come into effect.

Other HSE tools utilized on location were:

- Toolbox meeting during every shift change of rig contractor (06:45 & 18:45)
- Pre-job safety meetings (PJSM) before every non-drilling operation (casing running, cementing, well-test etc.)
- General safety meetings with rig crews
- O-card system of Innodrill
- Regular HSE inspections carried out by HSE coordinator
- Weekly HSE meeting day and night shift.

Total exposure hours: 22700 (PNA-GT-05) and 6930 (PNA-GT-05-S1)

6.2 *Incidents*

- 17 September 2018. Damage to windows of glasshouse
- 19 September 2018. Service Crane Hydraulic Fluid Leak
- 26 October 2018. BX elevator hydraulic fluid leak
- 27 October 2018. Damage to windows of glasshouse
- 19 July 2019. Hydraulic fluid leak on elevator

6.3 *HSE card overview*

301 O-cards were submitted during PNA-GT-05.
88 O-cards were submitted during PNA-GT-05-S1.

6.4 *Drills / Emergency exercises, inspections & audits*

Drill / emergency exercises:

- Fire drills: 26/8/2018, 11/09/2018, 23/09/2018, 4/10/2018
- Muster drills: 20/08/2018, 03/09/2018, 07/10/2018, 14/10/2018, 22/10/2018, 10/06/2019, 02/07/2019
- Kick drills: 22/08/2018, 01/09/2018, 08/09/2018, 23/09/2018, 10/10/2018, 20/10/2018, 10/06/2019, 02/07/2019, 5/07/2019, 07/07/2019, 20/07/2019
- BOP tests: 30/08/2018, 18/09/2018, 20/09/2018, 04-06-2019, 06/06/2019, 30/06/2019,
- SodM visits: 05/8/2018, 10/07/2019