Final Well Report

Woodside Energy Ltd

ACHERNAR-1

Version	**FINAL**	Issued by	Approved by
Name		geoNEXT Unit Crew	ML Field Services Manager
Signatures		Subash Rajamanickam Raju Thottan Mohamed Issaq	Nazem Sharaballi
Date		*26/06/2019*	*26/06/2019*

EXECUTIVE SUMMARY

The Geoservices' geoNEXT system V5 was utilised during the drilling of ACHERNAR-1 well. The Geoservices' crew onboard the Ocean Apex provided relevant and informative well surveillance with the early detection of anomalies before becoming problematic.

Such information was amassed from:

- Formation evaluation (Reserval ™ service)
- Changes in well cuttings and presence of abnormal cavings
- Variation in the background gas levels and the presence of connection gas
- Flow Back fingerprinting and monitoring
- Monitoring hole` displacements while tripping and drilling for irregularities

The displaying of real time data both on and off site using the geoNEXT system offers an important aspect of well surveillance and an integral part of well control.

A diagram of the geoNEXT system is provided in the Unit layout section.

Main Events List

- Drilling 8 ½" section at 2247.0m, Increase active volume – see Event Report # 1
- Drilling 8 ½" section at 2298.0m, Increase in active – see Event Report # 2
- Drilling 8 ½" section at 2439.0m, Increase in SPP,Torque change – see Event Report # 3
- Drilling 8 ½" section at 2717.0m, Increase in active volume see Event Report # 4
- Drilling 8 ½" section at 3130.0m, pop off valve activated – see Event Report # 5
- Drilling 8 ½" section at 3106.0m, pop off valve activated – see Event Report # 6

1.0 Introduction

ACHERNAR-1 is a vertical exploration well in WA-28-P permit within the Rankin Basin, offshore Australia for Woodside Energy Ltd. The well is in 122.28m of water depth from Rotary table.

The well ACHERNAR-1 was drilled to Total Depth of 3285.0m MDRT / 3284.94m TVDRT. No hydrocarbon bearing formation was discovered during drilling, the well is plugged and abandoned.

The geological objectives for Achernar-1 was to:

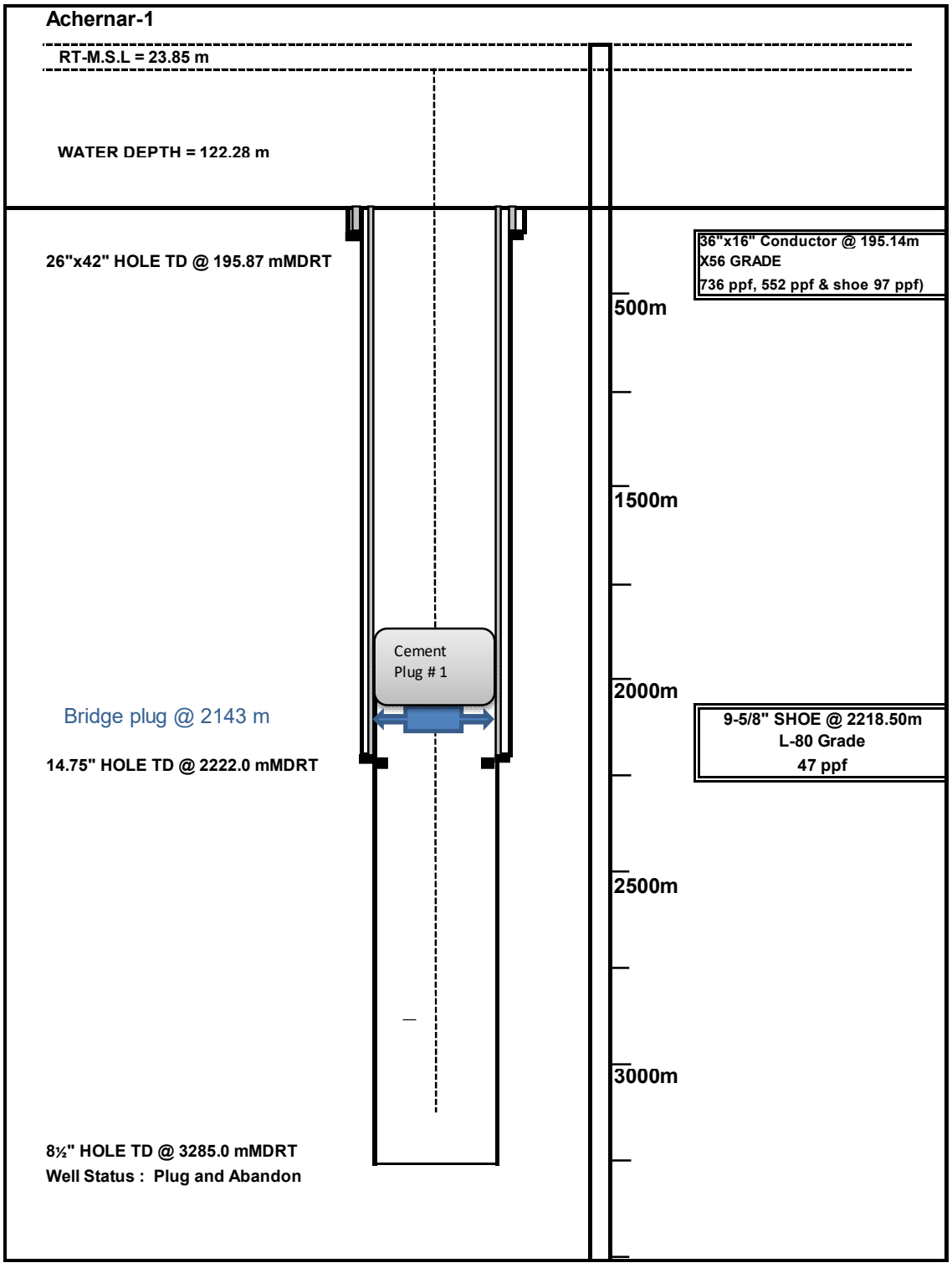
- Prove gas, discover commercial quantities.
- Confirm base below reservoir (J10.0_SB to J12.0_SB) to mature other prospects in WA-28-P
- De-risk volume uncertainty and confirm trap effectiveness (sandstone and sandstone X-fault juxtaposition)
- Acquire high quality LWD data to confirm seismic amplitude and inversion responses.

General Well Information

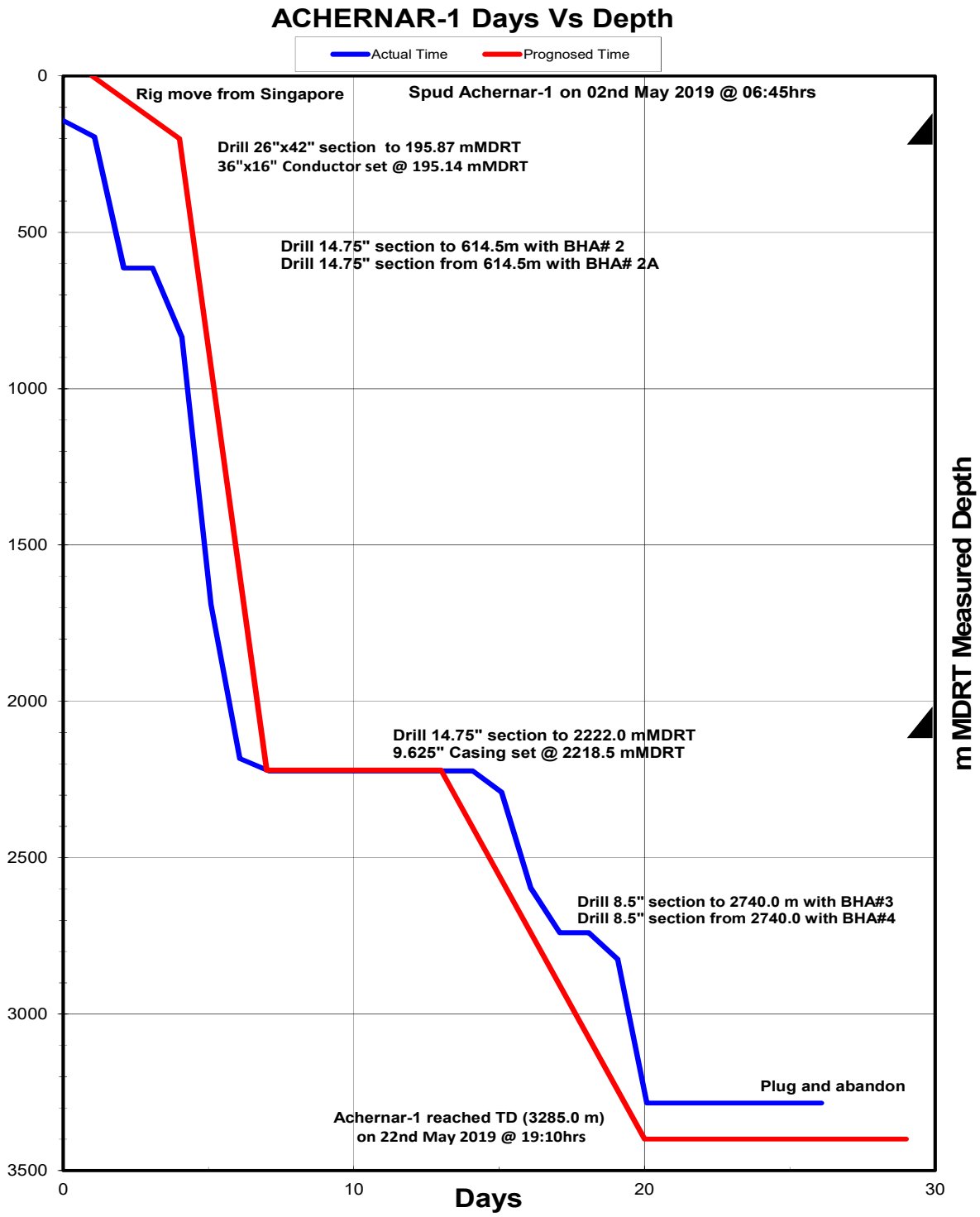
1.1 Well Data

Operator / JVPs	Woodside Pty Ltd (Operator) / BP, BHP, Chevron, MIMI, Shell, CNOOC			
Well name	ACHERNAR-1			
Country	Australia			
Location	North-west of Dampier offshore Western Australia			
Basin	Rankin basin			
Permit	WA-28-P			
Location GDA94 Coordinates	7847242.4mN	427062.7mE		
Location GDA94 Coordinates	Lat: 19° 28' 04.743" S	Long: 116° 18' 18.201" E		
Well classification	Wildcat			
Well type	Exploration			
Well profile	Vertical			
Reference depth	Rotary Table			
RT to Seabed	146.13m			
Air Gap	23.85m			
Water depth	122.28m			
Spud date	02nd May 2019 at 06:45hrs			
Total Depth date	22nd May 2019 at 19:15hrs			
Duration	24 days (Spud to P & A – 25th May 2019)			
Max. Planned Total Depth	3424.00m MDRT			
Actual Total Depth	3285.00m MDRT			
True Vertical Depth	3284.94m TVDRT			
Contractor	Diamond Offshore			
Rig name	Ocean Apex			
Rig type	Semi-sub			
Drilling phases	**Diameter mm (in)**	**From (mMDRT)**	**To (mMDRT)**	**Mud Type**
	660x1066 (26x42)	146.13	195.87	Seawater + PHG Sweeps
	375 (14¾)	195.87	2222.0	Seawater + PHG Sweeps
	216 (8 ½)	2222.0	3285.0	HPWBM
Cased hole	**Diameter mm (in)**	**Type**		**Shoe Depth (m MDRT)**
	914x (36x16)	Conductor X-56, 373 ppf		195.14
	244 (9⅝)	L-80, 47 ppf		2218.5

Well schematic



Well progress



2 Drilling Summary

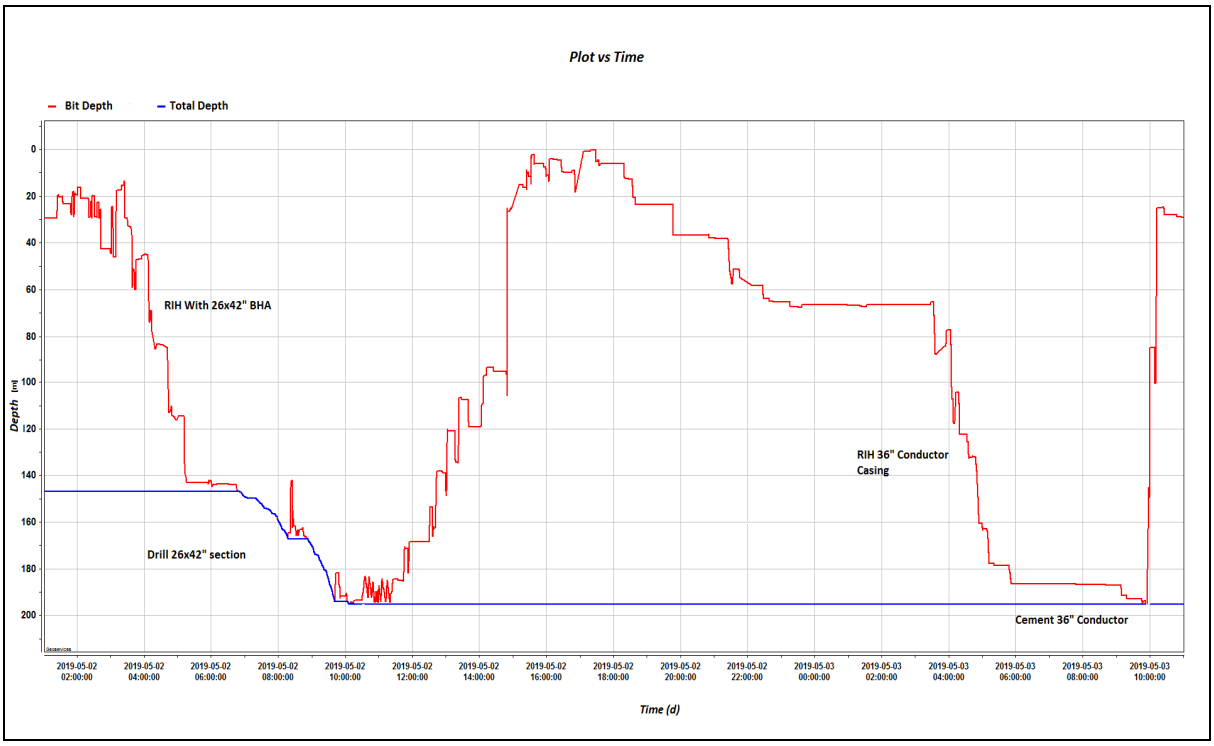
Hole Size	Bit Run #	Bit Type	Depth Interval (mMDRT)	AveROP (m/hr)	Mud Type / Mud Wt (sg)	Casing OD / Shoe Depth (mMDRT)	LOT / FIT	Incl / Azi at section TD (°)	Remarks
1066x 660 mm (42"x26")	1	NOV Tricone	146.13 - 195.87	21.16	SW/PHG sweeps	36"x16" / 195.14	N/A	0.15 / 290.45	Drill 42"x26" hole
375 mm (14¾")	2	Baker Kymera	195.87 - 2222.0	42.37	SW/PHG sweeps/	9 ⅝" / 2218.5	N/A	0.87 / 291.57	Drill 14¾" hole
216 mm (8 ½")	3	Baker Kymera	2222.0 – 2740.0	13.5	HPWBM		1.8	0.06 / 183.22	Drill 8 ½" hole
216 mm (8 ½")	4	Smith PDC	2740.0 – 3285.0	22.56	HPWBM		N/A	0.14 / 40.98	Drill 8 ½" hole

2.0 Phase Discussion

2.0.1 1067 x 660mm (42x26”) Drilling Phase & 914mm (36x16”) Conductor Casing run

Depth interval:
146.13 mMDRT – 195.87 mMDRT
146.13 mTVD – 195.87 mTVD

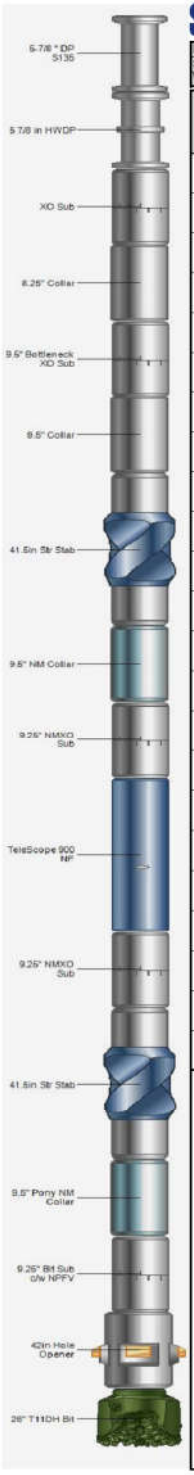
02nd May 2019 – 03rd May 2019



The 26" Bit x 42" Hole Opener BHA was made up and run in hole on 2nd May 2019. Tagged sea bed at 146.13 mMDRT and spudded Achernar-1. Drilled ahead 26x42” section to section total depth of 195.87 mMDRT with 1.03 sg Seawater pumping 100 bbl sweeps at mid stand and connections. At section TD displaced hole with 600 bbl type 1 displacement fluid. Pulled out 26 x 42” drilling BHA to surface. This 26” Bit drilled 48.97 m with an average ROP of 21.16 m/h and the bit was graded 1-1-WT-N-E-1-NO-TD.

Rigged up Weatherford casing handling equipment, ran in 36x16” conductor and stabbed conductor through mud-mat. Rigged down casing handling equipment. Made up LPWHH joint to conductor string and landed conductor on 5-7/8” hand slips. Made up 5 7/8” DP to LPWHH and running tool. Lowered conductor and made up inner string to LPWHH running tool. Ran in the 36” x 16” Conductor on 5 7/8” DP through open water from 85.0 to 185.0. Made up cement stand to string and washed down conductor to 195.14 mMDRT. Landed mud-mat on mud line. Performed conductor casing cement job as per program.

BHA 1



Schlumberger

woodside

Field Name	Woodside / WA-28-P R8			**Borehole Name**	Achernar-1			**Hole Size (in)**			42.000
Structure Name	Achernar-1			**BHA Name**	BHA-01_Spud BHA			**Depth In (m)**			146.13
Well Name	Achernar-1							**Depth Out (m)**			195.87

	Desc.	Manu.	Serial Number	OD (in) / ID (in)	Max OD (in)	Bot Type / Top Type	Bot Gender / Top Gender	FN OD (in) / FN Length (m)	Length (m)	Cum. Length (m)	Cum. Weight (1000 lbm)
				10.000							
1	26" T11DH Bit	NOV Reed	D245766	3.750	26.000	7-5/8 REG	Pin		0.67	0.67	2.2
				9.875		7-5/8 REG	Box	9.875			
2	42in Hole Opener	Smith	09981H	2.500	42.000	7-5/8 REG	Pin	0.61	2.57	3.24	4.7
			OSS12-	9.500		7-5/8 REG	Box	9.500			
3	9.25" Bit Sub c/w NPFV	Schlumberger	688J	3.500	9.500	7-5/8 REG	Box	0.89	0.89	4.13	5.3
			OSSO-	9.500		7-5/8 REG	Pin	9.500			
4	9.5" Pony NM Collar	Schlumberger	912119C	3.500	9.500	7-5/8 REG	Box	1.00	2.57	6.70	7.0
				9.500		7-5/8 REG	Pin	9.500			
5	41.5in Str Stab	Schlumberger	21746J	3.000	9.500	7-5/8 REG	Box	1.03	2.93	9.63	9.1
			OSS12-	9.000		7-5/8 REG	Pin	9.000			
6	9.25" NMXO Sub	Schlumberger	00170A	3.500	9.000	7-5/8 H90	Pin	0.42	0.42	10.05	9.3
				9.000		7-5/8 H90	Box	9.000			
7	TeleScope 900 NF	Schlumberger	E9300	5.900	9.160	7-5/8 H90	Box	1.00	7.69	17.74	13.4
			OSS12-	9.000		7-5/8 H90	Pin	9.000			
8	9.25" NMXO Sub	Schlumberger	00170A	3.500	9.000	7-5/8 REG	Box	0.42	0.48	18.22	13.7
				9.500		7-5/8 REG	Pin				
9	9.5" NM Collar	Schlumberger	SBD7736	3.500	9.500	7-5/8 REG	Box		8.77	26.99	19.7
				9.500		7-5/8 REG	Pin	9.500			
10	41.5in Str Stab	Schlumberger	21745J	3.000	9.500	7-5/8 REG	Box	1.02	2.85	29.84	21.7
				9.500		7-5/8 REG	Pin				
11	9.5" Collar (3 joints)	Rig		3.000	9.500	7-5/8 REG	Box		27.43	57.27	41.1
				9.500		7-5/8 REG	Pin				
12	9.5" Bottleneck XO Sub	Rig		3.000	9.500	6-5/8 REG	Box		1.15	58.42	42.0
				8.250		6-5/8 REG	Pin				
13	8.25" Collar (3 joints)	Rig		2.813	8.250	6-5/8 REG	Box		28.26	86.68	56.8
				7.000		6-5/8 REG	Pin				
14	XO Sub	Rig		3.000	7.000	FH VAM CDS	Box		0.89	87.57	57.1
				5.875		FH VAM CDS	Pin				
15	5 7/8 in HWDP (3 joints)	Rig		4.000	7.000	FH VAM CDS	Box		27.97	115.54	63.1
				5.875		FH VAM CDS	Pin				
16	5-7/8 " DP S135	Rig		5.045	7.000	FH VAM CDS	Box		9.30	124.84	64.0

Total Length (m)	124.84
Total Weight in Air (1000 lbm)	64.0
Total Buoyant Weight (1000 lbm)	56.2
Buoyant Weight Below Jar (1000 lbm)	
Weight in Air Below Jar (1000 lbm)	

BHA Comments

BHA length adjusted to allow drilling to commence on DP. MWD Flow range 700-1150GPM

Mud Properties	
Mud Weight (lbm/gal)	8.36
Mud Type	WBM
PV (cP)	15.00
YP (lbf/100ft2)	15.00

Sensor Offset from Bit (m)	
MVC	12.83
D&I	13.83

Stabilizer Summary	
Blade Mid-Pt to Bit (m)	Blade Length (m)
2.070	0.530
8.160	0.820
28.450	0.820

Bend Summary	
Bend Angle (deg)	Bend to Bit

BHA Nozzle Summary		
Component	Count x ID (1/32 in)	TFA (in2)
Bit	3 x 22	1.114
42in Hole Opener	6 x 14	0.902
PD Flow Restrictor (1/32 in)		
Rotor Bypass Nozzle (1/32 in)		

Date	30Apr2019
Designed By	DIR\dhay2
Approved By	

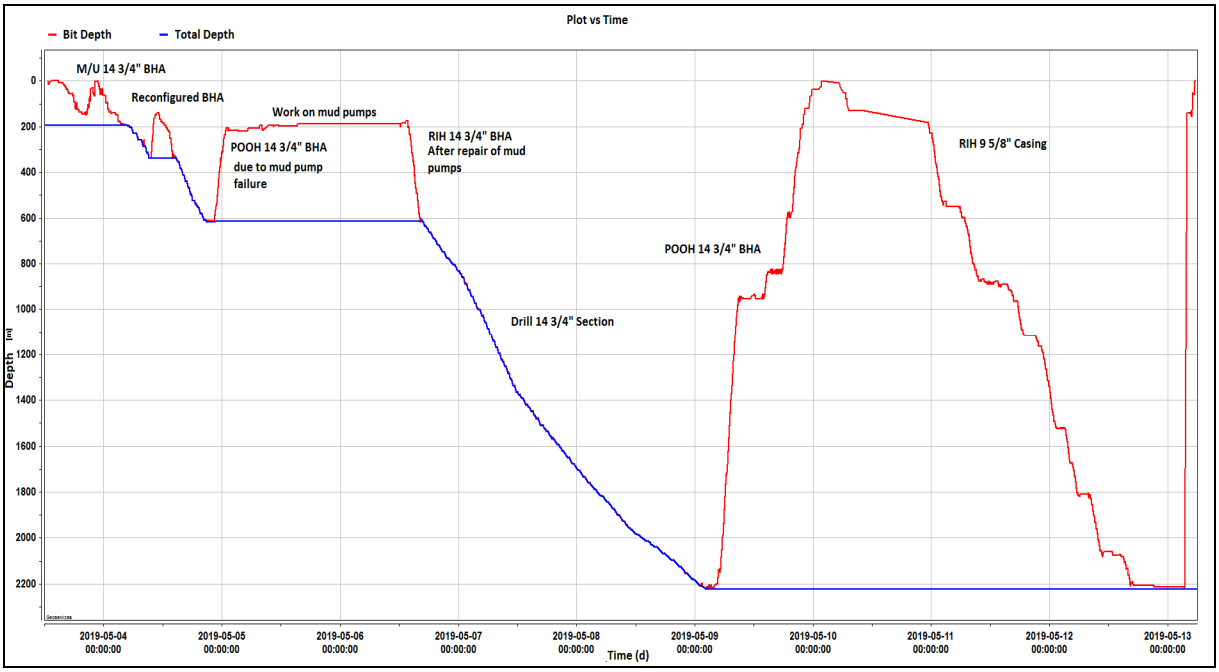
- Flowback

The 1067mm (42”) section was drilled riser-less with returns to seabed so no Drain-back was captured for this section.

2.0.2 375mm (14.75”) Drilling Phase and 245mm (9⅝”) Casing run

Depth interval:
195.87 mMDRT – 2222.0 mMDRT
195.87 mTVD – 2221.94 mTVD

03rd May 2019 – 13th May 2019



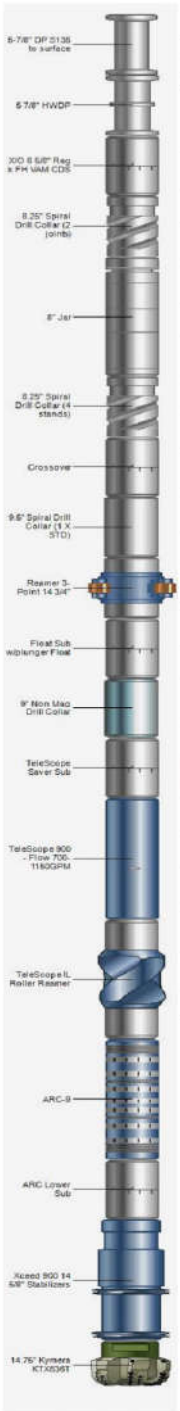
The 14¾” Kymera Bit BHA was made up to SLB Xceed RSS/ARC/ILR and Telsescope sub assemblies and ran in hole to 145.0 mMDRT(1.5 m above LPWHH), identified no dummy float installed in Xceed RSS. Pulled out of hole and installed dummy float in Xceed RSS. Ran in hole 14¾” drilling assembly, tagged top of cement at 191 mMDRT with 5 klb. Drilled cement and 16” float shoe from 191 to 196 mMDRT. Drilled formation up to 340 mMDRT with sea water and gel sweeps. Reconfigured BHA and continued drilling ahead to 614 mMDRT with seawater and gel sweeps. Suspended drilling due to mud pump failure. After repair of mud pumps continued drilling ahead 14¾” section from 614 m to section TD, 2222.0 mMDRT. Circulated hole clean with gel sweep and displacement fluids. Flow checked well with ROV. Pulled out 14¾” BHA to 952 mMDRT working clear tight spot at 1070 mMDRT. At 952 mMDRT 15-35 klb drag observed. Worked string across tight spot. Swept hole clean with 100 bbl PHB sweep followed by 200 bbl sweep. Continued to work string till torque and SPP reduced. Displaced well volume to 1.15sg Type 2 displacement fluid. Pulled out 14¾” BHA to 598 mMDRT working through tight spot at 844 mMDRT. Displaced remainder of well with 350bbls of 1.15sg Type 2 displacement fluid. Pulled out BHA to surface, and racked back. The 14 ¾” Bit drilled a total of 2026.13 m with an average ROP of 42.37 m/h. The bit was graded PDC: 1-3-LT-G-X-I-DL-TD, RC: 1-2-BT-G-E-I-CT-TD.

Rigged up 9⅝” casing handling equipment and RIH 9 5/8" casing up to 131 mMDRT. Waited on weather before stab in. Stabbed casing and started running in 9 5/8" casing up to 533 mMDRT. Rigged up remainder of Weatherford handling equipment. Picked up 9 5/8" single + PUP and ran in hole from 533 to 551 mMDRT. Picked up string and installed Weatherford FMS and function

tested. Rigged up Weatherford service loop. Picked up and installed 9 5/8" casing fill up assembly and made up to TDS. Rigged up 22' Bail links. 500T Varco slip type elevators. Continued to run in hole 9 5/8" casing as up to 602 mMDRT. Observed 15-35 klb drag while running in from 600-866 mMDRT. Continued to wash through tight hole condition. At 940 mMDRT pumped 150 bbl Type 2 mud. Continued to RIH 9 5/8" up to 1496 mMDRT washing down. Ran in top filling 3 x 9 5/8" singles to 1533 mMDRT. Pumped 50 bbl PHB sweep followed by 200 bbl of seawater. Pumped 1.15sg, 150 bbl of PHG type 2 fluid followed by 530 bbl seawater. Ran in top filling 9 5/8" casing from 1533 to 1672 mMDRT. Observed reduction is string weight. Washed down from 1672 to 1734 mMDRT. Continued running in top filling 9 5/8" casing from 1734 to 1810 mMDRT. Attempt to wash down but could not establish circulation. Worked and attempted establishing circulation. Worked sting until free. Continued running in washing down from 1835 to 2080 mMDRT. Laid out extra casing double. Rigged down 9 5/8" casing handling equipment. With shoe at 2059 mMDRT picked up and made up HPWH and 20" swage to last 9 5/8" casing. Made up MRLD with Weatherford plugs below. Run casing and HPWH on the 5 7/8" landing string. Picked up Weatherford cement head assembly. Stage up pumps, observed pressure build up, attempt to pick up observed 100 klb overpull. Attempt to work sting, no movement. Stage up pumps, pumped 100 bbl SAP pill and spotted 200 m into annulus. Obtain movement down. Continued washing down with no obstructions. Land HPWH in LPWHH with 20 klb down, slack off and set down 50 klb in stages. Take 50 klb overpull, confirm HPWH locked.

Pressure test cement lines to 2500 psi. Performed 9 5/8" casing cement job as per program keeping shoe at 2218.5 mMDRT

BHA 2



Schlumberger woodside

Field Name	Woodside / WA-28-P R8	**Borehole Name**	Achernar-1	**Hole Size (in)**			14.750
Structure Name	Achernar-1	**BHA Name**	BHA-02 14.75inXceed ARC9 MWD9	**Depth In (m)**			195.10
Well Name	Achernar-1			**Depth Out (m)**			340.00

	Desc.	Manu.	Serial Number	OD (in) / ID (in)	Max OD (in)	Bot Type / Top Type	Bot Gender / Top Gender	FN OD (in) / FN Length (m)	Length (m)	Cum. Length (m)	Cum. Weight (1000 lbm)
1	14.75" Kymera KTX636T	Baker	5298602	8.250 / 3.000	14.750	7-5/8 REG	Pin		0.50	0.50	0.3
2	Xceed 900 14 5/8" Stabilizers	Schlumberger	29867	9.000 / 6.750	14.625	7-5/8 REG / 7-5/8 FH	Box / Box	9.563 / 0.38	9.66	10.16	5.3
3	ARC Lower Sub	Schlumberger	OM13081	9.375 / 3.750	9.375	7-5/8 FH / 6-5/8 FH	Pin / Pin	9.375 / 0.36	0.36	10.52	5.5
4	ARC-9	Schlumberger	G5321	9.250 / 3.000	9.938	6-5/8 FH / 7-5/8 H90	Box / Box	9.250 / 1.45	5.47	15.99	8.3
5	TeleScope IL Roller Reamer	Schlumberger	GU4230	9.500 / 3.000	14.625	7-5/8 H90 / 7-5/8 H90	Pin / Pin	9.500 / 0.61	1.60	17.59	8.7
6	TeleScope 900 - Flow 700-1150GPM	Schlumberger	E7619	9.250 / 5.900	9.250	7-5/8 H90 / 7-5/8 H90	Box / Box	9.250 / 7.68	7.68	25.27	12.8
7	TeleScope Saver Sub	Schlumberger	OSS13-01566K	9.500 / 3.750	9.500	7-5/8 H90 / 7-5/8 REG	Pin / Box	9.500 / 0.45	0.45	25.72	13.1
8	9" Non Mag Drill Collar	Schlumberger	78541-1	9.500 / 3.000	9.500	7-5/8 REG / 7-5/8 REG	Pin / Box	9.500 / 1.00	8.83	34.55	19.3
9	Float Sub w/plunger Float	Schlumberger	OSS-0811237D	9.500 / 2.875	9.500	7-5/8 REG / 7-5/8 REG	Pin / Box	9.500 / 0.70	0.72	35.27	19.8
10	Reamer 3-Point 14 3/4"	RedBack	GU4226	9.500 / 3.000	14.750	7-5/8 REG / 7-5/8 REG	Pin / Box	9.500 / 0.76	2.47	37.74	21.6
11	9.5" Spiral Drill Collar (1 X STD) (3 joints)	Ocean Apex		9.500 / 3.500	9.500	7-5/8 REG / 7-5/8 REG	Pin / Box		27.87	65.61	40.6
12	Crossover	WEL		9.000 / 2.813	9.000	7-5/8 REG / 6-5/8 REG	Pin / Box		1.09	66.70	41.3
13	8.25" Spiral Drill Collar (4 stands) (6 joints)	Rig		8.250 / 2.813	8.250	6-5/8 REG / 6-5/8 REG	Pin / Box		54.67	121.37	68.4
14	8" Jar	NOV	PSDJ 0800-009	8.000 / 3.063	8.000	6-5/8 REG / 6-5/8 REG	Pin / Box	7.875 / 0.71	9.61	130.98	72.3
15	8.25" Spiral Drill Collar (2 joints) (2 joints)	Rig		8.250 / 2.813	8.250	6-5/8 REG / 6-5/8 REG	Pin / Box		18.37	149.35	81.4
16	X/O 6 5/8" Reg x FH VAM CDS	WEL		7.030 / 3.500	7.030	6-5/8 REG / FH VAM CDS	Pin / Box		1.11	150.46	81.8
17	5 7/8" HWDP (3 joints)	Ocean Apex		5.875 / 4.000	7.000	FH VAM CDS / FH VAM CDS	Pin / Box		27.74	178.20	87.7
18	5-7/8" DP S135 to surface (9 joints)	Ocean Apex		5.875 / 5.045	7.000	FH VAM CDS / FH VAM CDS	Pin / Box		9.30	187.50	88.6

Total Length (m)	187.50
Total Weight in Air (1000 lbm)	88.6
Total Buoyant Weight (1000 lbm)	76.7
Buoyant Weight Below Jar (1000 lbm)	59.3
Weight in Air Below Jar (1000 lbm)	68.4

BHA Comments

BHA for drilling out 16" Shoe. MWD Flow range 700-1150GPM

Mud Properties	
Mud Weight (lbm/gal)	8.60
Mud Type	rater / Sweep
PV (cP)	15.00
YP (lbf/100ft2)	15.00

Sensor Offset from Bit (m)	
D&I	5.60
APWD	11.92
ARC Resistivity	12.63
ARC Gamma Ray	12.71
MVC	20.35
MWD Gamma Ray	20.70
D&I	21.35

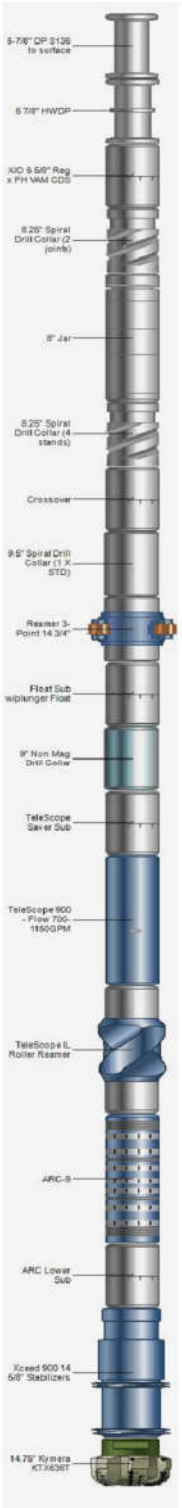
Stabilizer Summary	
Blade Mid-Pt to Bit (m)	Blade Length (m)
0.900	0.530
4.370	0.510
16.447	0.610
36.530	0.500

Bend Summary	
Bend Angle (deg)	Bend to Bit
0.500	0.994

BHA Nozzle Summary		
Component	Count x ID (1/32 in)	TFA (in2)
Bit	6 x 12, 3 x 11	0.941
Reamer 3-Point 14 3/4"		0
PD Flow Restrictor (1/32 in)		
Rotor Bypass Nozzle (1/32 in)		

Date	04May2019
Designed By	DIR\dhay2
Approved By	

BHA 2A



Schlumberger woodside

Field Name	Woodside / WA-28-P R8	**Borehole Name**	Achernar-1
Structure Name	Achernar-1	**BHA Name**	BHA-2A 14.75in Xceed AR
Well Name	Achernar-1		

Hole Size (in)	14.750
Depth In (m)	340.00
Depth Out (m)	2222.00

	Desc.	Manu.	Serial Number	OD (in) / ID (in)	Max OD (in)	Bot Type / Top Type	Bot Gender / Top Gender	FN OD (in) / FN Length (m)	Length (m)	Cum. Length (m)	Cum. Weight (1000 lbm)
				8.250							
1	14.75" Kymera KTX636T	Baker	5298602	3.000	14.750	7-5/8 REG	Pin		0.50	0.50	0.3
				9.000		7-5/8 REG	Box	9.563			
2	Xceed 900 14 5/8" Stabilizers	Schlumberger	29867	6.750	14.625	7-5/8 FH	Box	0.38	9.66	10.16	5.3
				9.375		7-5/8 FH	Pin	9.375			
3	ARC Lower Sub	Schlumberger	OM13081	3.750	9.375	6-5/8 FH	Pin	0.36	0.36	10.52	5.5
				9.250		6-5/8 FH	Box	9.250			
4	ARC-9	Schlumberger	G5321	3.000	9.938	7-5/8 H90	Box	1.45	5.47	15.99	8.3
				9.500		7-5/8 H90	Pin	9.500			
5	TeleScope IL Roller Reamer	Schlumberger	GU4230	3.000	14.625	7-5/8 H90	Pin	0.61	1.60	17.59	8.7
	TeleScope 900 - Flow 700-			9.250		7-5/8 H90	Box	9.250			
6	1150GPM	Schlumberger	E7619	5.900	9.250	7-5/8 H90	Box	7.68	7.68	25.27	12.8
			OSS13-	9.500		7-5/8 H90	Pin	9.500			
7	TeleScope Saver Sub	Schlumberger	01566K	3.750	9.500	7-5/8 REG	Box	0.45	0.45	25.72	13.1
				9.500		7-5/8 REG	Pin	9.500			
8	9" Non Mag Drill Collar	Schlumberger	78541-1	3.000	9.500	7-5/8 REG	Box	1.00	8.83	34.55	19.3
			OSS-	9.500		7-5/8 REG	Pin	9.500			
9	Float Sub w/plunger Float	Schlumberger	0811237D	2.875	9.500	7-5/8 REG	Box	0.70	0.72	35.27	19.8
				9.500		7-5/8 REG	Pin	9.500			
10	Reamer 3-Point 14 3/4"	RedBack	GU4226	3.000	14.750	7-5/8 REG	Box	0.76	2.47	37.74	21.6
	9.5" Spiral Drill Collar (1 X			9.500		7-5/8 REG	Pin				
11	STD) (3 joints)	Ocean Apex		3.500	9.500	7-5/8 REG	Box		27.87	65.61	40.6
				9.000		7-5/8 REG	Pin				
12	Crossover	WEL		2.813	9.000	6-5/8 REG	Box		1.09	66.70	41.3
	8.25" Spiral Drill Collar (4			8.250		6-5/8 REG	Pin				
13	stands) (12 joints)	Rig		2.813	8.250	6-5/8 REG	Box		110.25	176.95	95.9
			PSDJ 0800-	8.000		6-5/8 REG	Pin	7.875			
14	8" Jar	NOV	009	3.063	8.000	6-5/8 REG	Box	0.71	9.61	186.56	99.9
	8.25" Spiral Drill Collar (2			8.250		6-5/8 REG	Pin				
15	joints) (2 joints)	Rig		2.813	8.250	6-5/8 REG	Box		18.21	204.77	108.9
	X/O 6 5/8" Reg x FH VAM			7.030		6-5/8 REG	Pin				
16	CDS	WEL		3.500	7.030	FH VAM CDS	Box		1.11	205.88	109.3
				5.875		FH VAM CDS	Pin				
17	5 7/8" HWDP (12 joints)	Ocean Apex		4.000	7.000	FH VAM CDS	Box		110.98	316.86	133.1
	5-7/8" DP S135 to surface			5.875		FH VAM CDS	Pin				
18	(10 joints)	Ocean Apex		5.045	7.000	FH VAM CDS	Box		10.00	326.86	134.0

Total Length (m)	326.86
Total Weight in Air (1000 lbm)	134.0
Total Buoyant Weight (1000 lbm)	115.9
Buoyant Weight Below Jar (1000 lbm)	83.0
Weight in Air Below Jar (1000 lbm)	95.9

BHA Comments

BHA for continued drilling from 340m MD to section TD 2221m. MWD Flow range 700-1200GPM

Mud Properties	
Mud Weight (lbm/gal)	8.60
Mud Type	SW / Sweep
PV (cP)	15.00
YP (lbf/100ft2)	15.00

Sensor Offset from Bit (m)	
D&I	5.60
APWD	11.89
ARC Resistivity	12.60
ARC Gamma Ray	12.65
MVC	20.35
D&I	21.35

Stabilizer Summary	
Blade Mid-Pt to Bit (m)	Blade Length (m)
0.900	0.530
4.370	0.510
16.447	0.610
36.530	0.500

Bend Summary	
Bend Angle (deg)	Bend to Bit
0.500	0.994

BHA Nozzle Summary		
Component	Count x ID (1/32 in)	TFA (in2)
Bit	6 x 12, 3 x 11	0.941
PD Flow Restrictor (1/32 in)		
Rotor Bypass Nozzle (1/32 in)		

Date	04May2019
Designed By	DIR\dhay2
Approved By	

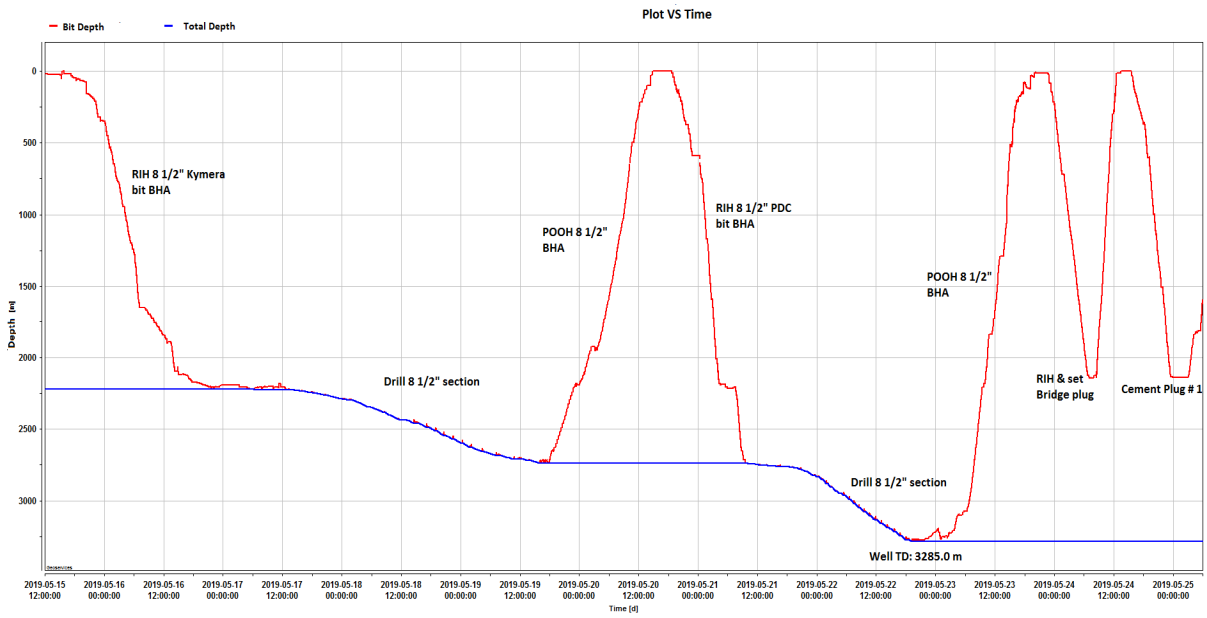
- Flow back

The 375mm (14 ¾") section was drilled riser-less with returns to seabed so no Drain-back was captured for this section.

2.0.3 216mm (8½") Drilling Phase

Depth interval:
2222.0 mMDRT – 3285.0 mMDRT
2221.94.0 mTVD – 3284.94 mTVD

15th May 2019 – 24th May 2019



On 15th May 2019, picked up and made up 8 ½" Kymera bit dressed with 3x14, 2x18 nozzles and ran in the drilling BHA to 354 mMDRT. Shallow tested MWD tools and continued to run in hole picking up singles1281 mMDRT. Conducted well control drills. Continued to run in hole 8 ½" BHA on 5 7/8" DP stands to 1649 mMDRT. Performed cement logging with Schlumberger LWD tool from 1649.0 to 1901.0 mMDRT. Held well control drills and continued to run in hole 8 ½" drilling BHA to 2098 mMDRT. Washed down from 2098 mMDRT and tagged top of cement at 2161 mMDRT. Drilled out plug, cement up to 2186 mMDRT and displaced well to 1.44 sg mud. Continued to drill cement to 2212 mMDRT and circulated hole clean. After well control drills continued to drill out shoe track, rat hole and 3 m of formation up to 2225 mMDRT. Racked back stand and picked up SES assembly. Rigged up cement hose and pressure tested cement lines to 250 psi/2500 psi. Performed leak off test whilst pumping 1.44 sg WBM at 0.5 bpm. Formation leaked off at 1490 psi/1.9 sg EMW. Noted sharp pressure drop to 1174 psi. Bled back pressure to cement unit. 2.7 bbl pumped, 2 bbl bled back. LOT value of 1.80 sg EMW was selected for calculations.

Drilled 8 ½" section from 2225 mMDRT to 2381.0 mMDRT. Flow checks were made at 2243 and 2295 due to 4 bbl increase in active observed while drilling. After adjusting rig position above well centre continued drilling ahead 8 ½" section from 2381 mMDRT to 2439 mMDRT. Made flow check due to increased ROP for more than 1.5m. Continued drilling ahead from 2439 mMDRT. At around 2620 mMDRT observed increase in loss rate up to 10 bbl/h. Added Circal 60/16 and

reduced flow rate to 570 gpm. Loss rate reduced. Continued drilling ahead to 2717 mMDRT. Flow checked well on trip tank- well static. Continued drilling ahead from 2717 to 2740 mMDRT. Decision made to POOH due to poor ROP. Circulated 2 x bottoms up. Flow checked well on trip tank and pulled pumping out of hole to inside casing shoe. Attempt to pull out on elevators from inside casing - no success, incorrect displacement. Continued pumping out of hole to 1952 mMDRT. Pumped 50 bbl SAPP pill down string and displaced same with 159 bbl 1.44 sg WBM. Soaked SAPP across 8 ½' BHA for 20 min. Displaced SAPP pill out and continued pumping out of hole to 1030 mMDRT. Continued pulling out on elevators to surface monitoring well on trip tank. The bit was graded PDC 1-1-WT-A-X-IN-PN-PR, RC 1-2-BT-S-E-IN-PN-PR. It drilled a total of 518 m with an average ROP of 13.5 m/h.

After rig service picked up and made up 8 ½" PDC bit drilling BHA and ran in hole to 382 mMDRT. Performed shallow test of MWD/LWD tool and continued running in hole 8 ½" drilling BHA from 328 mMDRT to 587 mMDRT. Performed well control drill. Continued to run in hole 8 ½" drilling BHA to 2181 mMDRT. Function tested BOP, recorded SCRs. After work on TDX software ran in hole 8 ½" BHA to 2713 mMDRT. Washed down from 2713.0 m and tagged bottom at 2740 mMDRT. Continued drilling ahead to 2780 mMDRT. Flow checked well due to drilling break, well static. Continued drilling ahead from 2780 to 2831 mMDRT. Flow checked well static and continued drilling ahead 8 ½" section to well TD of 3285.0 mMDRT. Circulated hole clean, performed correlation log and performed Stethoscope pressure point recording at 3254.62, 3225.49, 3207.49, 3097.9 and 3072.9 m (Correlated bit depth). Pulled out from 3072 to 2208 mMDRT. Flow checked well on trip tank. Pulled out to 1839 mMDRT. Pumped 30 bbl slug. Pulled out from 1839 to 525 m. Perform trip drill. Flow checked well static. Continued pulling out 8 1/2" BHA to surface unloading radioactive source and lay down 8 ½" BHA. Bit # 4 drilled 545.0 m with an average ROP of 22.5 m/h and was graded 1-1-WT-S-X-IN-CT-TD.

Picked up Bridge plug assembly, ran in hole and set bridge plug at 2143 mMDRT and pulled out setting tool to surface. Ran in with 3 ½" DP cement stinger and performed cement plug # 1 job as per program. .

BHA 3

Schlumberger woodside

Field Name	Woodside / WA-28-P R8	**Borehole Name**	Achernar-1	**Hole Size (in)**	8.500
Structure Name	Achernar-1	**BHA Name**	BHA 3_8.5" Orbit TST Eco MWD Sscope WCMD	**Depth In (m)**	2222.00
Well Name	Achernar-1			**Depth Out (m)**	2740.00

	Desc.	Manu.	Serial Number	OD (in) / ID (in)	Max OD (in)	Bot Type / Top Type	Bot Gender / Top Gender	FN OD (in) / FN Length (m)	Length (m)	Cum. Length (m)	Cum. Weight (1000 lbm)
1	8 1/2 " PDC Kymera Bit	Baker Hughes	5276494	6.000 / 1.750	8.500	4-1/2 REG	Pin	5.750 / 0.90	0.30	0.30	0.1
2	PD 675 Orbit AA 8 1/2" Stabilized Rec/Ported Float	Schlumberger	93291	6.750 / 4.200	6.875	4-1/2 REG / NC50	Box / Pin	6.750 / 3.00	4.12	4.42	1.5
3	PD Orbit Receiver Sub	Schlumberger	70094	6.875 / 3.875	8.375	NC50 / NC50	Box / Box	6.875 / 0.75	1.53	5.95	2.0
4	XO Saver Sub	Schlumberger	14907	6.875 / 3.875	6.875	NC50 / 5-1/2 FH	Pin / Pin	6.875 / 0.37	0.36	6.31	2.1
5	StethoScope 675 w/ 8 1/4" Stabilizer	Schlumberger	G3624	6.875 / 3.875	8.250	5-1/2 FH / 5-1/2 FH	Box / Box	6.938 / 0.48	9.92	16.23	5.0
6	EcoScope Saver Sub	Schlumberger	00678B	6.875 / 2.813	6.875	5-1/2 FH / 5-1/2 FH	Pin / Pin	6.875 / 0.37	0.37	16.60	5.2
7	EcoScope w/ 8 1/4" Stabilizer	Schlumberger	1990	6.875 / 2.800	8.250	5-1/2 FH / 5-1/2 FH	Box / Box	6.875 / 1.81	7.59	24.19	7.8
8	TeleScope Saver Sub	Schlumberger	00745D	6.875 / 3.875	6.875	5-1/2 FH / 5-1/2 FH	Pin / Pin	6.875 / 0.40	0.39	24.58	7.9
9	TeleScope 675 NF	Schlumberger	B0621R	6.750 / 5.125	6.750	5-1/2 FH / 5-1/2 FH	Box / Box	6.750 / 7.64	7.64	32.22	10.1
10	TeleScope Saver Sub	Schlumberger	00758D	6.875 / 2.813	6.875	5-1/2 FH / 5-1/2 FH	Pin / Box	6.875 / 0.48	0.48	32.70	10.2
11	SonicScope Saver Sub	Schlumberger	OSS18-00758F	6.750 / 2.813	6.750	5-1/2 FH / 5-1/2 FH	Pin / Box	6.875 / 0.39	0.39	33.09	10.3
12	SonicScope 675 w/ 2 x 8 1/4" Stabilisers	Schlumberger	H6641	6.900 / 5.157	8.250	5-1/2 FH / 5-1/2 FH	Pin / Box	6.875 / 1.50	9.75	42.84	13.9
13	Saver Sub	Schlumberger	OSS091010 5C	6.750 / 2.813	6.750	5-1/2 FH / NC50	Pin / Box	7.000 / 0.49	0.49	43.33	14.1
14	8 1/2" Roller Reamer	Schlumberger	GU3362	6.625 / 2.813	8.500	NC50 / NC50	Pin / Box	6.625 / 0.55	1.89	45.22	14.7
15	Well Commander (WCMD107) Ball Catcher Sub	MI Swaco	B2005072	6.875 / 2.938	6.875	NC50 / NC50	Pin / Box	6.875 / 1.00	1.86	47.08	15.4
16	Well Commander (WCMD107) Bypass Sub	MI Swaco	B2010244	7.000 / 2.010	7.000	NC50 / NC50	Pin / Box	7.000 / 0.33	2.09	49.17	16.0
17	Float Sub w/Non-Ported 5R Float Valve FlapperType	Schlumberger	OSS18-00516A	6.625 / 2.875	6.625	NC50 / NC50	Pin / Box	6.625 / 0.71	0.71	49.88	16.3
18	6.75" Spiral Collar (12 joints) (12 joints)	Rig		6.750 / 2.813	6.750	NC50 / NC50	Pin / Box	6.750 / 0.99	110.27	160.15	52.5
19	Hydro Mechanical Jar	NOV	PSDJ-0650-0013	6.500 / 2.750	6.500	NC50 / NC50	Pin / Box	6.500 / 1.01	9.57	169.72	54.4
20	6.75" Spiral Collar (5 joints) (5 joints)	Rig		6.750 / 2.813	6.750	NC50 / NC50	Pin / Box	6.750 / 0.99	44.58	214.30	69.0
21	X/O NC50 x FH VAM CDS	WEL	W-3260-2A-1	7.000 / 3.500	7.000	NC50 / FH VAM CDS	Pin / Box	7.000 / 0.62	1.13	215.43	69.4
22	5 7/8" Spiral HWDP (12 joints)	Ocean Apex		5.875 / 4.000	7.000	FH VAM CDS / FH VAM CDS	Pin / Box		111.06	326.49	93.2
23	5-7/8" DP S135 to surface (14 joints)	Ocean Apex		5.875 / 5.045	7.000	FH VAM CDS / FH VAM CDS	Pin / Box		14.00	340.49	94.5

Total Length (m)	340.49
Total Weight in Air (1000 lbm)	94.5
Total Buoyant Weight (1000 lbm)	77.5
Buoyant Weight Below Jar (1000 lbm)	43.4
Weight in Air Below Jar (1000 lbm)	52.5

BHA Comments

BHA designed to drill vertical hole to section TD. Optimum flow 575gpm to 665gpm

Mud Properties	
Mud Weight (lbm/gal)	12.02
Mud Type	WBM
PV (cP)	27.00
YP (lbf/100ft2)	33.00

Sensor Offset from Bit (m)	
Gamma Ray	2.76
D&I	3.01
FPWD	7.92
APRS	9.92
ECO Gamma Ray	18.03
APWD	18.20
Inclination	18.56
Density	19.24
Ultrasonic Caliper	19.66
Eco Resistivity	21.08
Neutron	21.33
Multi-axis Vibration	27.38
D+I	28.38
Sonic	38.63

Stabilizer Summary	
Blade Mid-Pt to Bit (m)	Blade Length (m)
3.506	0.213
4.960	0.250
7.761	0.588
19.230	0.716
34.770	0.320
41.190	0.320
44.290	0.370

Bend Summary	
Bend Angle (deg)	Bend to Bit

BHA Nozzle Summary		
Component	Count x ID (1/32 in)	TFA (in2)
Bit	3 x 14, 2 x 18	0.948
Well Commander (WCMD		3.93
PD Flow Restrictor (1/32 in)		32.00
Rotor Bypass Nozzle (1/32 in)		

Date	16May2019
Designed By	DIR\CAlleyne
Approved By	

BHA 4

Schlumberger

woodside

Field Name	Woodside / WA-28-P R8			**Borehole Name**	Achernar-1			**Hole Size (in)**				8.500
Structure Name	Achernar-1			**BHA Name**	8.5in BHA 4- Orbit-TST-Eco-MWD-SScope-WCMD			**Depth In (m)**				2740.00
Well Name	Achernar-1							**Depth Out (m)**				3285.00

	Desc.	Manu.	Serial Number	OD (in) / ID (in)	Max OD (in)	Bot Type / Top Type	Bot Gender / Top Gender	FN OD (in) / FN Length (m)	Length (m)	Cum. Length (m)	Cum. Weight (1000 lbm)
				6.000				6.000			
1	8 1/2 " PDC XZ616	Smith	QF3986	1.750	8.500	4-1/2 REG	Pin	0.12	0.27	0.27	0.1
	PD 675 Orbit AA 8 1/2"			6.750		4-1/2 REG	Box	6.750			
2	Stabilized Rec/Ported Float	Schlumberger	93291	4.200	6.875	NC50	Pin	3.00	4.12	4.39	1.5
				6.875		NC50	Box	6.875			
3	PD Orbit Receiver Sub	Schlumberger	70094	3.875	8.375	NC50	Box	0.75	1.53	5.92	2.0
				6.875		NC50	Pin	6.875			
4	XO Saver Sub	Schlumberger	14907	3.875	6.875	5-1/2 FH	Pin	0.37	0.36	6.28	2.1
	StethoScope 675 w/ 8 1/4"			6.875		5-1/2 FH	Box	6.938			
5	Stabilizer	Schlumberger	G3624	3.875	8.250	5-1/2 FH	Box	0.48	9.92	16.20	5.0
				6.875		5-1/2 FH	Pin	6.875			
6	EcoScope Saver Sub	Schlumberger	00678B	2.813	6.875	5-1/2 FH	Pin	0.37	0.37	16.57	5.1
				6.875		5-1/2 FH	Box	6.875			
7	EcoScope w/ 8 1/4" Stabilizer	Schlumberger	1990	2.800	8.250	5-1/2 FH	Box	1.81	7.59	24.16	7.8
				6.875		5-1/2 FH	Pin	6.875			
8	TeleScope Saver Sub	Schlumberger	00745D	3.875	6.875	5-1/2 FH	Pin	0.40	0.39	24.55	7.9
				6.750		5-1/2 FH	Box	6.750			
9	TeleScope 675 NF	Schlumberger	B0621R	5.125	6.750	5-1/2 FH	Box	7.64	7.64	32.19	10.0
				6.875		5-1/2 FH	Pin	6.875			
10	TeleScope Saver Sub	Schlumberger	00758D	2.813	6.875	5-1/2 FH	Box	0.48	0.48	32.67	10.2
			OSS18-	6.750		5-1/2 FH	Pin	6.875			
11	SonicScope Saver Sub	Schlumberger	00758F	2.813	6.750	5-1/2 FH	Box	0.39	0.39	33.06	10.3
	SonicScope 675 w/ 2 x 8 1/4"			6.900		5-1/2 FH	Pin	6.875			
12	Stabilisers	Schlumberger	H6641	5.157	8.250	5-1/2 FH	Box	1.50	9.75	42.81	13.9
			OSS091010	6.750		5-1/2 FH	Pin	7.000			
13	Saver Sub	Schlumberger	5C	2.813	6.750	NC50	Box	0.49	0.49	43.30	14.1
				6.625		NC50	Pin	6.625			
14	8 1/2" Roller Reamer	Schlumberger	GU3362	2.813	8.500	NC50	Box	0.55	1.89	45.19	14.7
	Well Commander (WCMD107) Ball Catcher			6.875		NC50	Pin	6.875			
15	Sub	MI Swaco	B2005072	2.938	6.875	NC50	Box	1.00	1.86	47.05	15.3
				7.000		NC50	Pin	7.000			
16	Well Commander (WCMD107) Bypass Sub	MI Swaco	B2010244	2.010	7.000	NC50	Box	0.33	2.09	49.14	16.0
	Float Sub w/Non-Ported 5R		OSS18-	6.625		NC50	Pin	6.625			
17	Float Valve FlapperType	Schlumberger	00516A	2.875	6.625	NC50	Box	0.71	0.71	49.85	16.2
	6.75" Spiral Collar (12 joints)			6.750		NC50	Pin	6.750			
18	(12 joints)	Rig		2.813	6.750	NC50	Box	0.99	109.70	159.55	52.3
			PSDJ-0650-	6.500		NC50	Pin	6.500			
19	Hydro Mechanical Jar	NOV	0013	2.750	6.500	NC50	Box	1.01	9.57	169.12	54.2
	6.75" Spiral Collar (5 joints)			6.750		NC50	Pin	6.750			
20	(5 joints)	Rig		2.813	6.750	NC50	Box	0.99	45.15	214.27	69.0
			W-3260-2A-	7.000		NC50	Pin	7.000			
21	X/O NC50 x FH VAM CDS	WEL	1	3.500	7.000	FH VAM CDS	Box	0.62	1.13	215.40	69.3
	5 7/8" Spiral HWDP (12			5.875		FH VAM CDS	Pin				
22	joints)	Ocean Apex		4.000	7.000	FH VAM CDS	Box		111.06	326.46	93.2
	5-7/8" DP S135 to surface			5.875		FH VAM CDS	Pin				
23	(14 joints)	Ocean Apex		5.045	7.000	FH VAM CDS	Box		14.00	340.46	94.5

Total Length (m)	340.46
Total Weight in Air (1000 lbm)	94.5
Total Buoyant Weight (1000 lbm)	77.5
Buoyant Weight Below Jar (1000 lbm)	43.2
Weight in Air Below Jar (1000 lbm)	52.3

BHA Comments

BHA designed to drill vertical hole to section TD. Optimum flow 550gpm to 640gpm

Mud Properties	
Mud Weight (lbm/gal)	12.02
Mud Type	WBM
PV (cP)	23.00
YP (lbf/100ft2)	41.00

Sensor Offset from Bit (m)	
Gamma Ray	2.74
D&I	2.99
FPWD	7.90
APRS	9.90
ECO Gamma Ray	18.02
APWD	9.90
Inclination	18.55
Density	19.23
Ultrasonic Caliper	19.65
Eco Resistivity	21.07
Neutron	21.32
Multi-axis Vibration	27.33
D+I	28.33
Sonic	38.58

Stabilizer Summary	
Blade Mid-Pt to Bit (m)	Blade Length (m)
3.476	0.213
4.930	0.250
7.731	0.588
19.200	0.716
34.740	0.320
41.160	0.320
44.260	0.370

Bend Summary	
Bend Angle (deg)	Bend to Bit

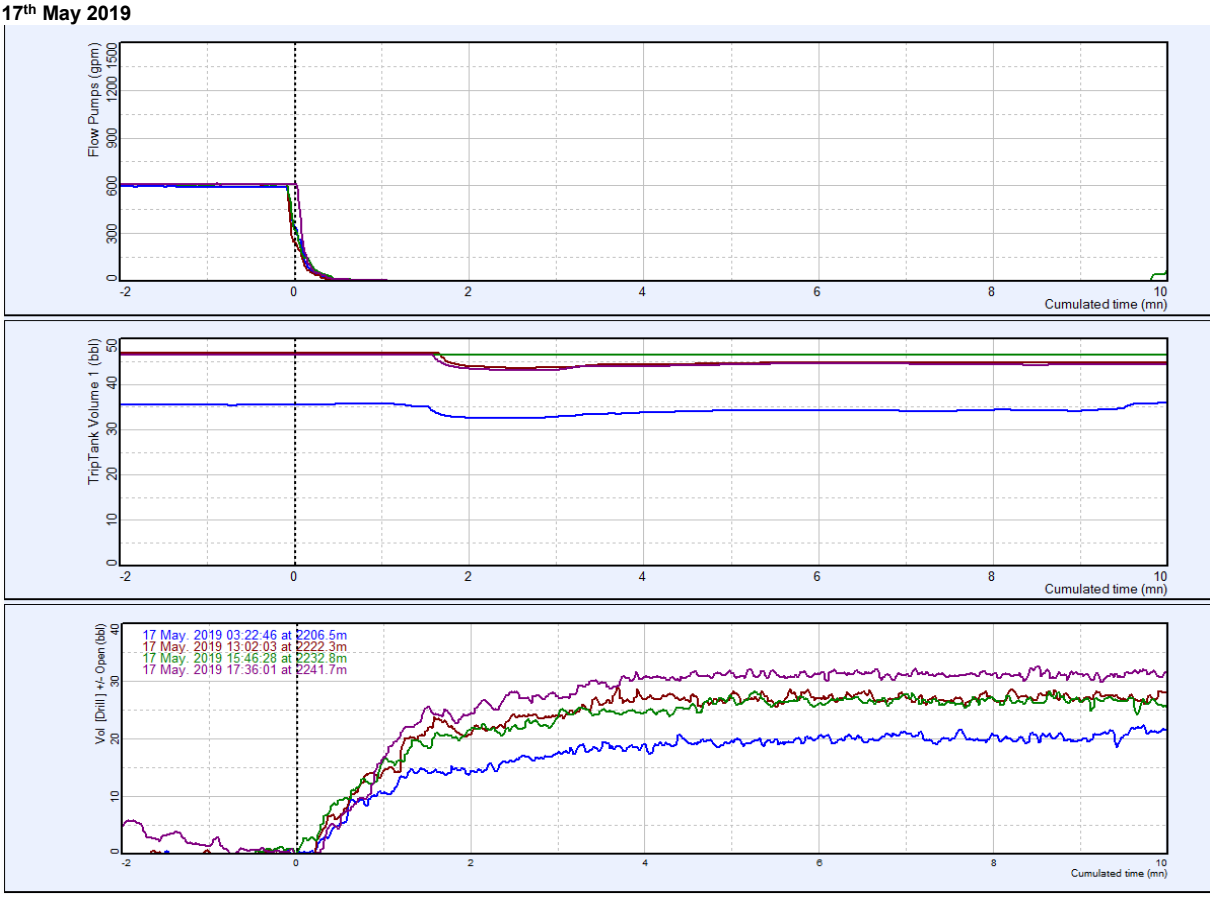
BHA Nozzle Summary		
Component	Count x ID (1/32 in)	TFA (in2)
Bit	6 x 14	0.902
Well Commander (WCMD		3.93
PD Flow Restrictor (1/32 in)		32.00
Rotor Bypass Nozzle (1/32 in)		

Date	20May2019
Designed By	DIR\CAlleyne
Approved By	

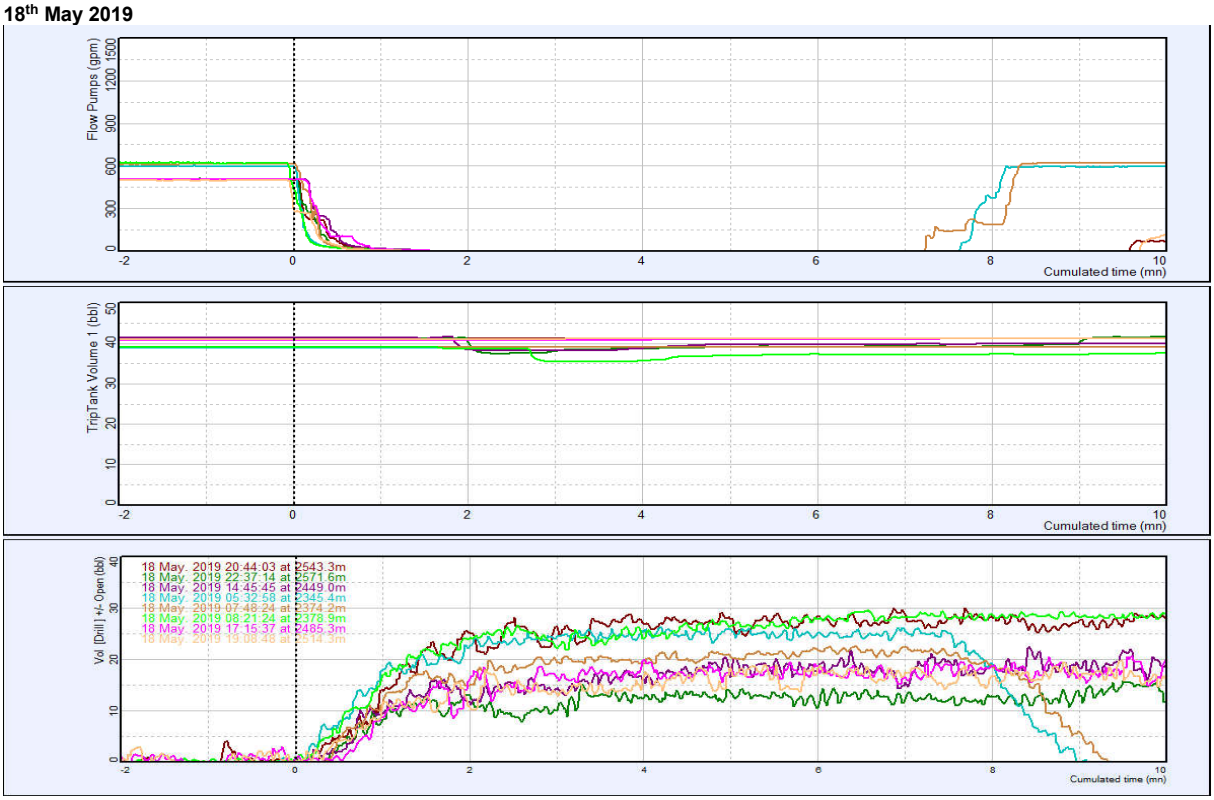
Flow back

The charts below represent some of the drain back return trends for the 8½" section. The trends were observed to be fairly consistent through the pipe connection times with drain back returns to the active pit of around 20-28bbls. The Trip tank trends also indicated no loss/gain during that time. Deviations in the Flowback and drain back curves trends were due to variations in pump strokes (gpm) and are not gains or losses from the well.

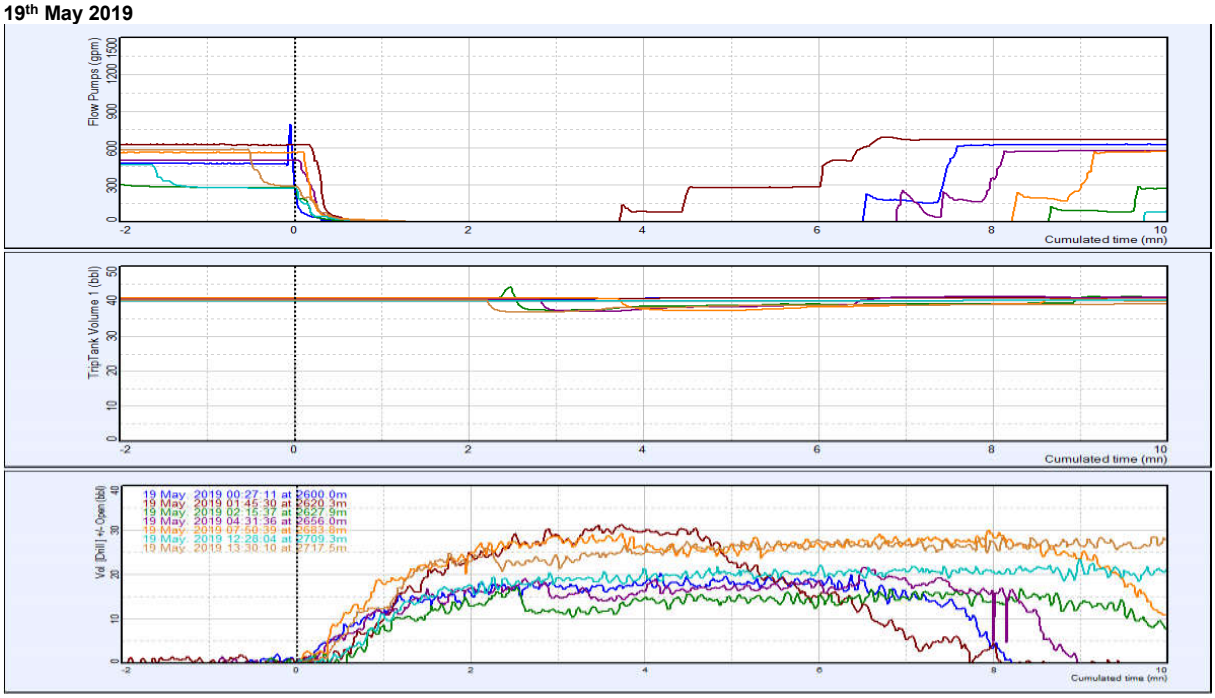
17th May 2019



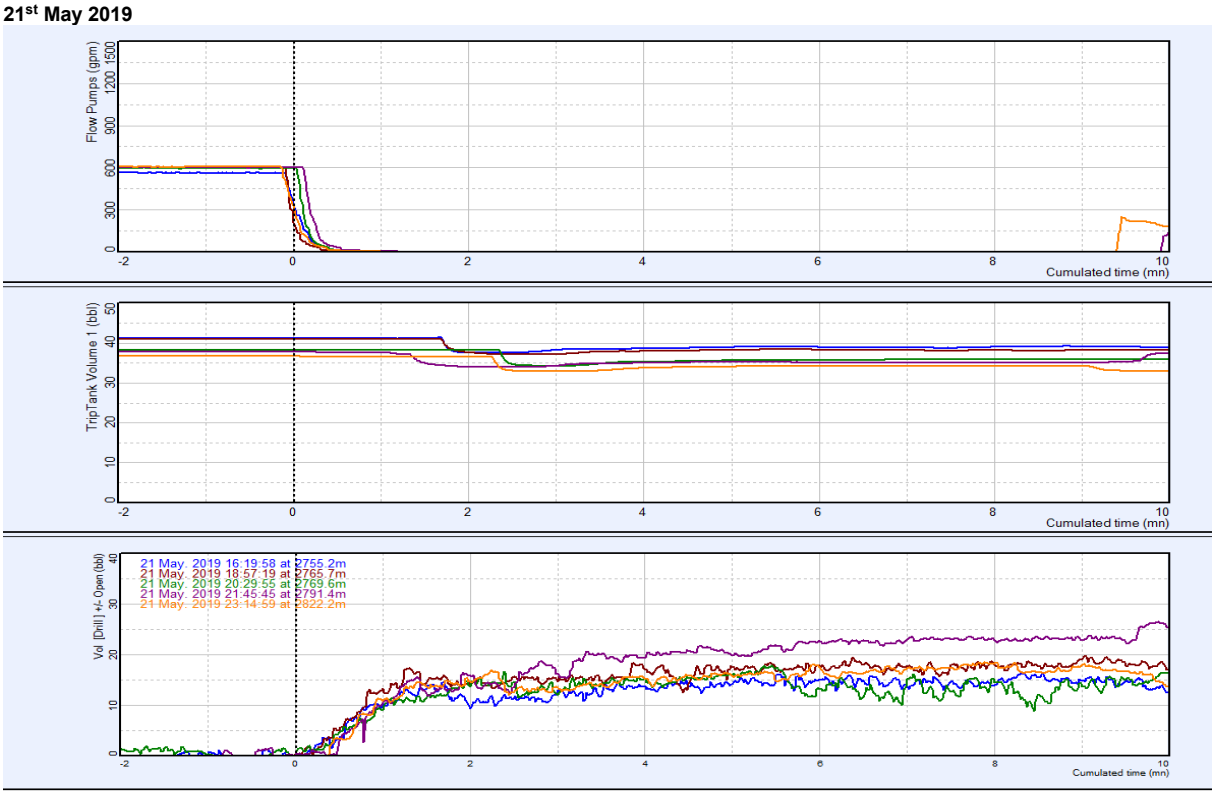
18th May 2019



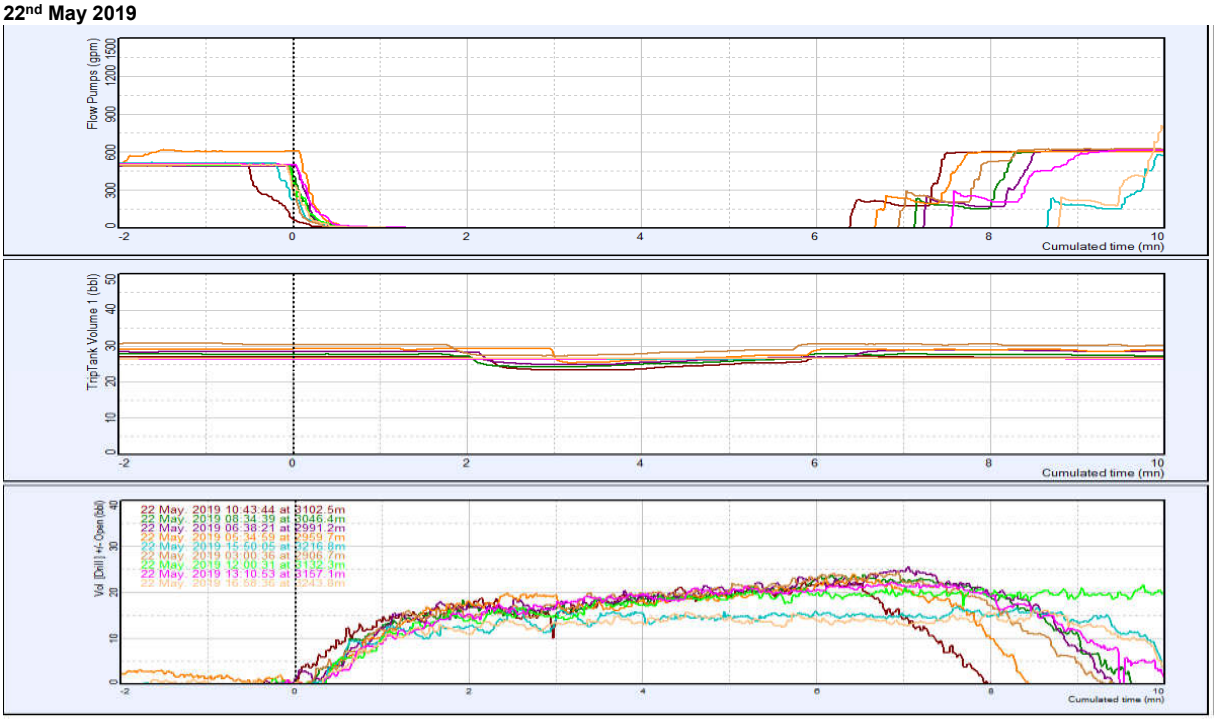
19th May 2019



21st May 2019



22nd May 2019



2.1 Pressure Evaluation

2.1.1 Formation Pressure

DEPTH m(MD)	DEPTH m(TVD)	SURFACE PRESSURE (psi)	MW (SG)	EMW (SG)	COMMENT
2218.5	**2218.44**	**1490**	**1.44**	**1.80**	LOT at 9 5/8" Shoe

2.1.2 1066mm x 660mm (42"x26") Drilling Phase

The 1066mmx660mm (42"x26") phase drilled from seabed at 146.13mMDRT to 195.87mMDRT with a 26" bit and 42" hole opener using seawater and PHG sweeps and returns to seabed. Hence, no pressure summary was applicable here.

2.2.3 375mm (14 ¾") Drilling Phase

The 375mm (14 ¾") phase drilled from 195.87m to section TD of 2222.0m with seawater and PHG gel sweeps. Since returns were at seabed, no pressure summary was applicable here.

2.1.4 216mm (8½") Drilling Phase

The 216mm (8½") phase was drilled with two bit runs. The 216mm (8½") Kymera PDC bit used to drill from 2222.0m to 2740.0m with 1.44sg water based mud. From 2740.0m to Well TD of 3285.0m drilled with Smith PDC bit and maintained same mud weight 1.44sg to well TD. A LOT was done at 9 5/8" Casing shoe with 1.44sg mud indicating EMW = 1.80sg.

Dexponent: This phase drilled dominantly through Calcareous Claystone and Sandstone with interbed of minor Argillaceous Calcilutite at various intervals. The D'Exponent trend line was set in the Claystone section and maintained till the end of the phase due to the continuous presence of Claystone beds, though interbedded. From the D'Exponent calculations the pore pressure was observed to be more or less normal except around 3049.5m to 3164.5m where there may have been a slight increase in formation pressure.

Flow-line Temperature: The flow-line temperature at the start of the phase was 33.8°C and 47.2°C at the end of it. This range indicated a positive gradient while increasing depth.

Cavings: This section saw no discernable cavings at the shakers while drilling this phase.

Overpull: Drilling was carried out normally without over-pull or drag.

Gas: There is no significant quantity of background gas encountered while drilling from 2221.0m to well TD of 3285.0m. The initial phase started with 1.44sg mud weight and maintained same mud weight to Well TD.

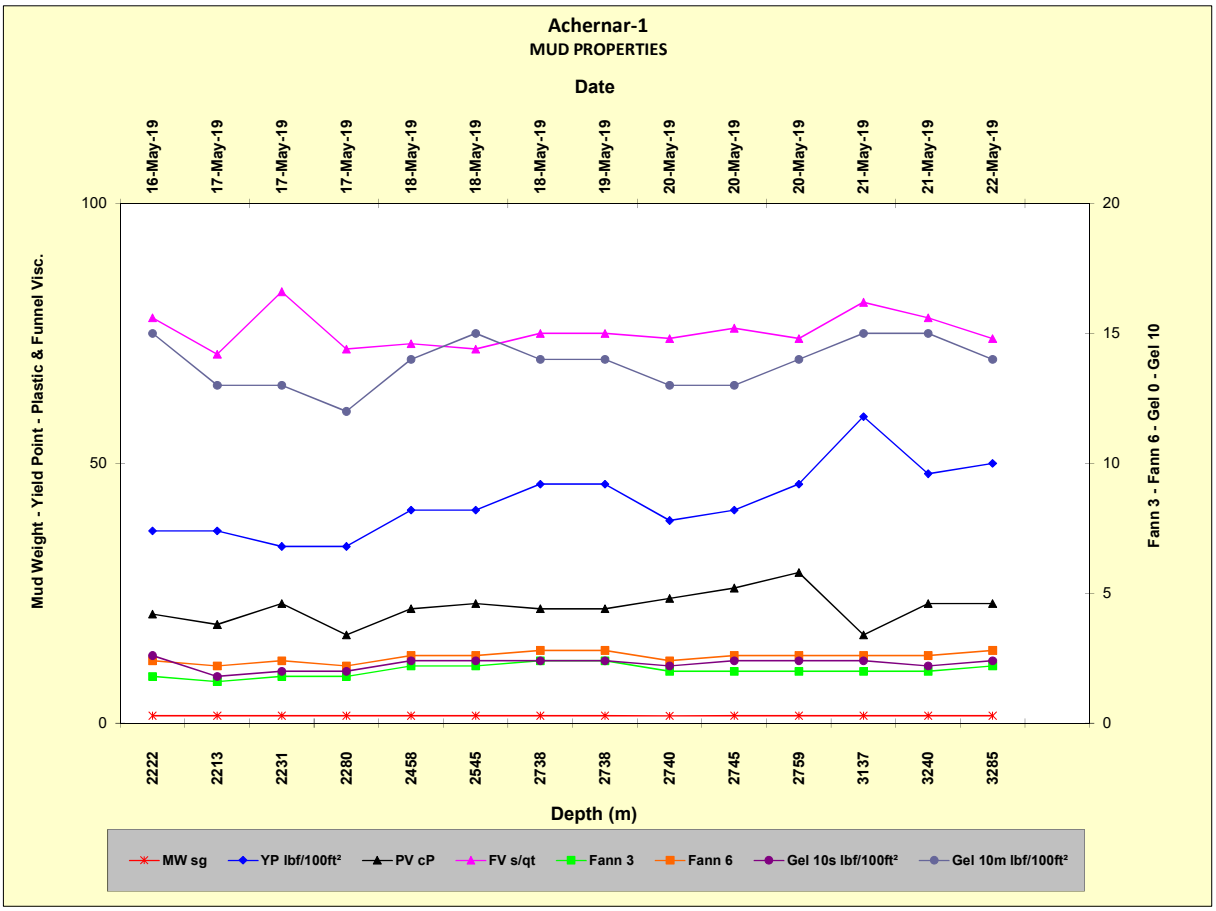
2.2 Bit Record

Bit #		1	2	3	4
Size	in	26 (Bit) X42" (HO)	14 3/4"	8½"	8½"
Bit Make		Smith / NOV Reed	Kymera	Kymera BHI	Smith
Bit Type		T11DH	KTX636T	PDC	PDC XZ616
Serial N°		D245766 / 0998H	D5298602	5276494	Q3986
Jets	/32 in	3x22, 6x14	3 x 12, 3 x 11	3 x 14, 2 X 18	6x14
TFA	in²	1.114 / 0.902	0.941	0.948	0.902
Depth In	m	146.13	195.87	2222.0	2740
Depth Out	m	195.87	2222.0	2740.0	3285
Run	m	49.74	2026.13	518	545
Bit Time	hr	2.35	47.81	38.38	24.16
Av. ROP	m/h	21.16	42.37	13.49	22.56
Grading		1-1-WT-N-E-NO-TD	PDC:1-3-LT-G-X-I-BT-TD RC: 1-2-BT-G-E-I-CT-TD	PDC:1-1-WT-A-X-I-PN-PR RC: 1-2-BT-S-E-I-PN-PR	1-1-WT-S-X-I-CT-TD

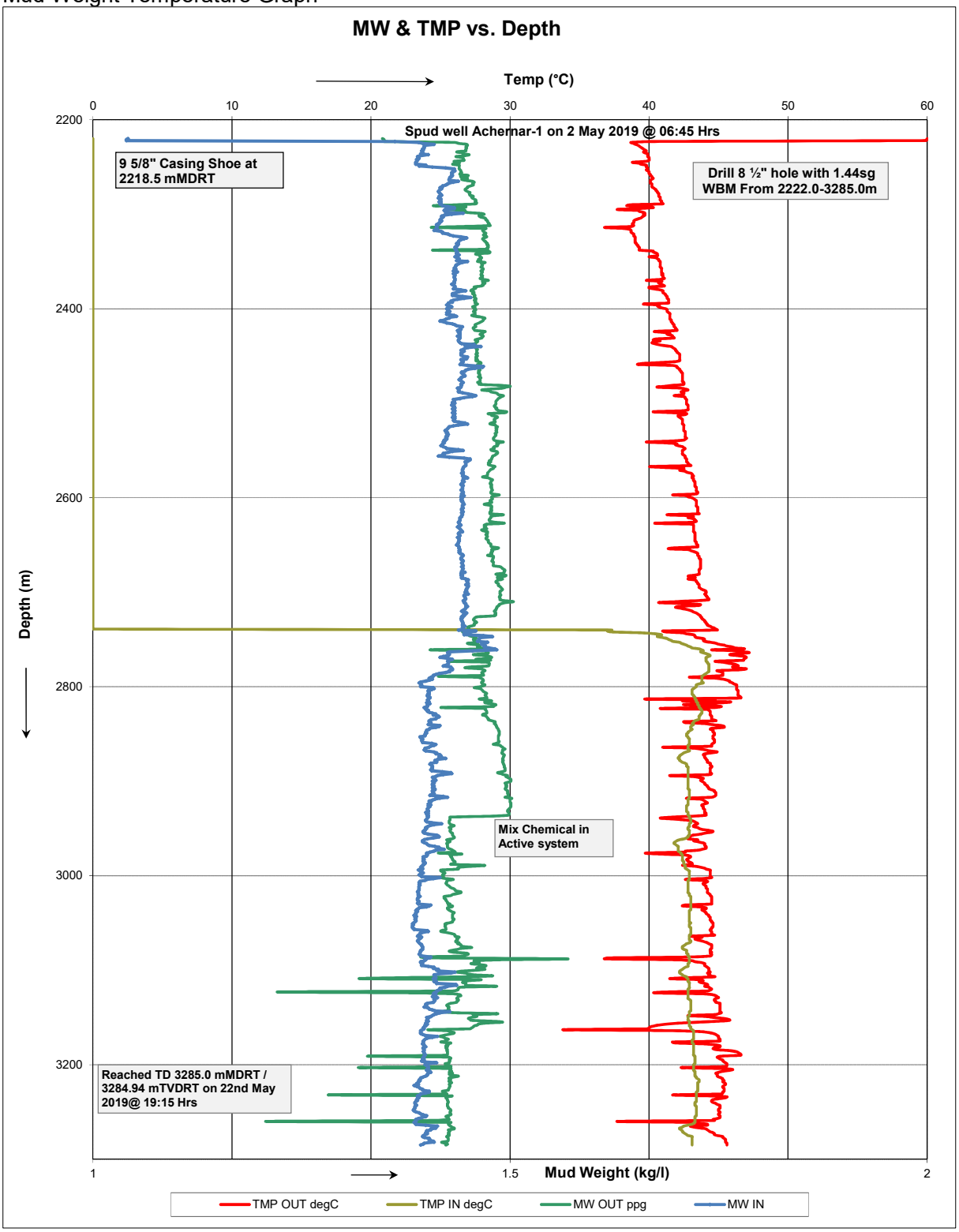
2.3 Mud Summary

Mud Data													
Units													
Depth	m												
Mud Weight (MW)	sg												
Funnel Viscosity (FV)	sec/qt												
Plastic Viscosity (PV)	cP												
Yield Point (YP)	lbf / 100 ft²												
Gels 10s	lbf / 100 ft²												
Gel 10 min	lbf / 100 ft²												
Water	%												
Corrected Solids	%												
Oil	%												
Sand	%												
Cl	Mg/l												
Date	**Depth**	**Type**	**MW**	**FV**	**PV**	**YP**	**Gel 10s**	**Gel 10m**	**Water**	**Corr Solid**	**Oil**	**Sand**	**CaCl2**
16-May-19	2222	WBM	1.44	78	21	37	13	15	83	17			56400
17-May-19	2213	WBM	1.435	71	19	37	9	13	83	17			52200
17-May-19	2231	WBM	1.44	83	23	34	10	13	83	17			52200
17-May-19	2280	WBM	1.44	72	17	34	10	12	83	17			52200
18-May-19	2458	WBM	1.44	73	22	41	12	14	83	17			50500
18-May-19	2545	WBM	1.44	72	23	41	12	15	82	18			50000
18-May-19	2738	WBM	1.44	75	22	46	12	14	83	17			52100
19-May-19	2738	WBM	1.44	75	22	46	12	14	83	17			52100
20-May-19	2740	WBM	1.42	74	24	39	11	13	85	15			48000
20-May-19	2745	WBM	1.44	76	26	41	12	13	83	17			50000
20-May-19	2759	WBM	1.44	74	29	46	12	14	82.5	17.5			53000
21-May-19	3137	WBM	1.44	81	17	59	12	15	82	18			51500
21-May-19	3240	WBM	1.44	78	23	48	11	15	82	18			52500
22-May-19	3285	WBM	1.44	74	23	50	12	14	82	18			51000

Mud Parameter Graph



Mud Weight Temperature Graph



2.5 Hydrocarbon Analysis

2.5.1 Phase Discussions

- **1066mm x 660mm (42x26") Drilling Section**

The 42" x 26" hole section was drilled riser-less with returns to sea floor from 146.13 mMDRT to 195.87 mMDRT.

- **375mm (14 ¾") Drilling Section**

The 375mm (14 ¾") phase drilled from 195.87m to section TD of 2222.0m with seawater and PHG gel sweeps. Since returns were at seabed, no hydrocarbon observed at surface.

- **216mm (8½") Drilling Section**

Gas: Drilling through the various formations in the 216mm (8½") hole the background gas broadly was between 0 - 0.06% from 2222.0m to 2892.5m. The background gas trend gradually increased 0.06% to 0.6% from 2892.5m to well TD (3285.0m).

There were no connection gas peaks, pump-off gas peaks or swab gas peaks encountered in this phase.

Gas Peaks: No significant Gas peaks observed while drilling 8 ½" section to well TD. Background gas recorded is summarised in the table below.

Depth (m)	Gas Type	TG%	C1 ppm	C2 ppm	C3 ppm	iC4 ppm	nC4 ppm	iC5 ppm	nC5 ppm
2221-2770	BG	0.0152	109	1	1	0	1	1	0
2770-2890	BG	0.043	291	10	6	1	1	1	0
2890-3030	BG	0.1448	1148	52	23	6	5	4	2
3030-3070	BG	0.2358	1689	102	54	7	13	5	3
3070-3165	BG	0.1695	1363	84	46	6	11	4	3
3165-3285	BG	0.2910	2148	225	135	12	29	6	5

3 Geological Summary

3.0 Geological Interval Description

2221.0 to 2260.0 mMDRT 2220.94 to 2259.94 mTVDRT **CALCILUTITE**	
ROP (Range):	1.44 to 10.43 m/h
Av. ROP:	6.1 m/h
CALCILUTITE (80 to 90%)	White to very light grey, firm to moderately hard, sub blocky, trace to 10% calcareous silt, traces very fine grained quartz, trance finely disseminated pyrite, traces of carbonaceous specks.
CALCAREOUS CLAYSTONE (0 TO 10%)	Medium light grey to medium grey, soft to firm, sub blocky to blocky, trace amorphous, 25-40% calcareous clay, 5-20% silty, traces of carbonaceous materials, traces of micro mica.
CHERT (Nil to 10%)	Pale yellowish brown to greyish orange, opaque to translucent, very hard, brittle, angular to conchoidal, micro, splintery, cryptocrystalline, trace black inclusions
HYDROCARBON FLUORESCENCE	Nil

2260.0 to 2380.0 mMDRT 2259.94 to 2359.94mTVDRT **CALCILUTITE and CALCAREOUS CLAYSTONE**	
ROP (Range):	2 to 37.4 m/h
Av. ROP:	12.3 m/h
CALCILUTITE (30 to 70%)	White to very light grey, minor light greenish grey, firm to moderately hard, sub blocky to blocky, trace to 10% calcareous silt, trace very fine grained quartz, trace carbonaceous specks, trace glauconite
CALCAREOUS CLAYSTONE (30 to 70%)	Medium light grey to medium grey, minor light brownish grey, soft to firm, sub blocky to blocky, trace amorphous, 25 to 40% calcareous clay, 10 -20% silt, in part grading to Calcareous Siltstone, trace carbonaceous materials, trace micro mica, trace micro pyrite, trace dark lithic fragments.
HYDROCARBON FLUORESCENCE	Nil.

2380.0 to 2630 mMDRT 2379.94 to 2629.94 mTVDRT **ARGILLACEOUS CALCILUTITE and CALCAREOUS CLAYSTONE**	
ROP (Range):	6.0 to 70 m/h
Av. ROP:	19.6 m/h
ARGILLACEOUS CALCILUTITE (95 to 100%)	Light grey to light greenish grey, trace light bluish grey, white, firm to moderately hard, sub blocky to blocky, trace to 5% calcareous silt, 20% to 30% argillaceous matrix, trace very fine grained quartz, trace carbonaceous specks, trace glauconite, trace fossils
CALCAREOUS CLAYSTONE (30 to 70%)	Medium grey to dark grey, trace light brownish grey, soft to firm, sub blocky to blocky, trace amorphous, 30 to 40% calcareous clay, 10 % silt, trace carbonaceous materials, trace micro mica, trace micro pyrite
HYDROCARBON FLUORESCENCE	Nil

2630.0 to 2870.0 mMDRT 2629.94 to 2869.94 mTVDRT **CALCAREOUS CLAYSTONE and ARGILLACEOUS CALCILUTITE**	
ROP (Range):	1.5 to 114 m/h
Av. ROP:	10.6 m/h
ARGILLACEOUS CALCILUTITE (Nil to 40%)	Light grey to light greenish grey, trace light bluish grey, white, firm to moderately hard, sub blocky to blocky, trace to 5% calcareous silt, 20% to 30% argillaceous matrix, trace very fine grained quartz, trace carbonaceous specks, trace glauconite, trace fossils
CALCAREOUS CLAYSTONE (60 to 100%)	Medium grey to dark grey, trace light brownish grey, soft to firm, sub blocky to blocky, trace amorphous, 30 -40% calcareous clay, 10 % silt, trace carbonaceous materials, trace micro mica, trace micro pyrite.
HYDROCARBON FLUORESCENCE	Nil.

2870.0 to 2920.0 mMDRT 2869.94 to 2919.94 mTVDRT **CLAYSTONE with minor ARGILLACEOUS CALCILUTITE.**	
ROP (Range):	13.4 to 80.4 m/h
Av. ROP:	38.46
CLAYSTONE (70 to 100%)	Medium light grey to medium dark grey, trace dark grey, soft to firm, to moderately hard in part, sub blocky to blocky, 20 to 30% calcareous clay, trace quartz silt, trace carbonaceous specks, trace micromica, trace disseminated pyrite.
ARGILLACEOUS CALCILUTITE (Nil to 30%)	White, light greenish grey to light bluish grey, soft to firm, sub blocky to blocky, amorphous in places, 25% argillaceous matrix, trace black thin bands, trace carbonaceous specks, trace glauconite,
HYDROCARBON FLUORESCENCE	Nil.

2920.0 to 3030.0 mMDRT 2919.94 to 3029.94 mTVDRT **CALCAREOUS CLAYSTONE with minor CALCAREOUS SANDSTONE.**	
ROP (Range):	8.4 to 73.3 m/h
Av. ROP:	31.9 m/h
CALCAREOUS CLAYSTONE (90 to 100%)	Brownish grey to olive black, , trace olive black, dominantly soft to firm, sub blocky to blocky, amorphous in part, 20% calcareous clay, 10% silt, trace very fine grained calcite cemented sandstone, trace carbonaceous specks, trace micromica, trace micro pyrite
CALCAREOUS SANDSTONE (Nil to 10%)	Very light grey to light grey, moderately hard to hard, sub blocky to blocky, very fine grained, sub angular to sub rounded, sub spherical, well sorted, strongly calcite cemented, nil visual porosity. No shows.
HYDROCARBON FLUORESCENCE	Nil.

3030.0 to 3070.0 mMDRT 3029.94 to 3069.94 mTVDRT **CALCAREOUS CLAYSTONE, CALCAREOUS SANDSTONE with minor CALCILUTITE**	
ROP (Range):	21.1 to 65.4 m/h
Av. ROP:	36.7 m/h
CALCAREOUS CLAYSTONE (20 to 90%)	Brownish grey to olive black, , trace olive black, dominantly soft to firm, sub blocky to blocky, amorphous in part, 20% calcareous clay, 10% silt, trace very fine grained calcite cemented sandstone, trace carbonaceous specks, trace micromica, trace micro pyrite
CALCAREOUS SANDSTONE (10 to 70%)	Very light grey to light grey, moderately hard to hard, sub blocky to blocky, very fine grained, sub angular to sub rounded, sub spherical, well sorted, strongly calcite cemented, traces to 5% argillaceous matrix, traces to rare carbonaceous fragments and laminations, poor visible porosity, no shows.
CALCILUTITE (Nil to 30%)	White to very light grey, firm to moderate hard, sub blocky to blocky, traces to 10% calcareous silt, traces of very fine grained quartz, traces of finely disseminated Pyrite, traces of carbonaceous specks.
HYDROCARBON FLUORESCENCE	Nil

3070.0 to 3165.0 mMDRT 3069.94 to 3164.94 Mtvdrt **CALCAREOUS SANDSTONE, SANDSTONE with minor CLAYSTONE & CALCAREOUS CLAYSTONE**	
ROP (Range):	17.1 to 98.0 m/h
Av. ROP:	36.3 m/h
CLAYSTONE (Nil to 60%):	Brownish grey to olive grey, traces of olive black, dominantly soft to firm, sub blocky-blocky, amorphous in parts, 10-20% silt, traces of very fine grained calcareous cemented sandstone fragments, traces of carbonaceous specks and laminations, traces of micro mica, traces of micro pyrite and pyrite nodules.
CALCAREOUS CLAYSTONE (0 to 30%)	Brownish grey to olive grey, traces of olive black, dominantly soft-firm, sub blocky to blocky, amorphous in parts, 20% calcareous clay, 10-20% silt, traces of carbonaceous specks and laminations, traces of micro mica, traces of micro pyrite
SANDSTONE (Nil to 90%):	Very light grey-light grey, minor light brownish grey, firm-moderately hard, traces hard, sub blocky to blocky, very fine to fine grained, traces medium grained, sub angular-sub rounded, sub spherical, moderately well sorted, 5% calcareous cement, traces of pyritic cement, traces to 10% argillaceous matrix, traces to rare carbonaceous fragments

	and laminations, traces of disseminated pyrite, poor visible porosity, no shows.
CALCAREOUS SANDSTONE (Traces to 90%)	Very light grey to light grey, minor light brownish grey, mod hard to hard, sub blocky-blocky, very fine to fine grained, traces medium grained, sub angular to sub rounded, sub spherical, moderately well sorted, strongly calcareous cemented, traces to 5 % argillaceous matrix, traces to rare carbonaceous fragments and laminations, traces of disseminated pyrite, poor visible porosity, no shows.
HYDROCARBON FLUORESCENCE	Nil

3165.0 to 3285.0 mMDRT 3164.94 to 3284.94 mTVDRT **SANDSTONE AND CLAYSTONE**	
ROP (Range):	9.5 to 77.9 m/h
Av. ROP:	32.2 m/h
CLAYSTONE (30-70%)	Brownish grey to olive black, trace olive black, minor medium dark grey, dominantly soft to firm, sub blocky to blocky, amorphous in part, trace to 5% calcareous clay, 10% -20% silt, trace very fine grained quartz, trace carbonaceous specks and laminae, trace micromica, trace micro pyrite
SANDSTONE (30 to 70%)	Very light grey to light grey, minor light brownish grey, firm to moderately hard, trace hard, sub blocky to blocky, very fine to fine grained, trace medium grains, sub angular to sub rounded, sub spherical, moderately well sorted, trace to 5% calcite cement, trace pyrite cement, trace to 10 % argillaceous matrix, trace to rare carbonaceous fragments and laminae, trace disseminated pyrite, poor visual porosity. No shows. (Sample returned predominantly as PDC bit generated texture)
HYDROCARBON FLUORESCENCE	Nil

3.1 Sample Summary

DITCH CUTTING SAMPLING INTERVAL

Depth	Sample interval	Sample Type
2221 – 2230m	9m	normal
2230 – 3000m	10m	normal
3000 – 3285m	5m	normal

LIST OF ALL MISSED / UNDERWEIGHT SAMPLES AND EXPLANATION : NIL

3.1.1 Sampling Manifest

SAMPLE DISTRIBUTION SUMMARY

SAMPLE TYPE	SET DESTINATION	REMARKS
DRILL CUTTINGS 200g washed/air dried (200 g foil bags) **FOUR Sets** All Sets to be sent to: **Note: All Sets to be packed separately.** Sets A & B to be sent separate consignment from Sets C&D	**Set A Geoscience Australia** **Set B WA DOIR** Note on transmittal: To be forwarded to DOIR - Contact Chris Brooks on (08) 9470 0305 for delivery arrangements. **Sets C, & D WEL (via Core Lab)** Core Laboratories 89 Leach Hwy Kewdale WA 6105 Attn: Justin Tomlinson 08 9353 8888 Mobile: 0428 728 763	**Set A Core Lab to forward to:** Geoscience Australia Cnr Jerrabomberra Avenue & Hindmarsh Drive Symonston ACT 2609 (GPO Box 378, Canberra ACT 2601) **Set B (WA DOIR) Core Lab to forward to:** Geological Survey Stores & Transportation Depot 37 Harris Street Carlisle WA 6101 **Sets C & D: Core Lab to Store**

SAMPLE TYPE	SET DESTINATION	REMARKS
3.1.1.1 DRILL CUTTINGS 300g ***3.1.1.2 Unwashed and air dried (300g foil bags)***	*3.1.1.3 Set E WEL (via Core Lab)*	**Core Lab to store**
3.1.1.4 FIS SAMPLES 30g (in 200g foil bags)	*3.1.1.5 Set F WEL (via Core Lab)*	**Core Lab to store – Forward on Request**
SAMPLEX TRAYS	**Set G WEL (via Core Lab)**	1 set in wooden boxes. **Core Lab to store**
MUDGAS SAMPLES	**Set H WEL (via Core Lab)**	Full boxes of 25 Isotubes (used or unused) packed in supplied Isotech shipping box. Note Hazardous Freight transportation regulations apply for gas concentrations of >5% by volume of methane (cannot fly in passenger aircraft).Fill in MOD 41/A form to transportation **Core Lab to Store and forward upon request to designated Company.**
MUD SAMPLES	**Set I WEL (via Core Lab)**	**Core Lab to store**
BIOSTRATIGRAPHIC SAMPLES 200g washed/air dried (200 g foil bags)	**Set J WEL (via Core Lab)**	**Core Lab to store – Forward on Request** **For hotshots:-Preferably hand-carried by WEL personnel or designate. Otherwise sent via rig Logistics Supervisor and marked urgent. Inform Ops Geo of ETS at Perth airport.**
MISCELLANEOUS SAMPLES & Worksheets/Charts	*3.1.1.6 Set K WEL (via Core Lab)*	**Core Lab to store**

SET - A, B, C & D

DRILL CUTTINGS, Washed and Air dried 200g packed in foil bags

Pacart Box	Small box	Initial depths	End depths	Intervals
1	1	2221-2230	2330-2340	9 & 10m
	2	2340-2350	2450-2460	10m
	3	2460-2470	2570-2580	10m
	4	2580-2590	2690-2700	10m
2	5	2700-2710	2810-2820	10m
	6	2820-2830	2930-2940	10m
	7	2940-2950	3025-3030	10m
	8	3030-3035	3085-3090	5 & 10m
3	9	3090-3095	3145-3150	5m
	10	3150-3155	3205-3210	5m
	11	3210-3215	3280-3285	5m
	12	Empty	Empty	

SET - E

DRILL CUTTINGS, Unwashed and Air dried 300g packed in foil bags

Pacart Box	Small box	Initial depths	End depths	Intervals
1	1	2221-2230	2320-2330	9 & 10m
	2	2330-2340	2430-2440	10m
	3	2440-2450	2540-2550	10m
	4	2550-2560	2650-2660	10m
2	5	2660-2670	2760-2770	10m
	6	2770-2780	2870-2880	10m
	7	2880-2890	2980-2990	5 & 10m
	8	2990-3000	3045-3050	5m
3	9	3050-3055	3100-3105	5m
	10	3105-3110	3155-3160	5m
	11	3160-3165	3210-3215	5m
	12	3215-3220	3280-3285	5m

SET - F : FIS Samples

DRILL CUTTINGS, Washed and Air dried 30g packed in 200g foil bags

Pacart Box	Small box	Initial depths	End depths	Intervals
1	1	2221 – 2230m	2520 – 2530m	9 & 10m
	2	2530 – 2540	2820 – 2830m	10m
	3	2830-2840	3065-3070	5 & 10m
	4	3070-3075	3280-3285	5m

SET - G: SAMPLEX Trays, 1 wooden box

Pacart Box	Small box	Initial depths	End depths	Intervals
1	1	2221 – 2230m	3280 – 3285 m	9, 10, 5m,

SET - H: ISOTUBE SAMPLES

MUDGAS SAMPLES were collected in Isotubes at the following depths:

Box # 1

Isotube No.	Depth (mMDRT)	Date	Time	Total Gas (%)	Remark
1	2300	18-May-2019	02:41	0.02	Scheduled Sample
2	2400	18-May-2019	10:02	0.02	Scheduled Sample
3	2500	18-May-2019	18:38	0.01	Scheduled Sample
4	2600	19-May-2019	00:50	0.02	Scheduled Sample
5	2700	19-May-2019	9:51	0.015	Scheduled Sample
6	2740	19-May-2019	16:47	0.016	Scheduled Sample
7	2800	21-May-2019	22:45	0.04	Scheduled Sample
8	2900	22-May-2019	3:20	0.12	Scheduled Sample
9	3000	22-May-2019	7:32	0.178	Scheduled Sample
10	3010	22-May-2019	7:56	0.164	Scheduled Sample
11	3020	22-May-2019	8:10	0.1718	Scheduled Sample
12	3030	22-May-2019	8:35	0.1728	Scheduled Sample
13	3040	22-May-2019	9:00	0.255	Scheduled Sample
14	3050	22-May-2019	9:13	0.350	Scheduled Sample
15	3060	22-May-2019	9:38	0.25	Scheduled Sample
16	3070	22-May-2019	10:03	0.21	Scheduled Sample
17	3080	22-May-2019	10:30	0.14	Scheduled Sample
18	3090	22-May-2019	11:00	0.15	Scheduled Sample
19	3010	22-May-2019	11:10	0.2	Scheduled Sample
20	3110	22-May-2019	11:40	0.15	Scheduled Sample
21	3120	22-May-2019	11:55	0.27	Scheduled Sample
22	3130	22-May-2019	12:28	0.10	Scheduled Sample
23	3140	22-May-2019	12:58	0.21	Scheduled Sample
24	3150	22-May-2019	13:25	0.29	Scheduled Sample
25	3160	22-May-2019	13:40	0.05	Scheduled Sample

BOX 2

Isotube No.	Depth (mMDRT)	Date	Time	Total Gas (%)	Remark
1	3170	22-May-2019	14:14	0.19	Scheduled Sample
2	3180	22-May-2019	14:40	0.23	Scheduled Sample
3	3190	22-May-2019	15:01	0.36	Scheduled Sample
4	3200	22-May-2019	15:32	0.15	Scheduled Sample
5	3210	22-May-2019	16:10	0.56	Scheduled Sample
6	3220	22-May-2019	16:40	0.20	Scheduled Sample
7	3230	22-May-2019	16:55	0.41	Scheduled Sample
8	3240	22-May-2019	17:20	0.34	Scheduled Sample
9	3250	22-May-2019	17:53	0.28	Scheduled Sample
10	3260	22-May-2019	18:40	0.36	Scheduled Sample
11	3270	22-May-2019	18:52	0.34	Scheduled Sample
12	3280	22-May-2019	19:28	0.28	Scheduled Sample
13	3285	22-May-2019	19:40	0.31	Well TD
14					Empty
15					Empty
16					Empty
17					Empty
18					Empty
19					Empty
20					Empty
21					Empty
22					Empty
23					Empty
24					Empty
25					Empty

SET - I: MUD SAMPLES

DRILLING FLUID and DRILLING FLUID FILTRATES SAMPLES

Drilling Fluid and Drilling Fluid Filtrate samples were collected and stored in Pyrex Bottles at the following depths:

Sample Type	Lagged Depth (mMDRT)	Time/Date	Volume	Remarks
Drilling Fluid	2225	10:30 / 17-May-19	500ml	Start of 8.5” Section
	3025	08:30 / 22-May-19	500ml	Before entering Reservoir
	3060	09:16 / 22-May-19	500ml	Reservoir
	3285	19:20 / 22-May-19	500ml	Well TD
Mud Filtrate	2225	10:30 / 17-May-19	10ml	Start of 8.5” Section
	3025	08:30 / 22-May-19	10ml	Before entering Reservoir
	3060	09:16 / 22-May-19	10ml	Reservoir
	3285	19:20 / 22-May-19	10ml	Well TD

SET J: BIOSTRATIGRAPHIC Samples

DRILL CUTTINGS, Washed and Air dried 200g packed in foil bags

Pacart Box	Small box	Initial depths	End depths	Intervals
1	1	2221-2230	2330-2340	9 & 10m
	2	2340-2350	2450-2460	10m
	3	2460-2470	2570-2580	10m
	4	2580-2590	2690-2700	10m
2	5	2700-2710	2810-2820	10m
	6	2820-2830	2930-2940	10m
	7	2940-2950	3025-3030	10m
	8	3030-3035	3085-3090	5 & 10m
3	9	3090-3095	3145-3150	5m
	10	3150-3155	3205-3210	5m
	11	3210-3215	3280-3285	5m
	12	-	-	-

Sample Set Number	Sample Type	No. of Samples per Box & Total	Composition			Packing Details	Destination	Remarks
			Pacart Box #	Split Box #	Depth / Interval(m)			
A	**DRILL CUTTINGS** 200g Washed/air dried (200g in foil bags)	12 12 12 12 12 12 12 12 12 12 12 15 Total: 135 By 1 Set	1 2 3	1 2 3 4 5 6 7 8 9 10 11	2221 – 2340 2340 – 2460 2460 – 2580 2580 – 2700 2700 – 2820 2820 – 2940 2940 – 3030 3030 – 3090 3090 – 3150 3150 – 3210 3210 – 3285	**<u>200g washed and dried in foil bags</u>** Approx weight each pacart box= 10 kg Approx Total Weight = (2.5kg x 11 split box or 3 pacart box) = 27.5kg.	**Set-A:** To be sent to: Core Laboratories 89 Leach Hwy Kewdale WA 6105 Attn: Justin Tomlinson 08 9353 8888 Mobile: 0428 728 763 CoreLab to forward to : Geoscience Australia Cnr Jerrabomberra Ave & Hindmarsh Drive Symonston ACT 2609 (GPO Box 378, Canberra ACT 2601)	

Sample Set Number	Sample Type	No. of Samples per Box & Total	Composition			Packing Details	Destination	Remarks
			Pacart Box #	Split Box #	Depth / Interval(m)			
B	**DRILL CUTTINGS** 200g Washed/air dried (200g in foil bags)	12 12 12 12 12 12 12 12 12 12 15 Total: 135 By 1 Set	1 2 3	1 2 3 4 5 6 7 8 9 10 11	2221 – 2340 2340 – 2460 2460 – 2580 2580 – 2700 2700 – 2820 2820 – 2940 2940 – 3030 3030 – 3090 3090 – 3150 3150 – 3210 3210 – 3285	**<u>200g washed and dried in foil bags</u>** Approx weight each pacart box= 10 kg Approx Total Weight = (2.5kg x 11 split box or 3 pacart box) = 27.5kg.	**Set-B:** To be sent to: Core Laboratories 89 Leach Hwy Kewdale WA 6105 Attn: Justin Tomlinson 08 9353 8888 Mobile: 0428 728 763 CoreLab to forward to : Geological Survey Stores & Transportation Depot 37 Harris Street Carlisle WA 6101	

Sample	Sample Type	No. of	Composition	Packing Details	Destination	Remarks

Set Number		Samples per Box & Total	Pacart Box #	Split Box #	Depth / Interval(m)			
C & D	**DRILL CUTTINGS** 200g Washed/air dried (200g in foil bags)	12 12 12 12 12 12 12 12 12 12 15 Total: 135 By 2 Set	1 2 3	1 2 3 4 5 6 7 8 9 10 11	2221 – 2340 2340 – 2460 2460 – 2580 2580 – 2700 2700 – 2820 2820 – 2940 2940 – 3030 3030 – 3090 3090 – 3150 3150 – 3210 3210 – 3285	**<u>200g washed and dried in foil bags</u>** Approx weight each pacart box= 10 kg Approx Total Weight = (2.5kg x 11 split box or 3 pacart box) = 27.5kg.	**Set-C & D:** To be sent to: Core Laboratories 89 Leach Hwy Kewdale WA 6105 Attn: Justin Tomlinson 08 9353 8888 Mobile: 0428 728 763 **To Store for WEL**	

Sample Set Number	Sample Type	No. of Sample sper Box & Total	Composition			Packing Details	Destination	Remarks
			Pacart Box #	Split Box #	Depth / Interval(m)			
E	**DRILL CUTTINGS** 300g Unwashed/air dried (200g in foil bags)	11 11 11 11 11 11 11 11 11 11 11 11 14 Total: 135 By 1 set	1 2 3	1 2 3 4 5 6 7 8 9 10 11 12	2221 – 2330 2330 – 2440 2440 – 2550 2550 – 2660 2660 – 2770 2770 – 2880 2880 – 2990 2990 – 3050 3050 – 3105 3105 – 3160 3160 – 3215 3215 – 3285	**<u>300g unwashed and dried in foil bags</u>** Approx weight each pacart box= 14 kg Approx Total Weight = (3.5kg x 12 split box or 3 pacart box) = 42 kg.	**Set-E:** To be sent to: Core Laboratories 89 Leach Hwy Kewdale WA 6105 Attn: Justin Tomlinson 08 9353 8888 Mobile: 0428 728 763 **To Store for WEL**	

Sample Set Number	Sample Type	No. of Sample sper Box & Total	Composition			Packing Details	Destination	Remarks
			Pacart Box #	Split Box #	Depth / Interval(m)			
F	**DRILL CUTTINGS** 30g FIS SAMPLES washed/air dried (200g foil bags)	31 30 31 43 Total: 135 By 1 set	1	1 2 3 4	2221 – 2530 2530 – 2830 2830 – 3070 3070 – 3285	**<u>30g washed and dried in foil bags</u>** Approx weight each pacart box= 4 kg Approx Total Weight = (1 kg x 4 split box or 1 pacart box) = 4 kg.	**Set-F:** To be sent to: Core Laboratories 89 Leach Hwy Kewdale WA 6105 Attn: Justin Tomlinson 08 9353 8888 Mobile: 0428 728 763 **CoreLab to store – Forward on Request**	

Sample Set Number	Sample Type	No. of Samples per Box & Total	Composition			Packing Details	Destination	Remarks
			Pacart Box #	Split Box #	Depth / Interval(m)			
Samplex Trays Set (G)	**Samplex Trays**	27 sticks Total: 135 samples By 1 sets	1	1	2221 – 3285	**Samplex Trays in box** Approx weight each pacart box = 4 kg *Approx Total Weight = (4kg x 1 box) = 4kg*	**Samplex Set G:** To be sent to: Core Laboratories 89 Leach Hwy Kewdale WA 6105 Attn: Justin Tomlinson 08 9353 8888 Mobile: 0428 728 763 **To Store for WEL**	

Sample Set number	Sample Type	No. of Samples per Box & Total	Composition		Packing Details	Destination	Remarks
			Box #	Depth / Interval(m)			
H	**Isotube Samples** (Mudgas Sample)	25 Isotubes packed in a Box	1 2	2300 - 3160 3170 – 3285	**2 Iso tech cardboard Boxes Packed in pacart box** Approx weight each isotech box = 2 kg Approx Total Weight = (1 pacart box) = 4 kg	**Isotube Samples Set H:** To be sent to: Core Laboratories 89 Leach Hwy Kewdale WA 6105 Attn: Justin Tomlinson 08 9353 8888 Mobile: 0428 728 763 **CoreLab to Store and forward upon request to designated Company.**	

Sample Set number	Sample Type	No. of Samples per Box & Total	Composition			Packing Details	Destination	Remarks
			Pacart Box #	Split Box #	Depth / Interval(m)			
I	**Mud Samples** In 500ml Pyrex Bottle	1 1 1 1 Total = 4	1	1	2225.0 3025.0 3060.0 3285.0	**Packed in one Split boxes** Approx weight 1 split box = 6 kg _____ Packed in same box with Mud samples _____ Approx Total Weight = 1 pacart box = 6 kg	**Mud Samples Set I:** To be sent to: Core Laboratories 89 Leach Hwy Kewdale WA 6105 Attn: Justin Tomlinson 08 9353 8888 Mobile: 0428 728 763 **To Store for WEL**	
	Mud Filtrate Samples In 50ml Pyrex Bottle	1 1 1 1 Total = 4		2	2225.0 3025.0 3060.0 3285.0			

Sample Set Number	Sample Type	No. of Sample sper Box & Total	Composition			Packing Details	Destination	Remarks
			Pacart Box #	Split Box #	Depth / Interval(m)			
BIOSTRAT Set (J)	**BIOSTRAT Sample** 200g Washed & air dried (200g in foil bags)	12 12 12 12 12 12 12 12 12 12 15 Total: 135 By 1 Set	1 2 3	1 2 3 4 5 6 7 8 9 10 11	2221 – 2340 2340 – 2460 2460 – 2580 2580 – 2700 2700 – 2820 2820 – 2940 2940 – 3030 3030 – 3090 3090 – 3150 3150 – 3210 3210 – 3285	**<u>200g washed and dried in foil bags</u>** Approx weight each pacart box= 10 kg Approx Total Weight = (2.5kg x 11 split box or 3 pacart box) = 27.5kg	**BIOSTRAT Set J:** To be sent to: Core Laboratories 89 Leach Hwy Kewdale WA 6105 Attn: Justin Tomlinson 08 9353 8888 Mobile: 0428 728 763 CoreLab to on-send to WEL.	

4 Well Deviation

4.0 Overview

Well ACHERNAR-1 was drilled as a vertical exploration well.

Deviation surveys were measured by Schlumberger utilising MWD/LWD tools at each connection whilst drilling. The computation method used was the minimum radius of curvature / Lubinski method. Surveys were conducted at the bottom of each stand of drill pipe prior each connection was made.

5 Mud logging Services

The Geoservices' geoNEXT system is a well monitoring service designed to be integrated with the drilling practices at the well site and to provide real time information both on and off site. One of geoNEXT's objectives in providing this information is to help initiate real time well control decisions to enable the well to be drilled in a safer and a more cost effective manner.

Apart from the usual tools used in the task of well surveillance, advanced data processing and smart event detection was available. The use of extra surveillance practices such as Mechanical specific energy (MSE), flow back, Vibration monitoring, Pick up slack off monitoring and simultaneous event detection (SED) can be used in identifying anomalies before they become problematic.

Geoservices offers a comprehensive mud logging service, which entails drilled formation sampling and analysis, hydrocarbon and gas detection within - and liberated from - the drilling fluids, as well as the monitoring of drilling parameters, passive sensors positioned at strategic points around the rig give warning to the presence of Hydrogen Sulfide gas (H2S).

Sample analysis involves the cleaning and cuttings description from the different lithologies drilled. Further analysis includes the determination of calcium and magnesium carbonate content, and qualifying any oil shows.

Gas analysis of the drilling fluid involves the liberation of formation gas contained within the drilling fluid, using a mechanical agitator immersed in the mud pumped at constant flow in the GZG. The gas is then sampled into the RESERVAL™ to give instantaneous real time gas values and component chromatographic breakdown analysis.

The main gas detection equipment used on the well was a RESERVAL™

The Total Gas detector ionizes the sampled gas in a hydrogen flame, across a high voltage field. The detecting electrode registers the number of carbon ions. The detector gives continuous readings as percentage in CH4 equivalent.

The Chromatograph takes a gas sample every 42 sec, separates light and heavy gases in a chromatograph column, and then analyses each gas (up to nC5) in the FID detector.

5.0 Service Overview

The key services provided by Geoservices' geoNEXT GN5, Unit 1010979, throughout the drilling of Achernar-1 include but are not limited to:

- Data acquisition
- On site data display to rig personnel, company representatives and third party
- Data Interpretation
- Gas Detection and Analysis
- Hydraulics & Swab and Surge Reports
- Cuttings sample collection, analysis and interpretation
- Assisting the Well site Geologist
- Real time data streaming to InterAct
- Well control and spill control surveillance
- Daily Reporting

The reports produced include; Daily Midnight reports, Master-log, Drill log, Pressure log and Gas log plots, depth and time ASCII, and PVT trip sheets when applicable.

Depth data was recorded in 0.5 metre increments

A digital backup of the well data was provided on CD

The sampling schedule for Achernar-1 was; Four (4) sets of washed and dried ditch cuttings at 200 grams each and 1 set of washed and dried ditch cuttings in Samplex trays, 1 set of 30 grams of washed and dried ditch cuttings for FIS and 1 set of 200 grams of washed and dried ditch cuttings for Bio-stratigraphy, I set of 300 grams for Unwashed and dried ditch cuttings sample. Isotube gas samples were collected at 100 m interval during 8 ½" section till 3000 m, at 10 m interval between 3000 m to 3285 m (section TD) and any gas peaks.

Mud and filtrate samples were collected at regular intervals as specified in the sampling program.

These samples were shipped to Core laboratories PTY LTD for on delivery to the required parties. For further details see included sample manifest in Appendix

5.1 Personnel involved on board

The working pattern is briefly described here (shift duration, crew composition depending on the phase of the well).

Data Analysts	Mud Logging Analysts	Sample Catchers
Raju Thottan	Santosh Kulkarni	Kamran Ramzan
Subash Rajamanickam	Umair Rabnawaz	Syed Shah
Issaq Mohamed	Daniele Veronelli	

5.2 Base and HQ support

- Australia

Mud Logging Field Service Manager: Nazem Sharaballi

Email: nsharaballi@slb.com
Mobile: +61 8 64307149

5th Floor, 256 St. George Terrace
Perth 6000

Job Delivery Lead: Arun Raveendran

Email: araveendra@slb.com
Mobile: +61 421905772

5th Floor, 256 St. George Terrace
Perth 6000

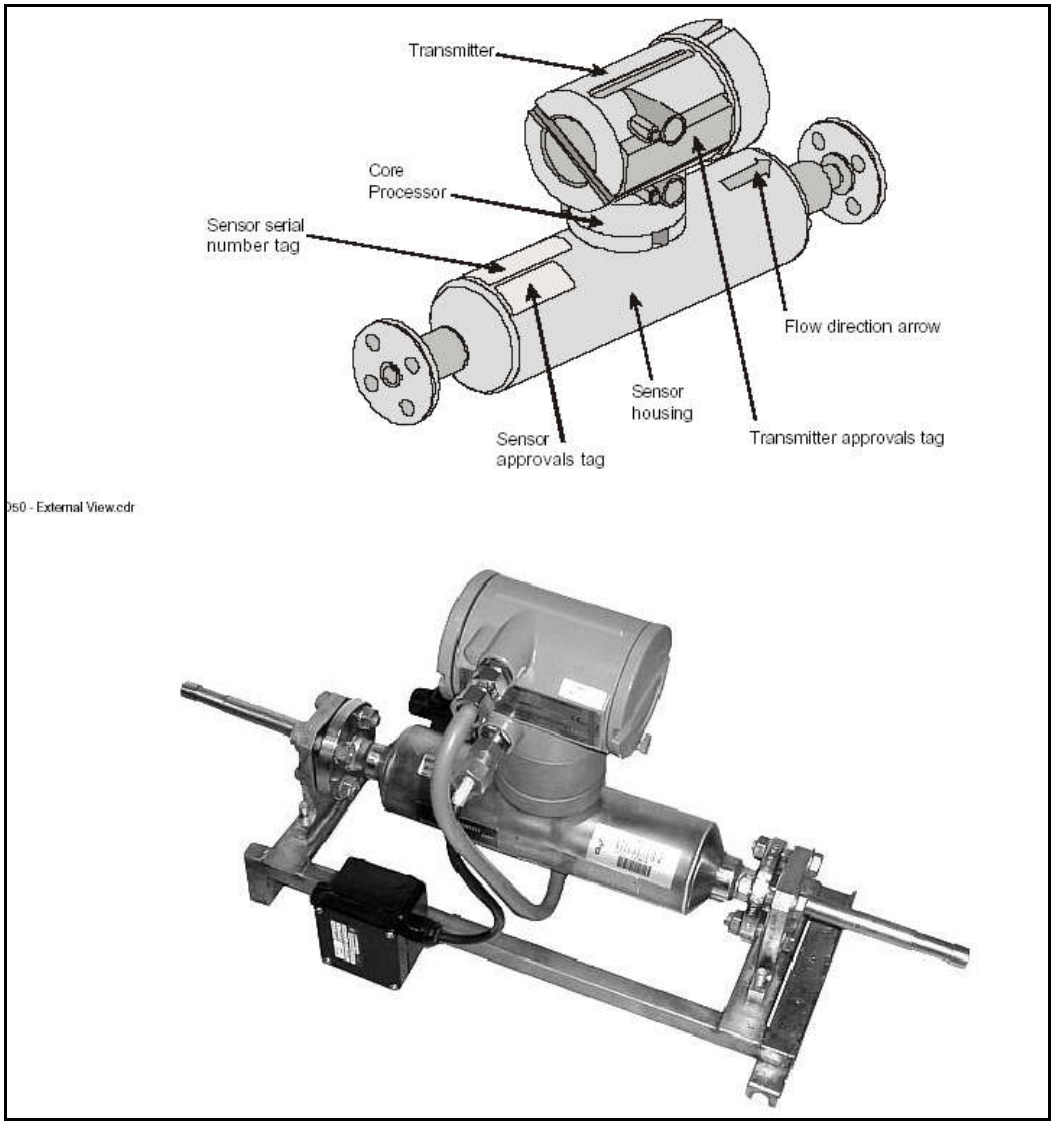
Technical Support: Kwang Yiang Law
Email: kylaw@slb.com
Mobile:+61 407070757

Schlumberger Australia Pty Ltd;
15 Pilatus Street, 6164 Jandakot, WA

5.3 Equipment

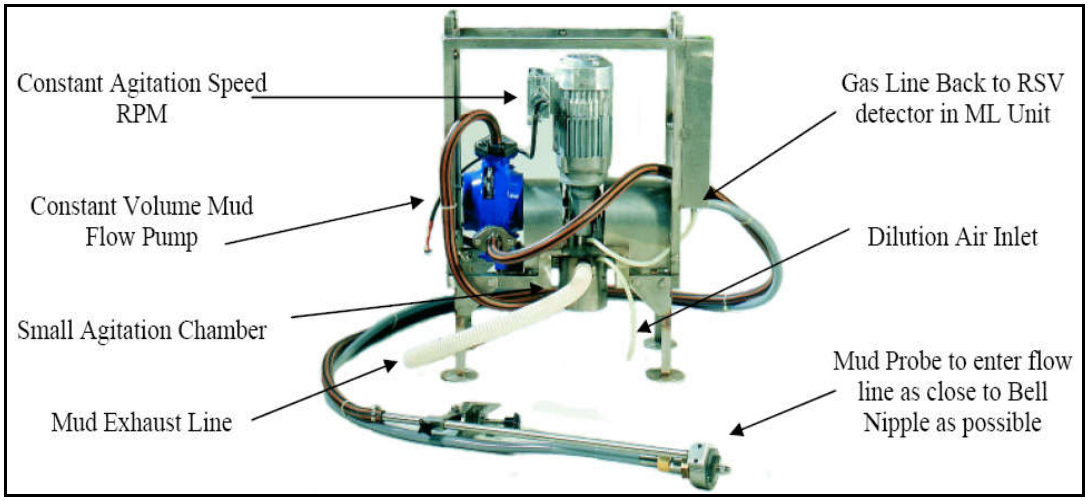
5.3.1 DSM 700 Presentation

Geoservices was monitoring mud weight and mud temperature out using a DSM 700 sensor (Coriolis). The DSM 700 accuracy is 0.5% for mud weight and 0.1°C for temperature. The sensor is installed on the GZG main frame out of the cuttings bed and has a continual mud flow from the flow line based on the Coriolis Effect and provides good accurate continuous data. Please refer to the Mud Weight and Temperature vs Depth graph below.



5.3.2 GZG & RESERVAL™ Presentation

- **GZG Degasser**



Geoservices' GZG degasser is a constant volume gas trap, specially designed for high accuracy gas detection system. Only the sampling probe needs to be in the drilling fluid; this can be placed right to the bell nipple for the earliest detection and sampling of the most representative gas composition. The GZG characteristics are as follows:

- Very high and constant degassing efficiency for all components from C1 to nC5.
- Reduced Agitation chamber volume and reduced Air dilution volume.
- Improved & constant Agitation speed.
- Improved Imaging of transition zones (Oil/Gas, Oil/Water).
- Improved correlation with Electric Logs.
- Identification of recycling effects from Gas In/Out data.
- Improved analysis of Mud Contamination.
- Improved Reservoir Fluid Characterisation by analysis of Gas ratios (Wh, Bh, Ch).
- Possibility to steer horizontal well-bores.
- Improved design eliminates entry of any unfiltered air.
- Degassed Mud returns back to the pits or Flow Line.

- **Reserval™**

Sensitive detection of very small gas shows (to 1 ppm methane equivalent).

Fast chromatographic analysis cycle (C1 to nC5 in 42 sec).

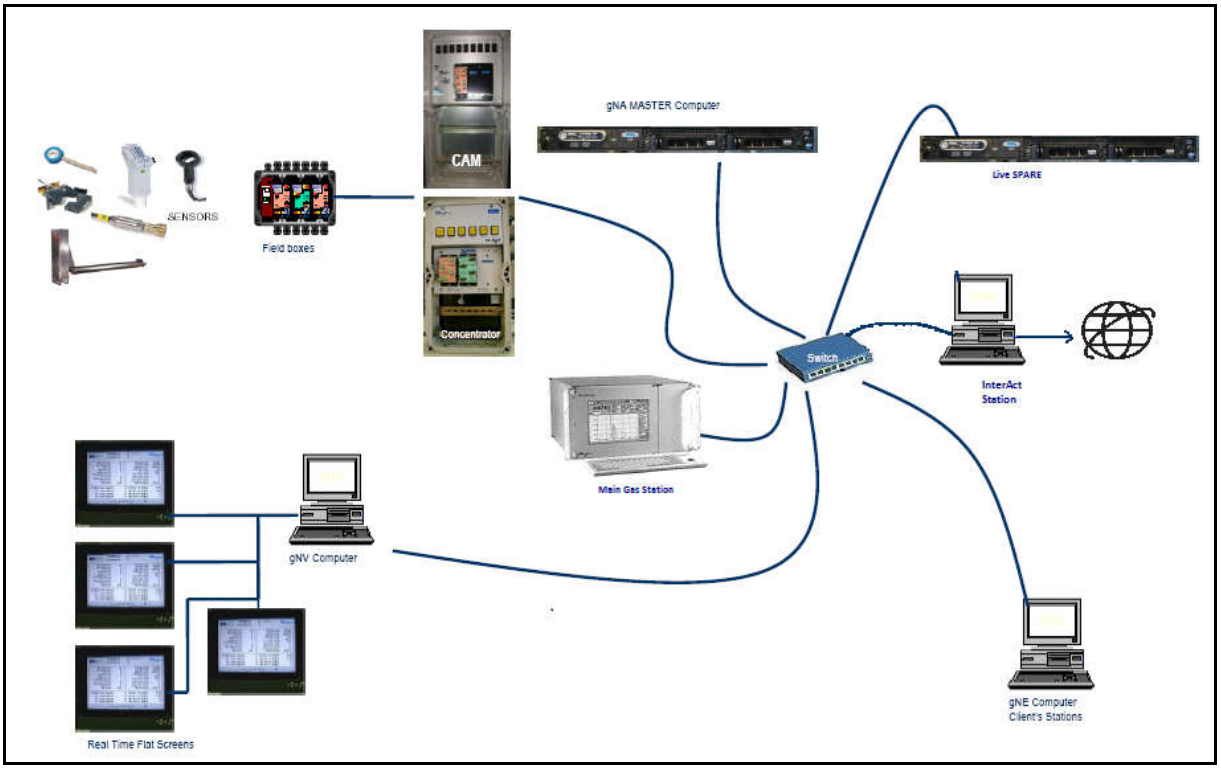
Excellent mud-degassing for all gas components, heavy or light.

The Reserval™ is accurate to 1 ppm, but combines this with a fast analysis speed normally only found with much less accurate systems (C1 – nC5 in 42 seconds). This, combined with the proven qualities of our improved constant-volume degasser, makes the Reserval™ the new industry reference for quantitative on-site hydrocarbon analysis. The system's reliability and repeatability make it an excellent tool for:

- Geological correlation
- First indications of reservoir potential
- Over pressure evaluation
- Identification of reservoir fluid and compositional gradients
- Horizontal well bore guidance
- Thin bed detection
- Controlled and managed by an integrated computer (colour tactile touch screen)
- Integrated hard disk allows data to be stored for 30-40 days
- User graphic interface with playback facility
- Real-time display of chromatograms
- Direct control of different chromatograph sequences
- Real-time display of all operating temperatures, flows and pressures
- Simplified multi-point calibration (manual & automatic)
- All calibration safely recorded in data base
- Multilingual user interface
- Direct Ethernet network interface
- QA and QC assured by database analysis

Also the Reserval™ has simplified maintenance, due to the modular design, a new generation of fixed flow restrictors and integrated electronic flow meters.

5.3.3 Unit Layout



5.3.4 Sensors

Sensors List		
Measurement Point	**Sensor Type**	**Location**
Hook Height	Geolograph	Doghouse
Weight on Hook	Tensiometer	Dead line anchor
Rotary RPM and Torque	Electrical connection	Rig signal from LER
Stand Pipe Pressure	15000psi pressure transducer	Stand Pipe manifold
Wellhead pressure (C&K)	15000psi pressure transducer	Choke & Kill manifold
Pump Stroke	Electrical connection	Pumps 1, 2, 3 and 4
Pit Level	Sonic Probe Sensor	Pit 1, 2A, 2B, 3A, 3B, 4, 5 Sand trap, Degasser Tanks, Desander, Desilter, Returns Tank, Gravity tank. Trip Tank 1 & 2, Stripping Tank
Mud weight – Out	DSM 700	Flow line at bell nipple
Mud Temperature – Out	DSM 700	Flow line at bell nipple
Mud weight – In	DSM 4000	Pit 3
Mud Temperature – In		Pit 3
Flow out	Flow Paddle / Radar sensor	Flow line
Heave	Zun 9D	Riser Tensioner
Cement Pump rate	WITS data transfer	Cement Unit
Cement Pressure	15000 psi pressure transducer	Cement Unit

Gas Equipment	
Equipment	**Type**
Degasser	1 x GZG constant volume degassers for Gas OUT
Gas Analyser – OUT	Reserval™
H2S	Gas line (in mud logging unit), Drill floor, Shaker house & Pit room
CO2	Gas line (in mud logging unit)

Computer System	
Computer	**Name and Use**
Dell Poweredge R610	GNX Core Computers (Master, Live Spare)
HP Desktop DC5800	Data Engineer's Station
HP Desktop DC5800	Mudlogger's Station
HP Desktop DC5800	Company Man, Drilling Engineer
HP Desktop DC5800	Tool Pusher
HP Desktop DC5800	Mud Engineer
Challenger Monitor	Pit Room Display Monitor
Challenger Monitor	Rig floor

Software
geoNEXT GN5 system
SQL Server 2005
Microsoft Windows server 2012
Microsoft Office 2013
Foxit Reader PDF printer / SLB Custom PDF printer

5.4 Lessons learnt and recommendation

Mud logging Unit problems encountered during the drilling were as follows:

No Problem encountered while drilling well Achernar-1 from spud to TD.

6 Appendix

6.0 HSE Report

No of Persons on Site for Well:	2-6
Total Number of Man Days for Well:	138
Total Number of Man Days since start of Project	138
Number of MTI for the Well:	0
Number of LTI for the Well:	0
Total number of STOP cards for the Well	135
Safe/Positive STOP cards for the Well	130
Unsafe/Negative STOP cards for the Well	5
PROMPT cards / rig inductions reviewed for the Well	6
Hazard hunts conducted	0
Contractor / Geoservices Safety meetings attended	4

The Geoservices's crew of Unit 1010979 onboard the Ocean Apex were committed, as always, to fullfilling their duties to Woodside Energy Ltd and Diamond Offshore in a professional manner while being committed to safety at the same time.

There were no accidents or incidents involving Geoservices crew during this campaign. The crew were very often reminded about doing certain things correctly and safely. They showed their commitment to safety and the prevention of accidents to themselves and all co-workers. START cards were written everyday by all crew members. PROMPT cards were written when ever equipment had to be serviced or some tasks undertaken especially splitting, packing and lifting of sample boxes to containers.

The Geoservices's crew of Unit 1010979 based their commitment to safety on the objectives of;

- No injuries to personnel.
- Not being the direct cause of a spill or safety incident.
- No lost time due to equipment failure.

In addition Geoservices Unit 1010979 crew also chaired their own safety meetings, the topics of which were as follows;

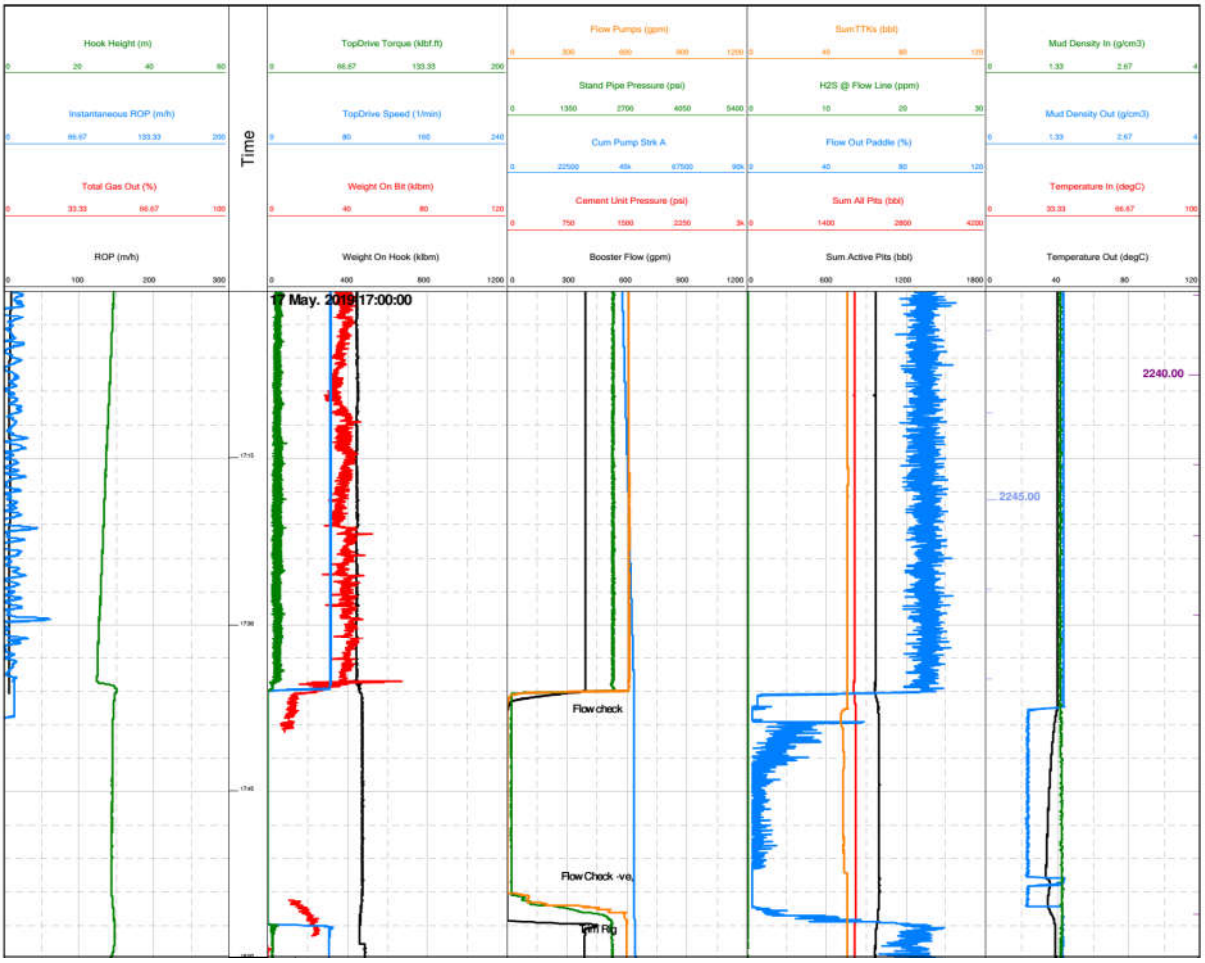
- Maintain Well integrity and confidentiality
- Great care when having to deal with equipment and sample collection at shakers/pit room
- Manual handling and correct lifting techniques especially samples boxes
- Wearing of correct PPE outside of accommodation and Mud-logging unit.
- Correct PPE and procedure for collecting and washing sample cuttings
- Adhering to all Ocean Apex and Woodside policies while on the ship.
- Mentoring and Training green hands assigned to Unit.

- Maintaining good housekeeping habits inside and around the unit
- Drinking water more often even when it was cold outside to maintain body hydration.
- Use of cell phones only in the accommodation as per rig safety policy

6.1 Drilling Events

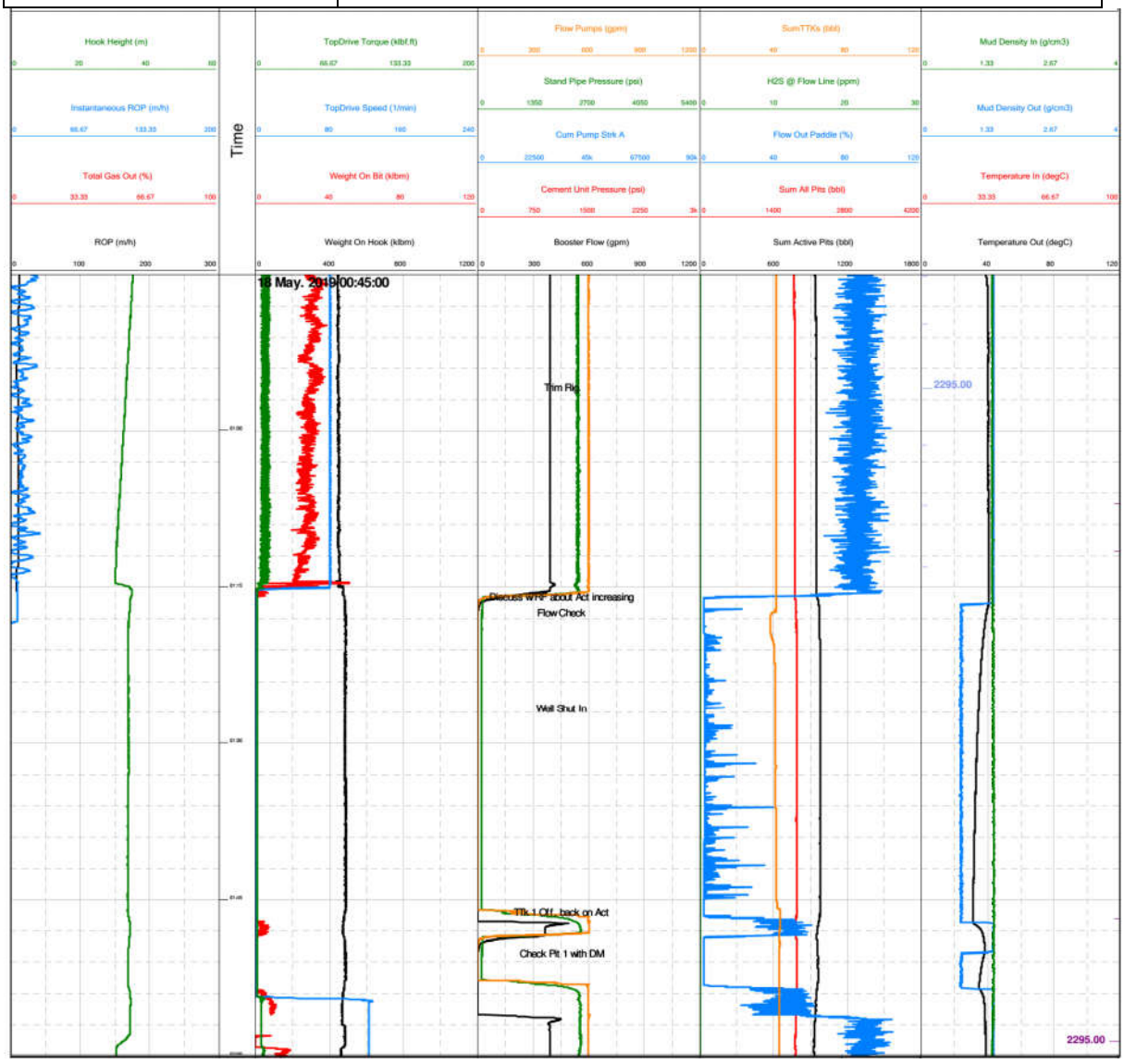
6.1.1 Event Report # 1

Date: 17th May 2019	**Summary:** Drilling 8 ½" section at 2247.0m. Observed the hole fill is not correct (3-4 bbls gain). Informed rig floor and WSM Stopped pumps and flow check well. Well static.
Time: 17:35 h	
Operation: Drilling 8 ½" section	
Event: Incorrect hole fill, gain in active volume.	



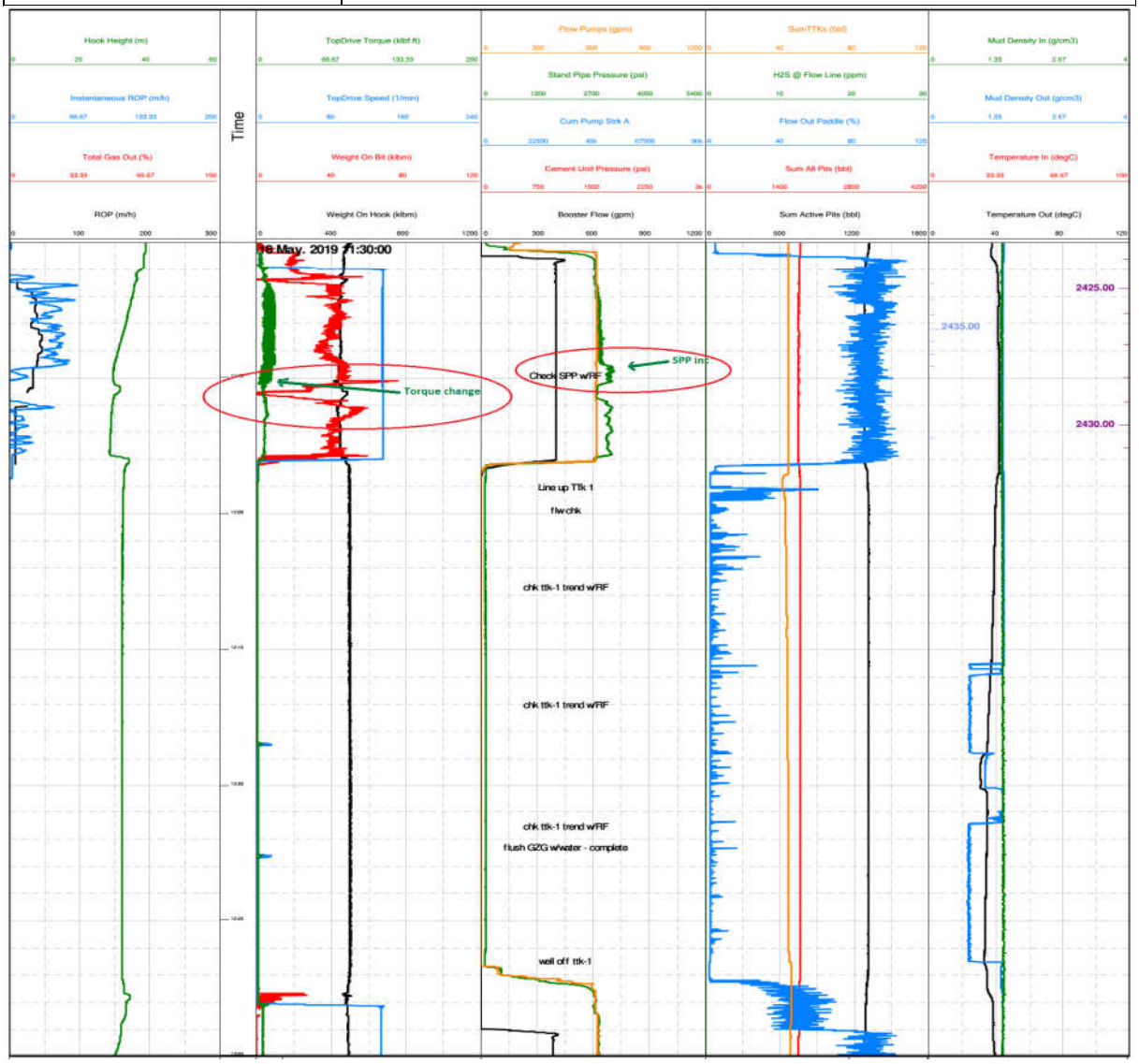
6.1.2 Event Report # 2

Date: 18th May 2019	**Summary:** At 2298 m. Observed 4.5 bbl gain in active, checked active volume increase with rig floor. Flow checked well on trip tank. Observed 1.8 bbl gain in active. Shut in well as precautionary measure and monitored pressure build up for 15 minutes. No pressure build up. Opened well and monitored on trip tank- well static.
Time: 01:30h	
Operation: Drilling 8 ½" Section	
Event: Increase in active volume. Made flow check	



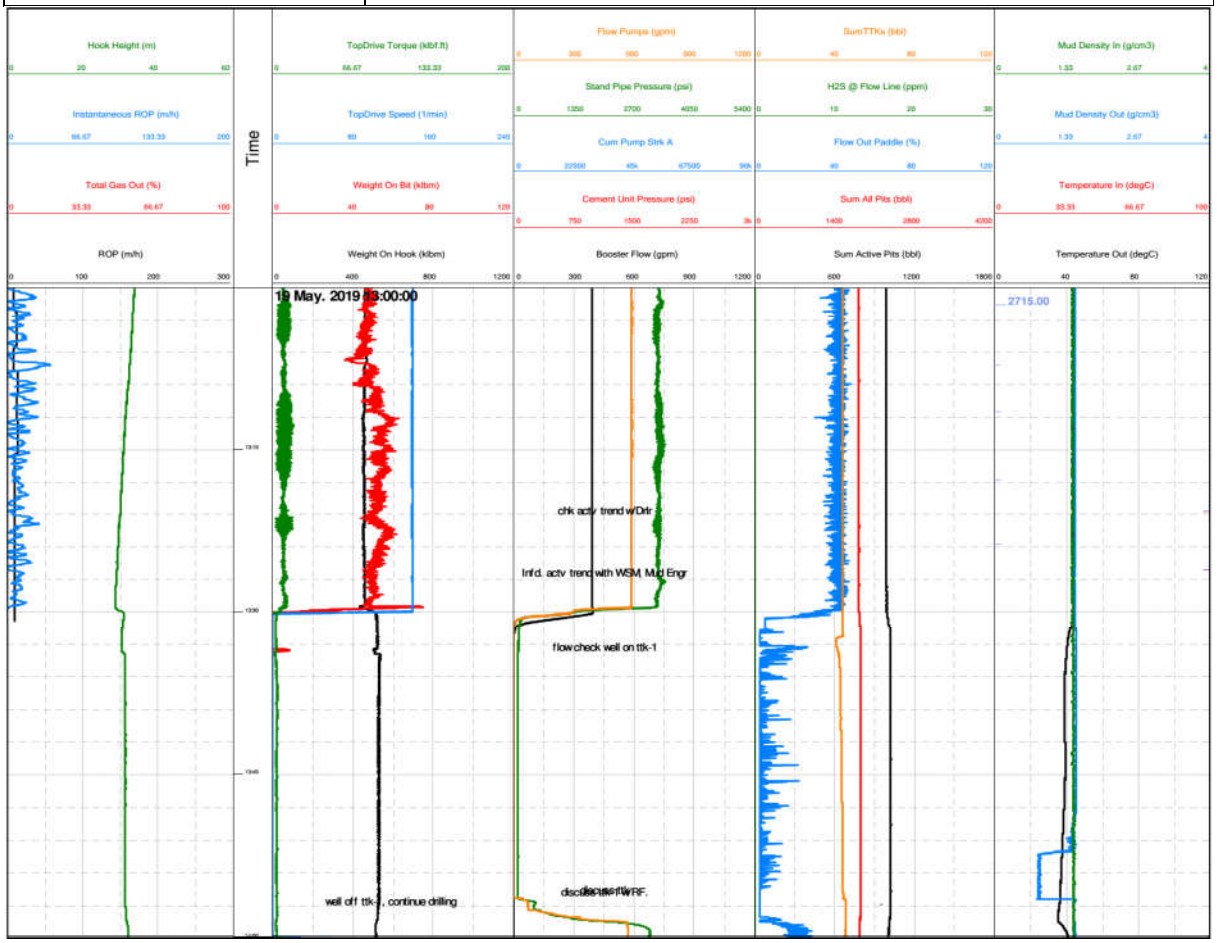
6.1.3 Event Report # 3

Date: 18th May 2019	**Summary:** While at 2439 mMDRT observed increase in SPP and change in Torque signature. Picked off bottom and flow checked well on trip tank. Observed 2.8 bbl gain with declining trend.
Time: 12:10 h	
Operation: Drilling 8 ½" section	
Event: Increase in SPP and change in Torque.	



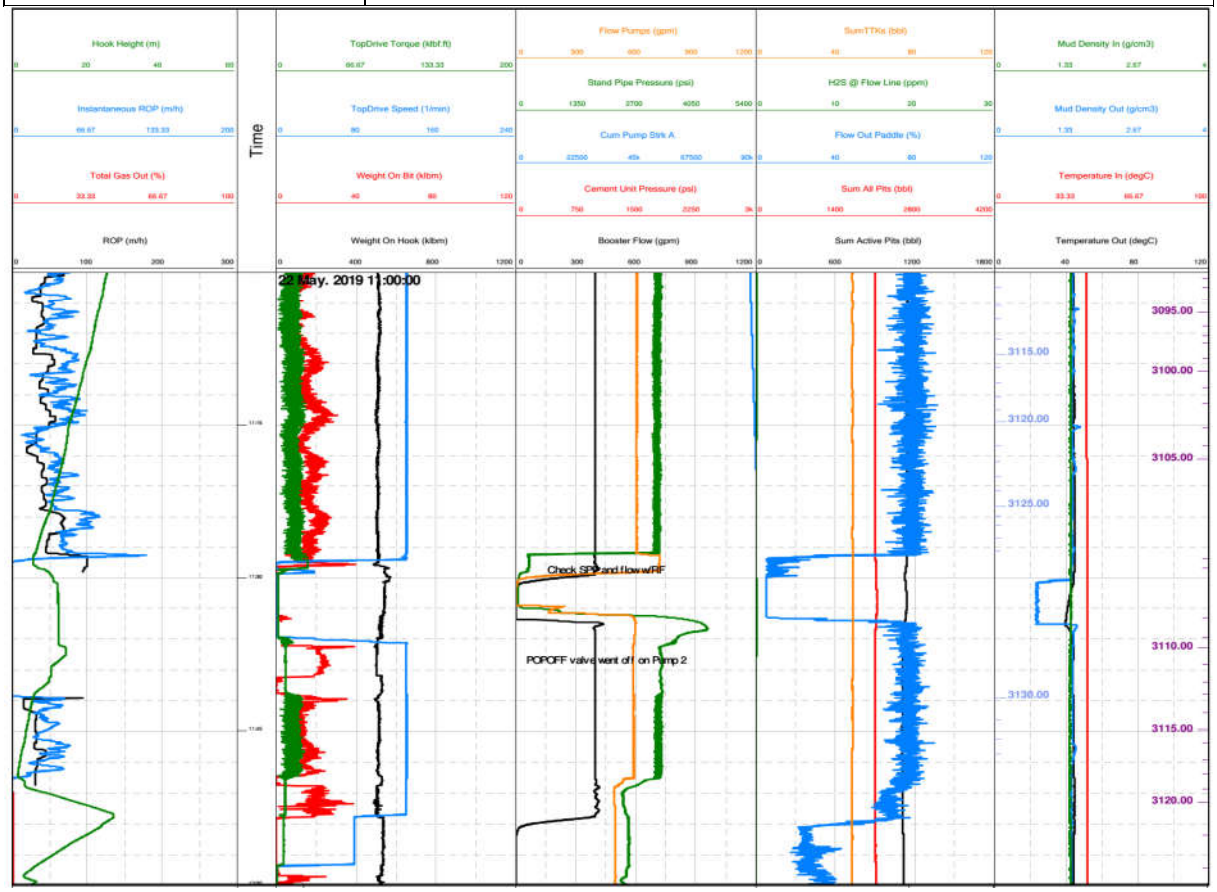
6.1.4 Event Report # 4

Date: 19th May 2019	**Summary:** While at 2717 mMDRT observed increase in active volume by 5 bbl. Picked off bottom and flow checked well on trip tank. Well static.
Time: 13:30 h	
Operation: Drilling 8 ½" section at 2717 mMDRT	
Event: Increase in active volume.	



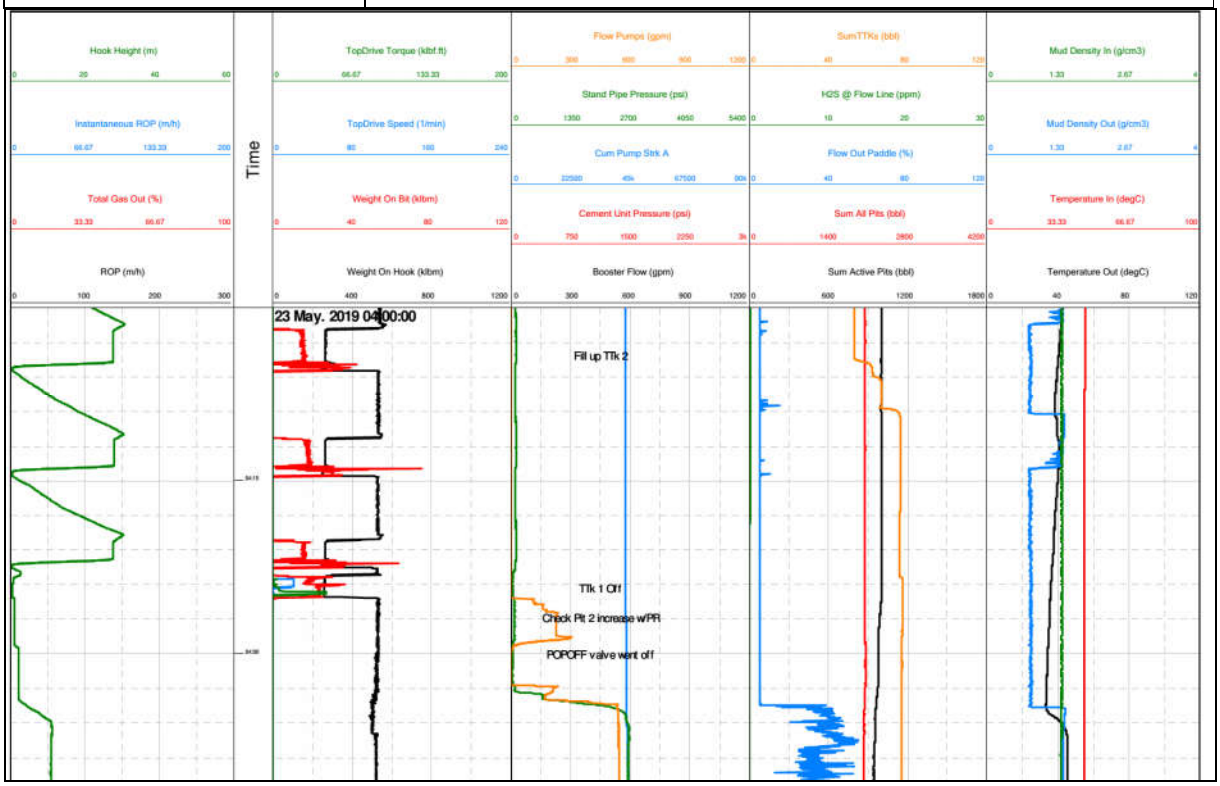
6.1.5 Event Report # 5

Date: 22nd May 2019	**Summary:** Pop off valve got activated at while drilling at 3130 m. Informed rig floor no SPP while circulating. Pop off of Mud Pump#2 had got activated. Swapped pumps and resumed drilling.
Time: 11:30 h	
Operation: Drilling 8 ½" section at 3130.0 mMDRT	
Event: Pop off valve activated.	



6.1.6 Event Report # 6

Date: 22nd May 2019	**Summary:** Pop off valve got activated while pumping out of hole at 3106 m. Informed pit room of volume mud change in Pit # 2, Pumps was shut and resumed operation after swapping pumps.
Time: 11:30 h	
Operation: POOH pumping out 8 ½" drilling BHA	
Event: Pop off valve activated.	



6.2 Enclosures

1) Mud Log – 1:500
2) Gas Log – 1:1000
3) Drill Log – 1:1000
4) Pressure Log: 1:2500

6.3 Explanatory Notes

6.4.1 Vibrations and Drilling Efficiency

The Geoservices geoNEXT™ system samples surface signals at high frequency from RPM, Torque, Standpipe pressure and Weight on Hook in order to provide a real time indication of drill string vibrations. These vibrations can be defined as either Axial and Torsional vibrations, or a combination of both, and are displayed on the geoNEXT™ system via a "traffic light" system of alarms, from green (normal) to orange (warning) through to red and purple, which indicate very high levels of string vibration. The getSMART computer analyses the high frequency signals, and via a Fast Fourier Transform, provides a quantitative analysis of the frequency of high energy signals, ie, how often high energy signals are recorded - Higher the frequency of occurrence, higher the vibration level. The gNA can then be used to examine signal traces to determine which type of vibration is occurring.

The three most common type of drill string vibration are Stick-slip (Torsional), Bit Bouncing (Axial), and String whirl (Axial). When encountered during drilling, these vibration states can be avoided or minimised by altering drilling parameters, most commonly, WOB and RPM. BHA and bit selection also play a part in avoiding drill string vibrations.

The Mechanical Specific Energy (MSE) principle was developed by Exxon-Mobil as a method of maximising drilling efficiency, and can be utilised to identify the point where increasing energy to the drill string via increases in WOB or RPM will not create a significant increase in ROP. The Geoservices geoNEXT™ system provides real time MSE calculation and graphical display, and can be used to maximise drilling efficiency, while maintaining drilling parameters within limits to avoid, or minimise string vibrations.

Information related to Drilling Efficiency and Mechanical Specific Energy can be found in the following documents:

- Pessier, R.C., Hughes Tool Co., and M.J. Fear, BP Exploration*, " Quantifying Common Drilling Problems With Mechanical Specific Energy and a Bit-Specific Coefficient of Sliding Friction",* **SPE 24584**
- Waughman, R.J., Woodside Energy Ltd, Kenner, J.V., Hughes Christensen, Moore, R.A., Hughes Christensen, *"Real-Time Specific Energy Monitoring Reveals Drilling Inefficiency and Enhances the Understanding of When to Pull Worn Bits",* **SPE 74520**
- Fred. E Dupriest, ExxonMobil, Koederitz, W.L. M/D Totco, *"Maximazing Drill Rates with Real-Time Surveillance of Mechanical Specific Energy",* **SPE 92194**
- Caicedo, H.U., Calhoun, W.M., Russ, T.E., ChevronTexaco Energy Technology Company, *"Unique ROP Predictor Using Bit-specific Coefficient of Sliding Friction and Mechanical Efficiency as a Function of Confined Compressive Strength Impacts Drilling Performance",* **SPE 92576**
- Detournay, E. and P. Detournay *(1992). A phenomenological model of the drilling action of drag bits.* **Int. J. Rock Mech. Min. Sci., 29(1):13-23**

6.4.2 Pressure Analysis

There are several techniques available which when used in the appropriate over pressured environment, can often predict an approaching over pressured zone while drilling. Each technique may give slightly different results according to geological and drilling conditions. Geoservices currently uses the following parameters to indicate over pressured regions while drilling:

D Exponent: This is a normalized rate of penetration that takes into account mud weight, bit wear and hydraulics. It can be reliably used in shale and clean Claystone; and as an indicator in siltstones, silty shale and calcareous Claystone. A normal trend line is established through normally pressured shale points, representing a normal compaction trend, and any leftward deviation of subsequent shale points from this trend, representing relative under compaction, indicates overpressure (plotted relative to depth) or increased porosity due to changes in the lithology.

Temperature: By plotting mud flow line temperature against depth a temperature gradient can be established. Theory states that a zone of low heat flow or "thermal shadow" occurs prior to the over pressured zone, which in turn is followed, by a complementary zone of abnormally high heat flow in the over pressured zone (due to its higher water content). However, the data has to be interpreted cautiously as additions of water to the active system/shakers can lower the mud temperature and mud chemicals added to the active system can cause exothermic/endothermic reactions. Bit and wiper trips cause decreases in temperature on surface.

Cuttings: Small, splintery cuttings can be used as an indicator of over pressured regions. Long propeller shaped cuttings may be an indicator of overpressure or may be the result of hydration of reactive or swelling clays.

Overpull/Torque/Fill: Overpull when making a connection or tripping can be an indicator that the hole is collapsing into the well bore, either due to clay hydration or a formation pressure that is greater than the mud weight. Similarly, excessive fill on a trip or after a connection can also indicate that the well bore is collapsing in. High torque can also be an indicator of well bore collapse, although it can also be due to formation type, bearing failure or simply the annulus becoming clogged up by cuttings due to insufficient hole cleaning in large diameter holes.

Gas *Connection gas*: During circulation the down hole pressure exerted by the mud, weight increases due to friction losses in the annulus. This is calculated as an ECD or equivalent circulating density. When the pumps are stopped for a connection, the down hole pressure exerted by the mud decreases by an amount equivalent to the difference between the ECD and mud weight. If the mud weight is close to or actually underbalanced, then gas may be fed-in to the well bore during the few minutes the pumps are turned off and register as a gas peak one lag time after the connection. The magnitude of this peak is determined by such factors as permeability, gas content of the formation, amount of swabbing as well as the relative pore pressure / mud weight.

Background gas: Background gas is not as good an indicator of formation pressure as connection gas since several factors can influence it unrelated to abnormal pressure. Increases in porosity and permeability, gas saturation, coal content of formation, etc., can cause the background to increase in addition to an underbalanced situation. Another point is that the formation pressure would have to exceed the ECD (not just the mud weight as in connection gas), in order for the formation gas to feed-in to the well bore.

Trip gas: Analogous in some ways to connection gas, trip gas is the gas registered at surface after circulating bottoms up after a round trip. However, trip gas magnitude is influenced by various other factors such as amount of swabbing and time since last circulation. The presence of trip gas is not necessarily indicative of an underbalanced situation, but the value above background can be used comparatively with other trip peaks.

6.4.3 Wetness / Balance / Character

A method for evaluating gas zones involves plotting depth against three ratios: hydrocarbon Wetness (W_h), hydrocarbon Balance (B_h) and hydrocarbon Character (C_h), where:

$$W_h = \frac{(C2 + C3 + C4 + C5)}{(C1+C2+C3+C4+C5)} \times 100\ (\%)$$

$$B_h = \frac{(C1 + C2)}{(C3 + C4 + C5)}$$

$$C_h = \frac{(C4 + C5)}{C3}$$

Wetness (W_h) is the primary zone indicator and provides a measure of the relative proportion of heavier gases in the overall gas show as follows:

$W_h < 0.5$	Light non-associated gas with low productivity potential or only geo-pressured methane.
$0.5 < W_h < 17.5$	Potentially productive gas with gas density increasing with W_h.
$17.5 < W_h < 40.0$	Potentially productive oil with gravity decreasing as W_h increases.
$W_h > 40.0$	Heavy or residual oil with low productivity potential.

As reservoir hydrocarbons become denser in the transition from gas to oil, Balance (B_h) and Wetness (W_h) values move closer together and eventually intersect. The zone guidelines for B_h combine with those for W_h to improve reliability of show evaluation as follows:

$W_h < 0.5$ and $B_h > 100$	Very light, dry gas that is almost certainly non-productive.
$0.5 < W_h < 17.5$ and $W_h < B_h < 100$	Productive gas with gas increasing in wetness and density as the two curves converge.
$0.5 < W_h < 17.5$ and $B_h < W_h$	Productive gas condensate or a high gravity gas/oil ratio.
$17.5 < W_h < 40$ and $B_h < W_h$	Productive oil with oil gravity decreasing density increasing as the curves diverge.
$17.5 < W_h < 40$ and $B_h > W_h$	Non-productive residual oil.

Character (C_h) values serve to resolve ambiguities between oil or gas indications by defining the following:

$0.5 < W_h < 17.5$ and $B_h < W_h$ and $C_h < 0.5$ — Productive wet gas or condensate.

$0.5 < W_h < 17.5$ and $B_h < W_h$ and $C_h > 0.5$ — Productive high gravity and/or high GOR oil.

It is important to note that in the conclusion to each of the interpretive tools, the terms “productive” and “non-productive” are used in a geochemical sense. Ultimate production of a zone is dependent upon reservoir thickness and extent as well as other physical and economic factors that are not taken into account when analysing gas compositions. The methods discussed here are intended to assist the interpretive skills of the geologist or log analyst.