Table 4-8 Formation pressure measurements from XPT and MDT

Test No	FORMATION	DEPTH		Hydrostatic Before	Hydrostatic After	Formation pressure	Temp.	Mobility	Comments
		m MD	m TVD MSL	bar	bar	bar	degr C	md/cP	
RUN 1 XPT Pressure point									
1	Stø	2568.9	2352.0	297.090		266.068	77.5	1.3	OK, Took test 3 times for QC
2	Stø	2571.9	2354.9	297.401	297.200	265.895	77.5	8.4	OK
3	Stø	2582.2	2364.7	298.607	298.400	266.040	78.0	30.0	OK
4	Stø	2584.4	2366.8	298.760	298.676	266.219	78.7	4.0	OK, Took test 3 times for QC
5	Stø	2589.4	2371.5	299.255			80.0	0.4	Super charged
6	Stø	2601.7	2383.2	300.994	300.700	266.632	80.1	1.1	OK
7	Stø	2612.0	2393.0	302.140	301.930	266.628	80.9	20.0	OK
8	Stø	2615.0	2395.9	302.359	302.280	266.693	81.2	14.0	OK
9	Stø	2618.0	2398.7	302.728	302.620	266.766	81.4	71.0	OK
10	Stø	2622.4	2402.9	302.294	303.140	266.865	81.5	18.0	OK
11	Stø	2623.9	2404.4	303.418	303.340	266.874	81.5	7.0	OK
12	Stø	2626.0	2406.5	303.620	303.603	266.925	81.8	5.0	OK
13	Stø	2627.9	2408.4	303.916	303.830	267.046	82.0	21.0	OK
14	Stø	2630.5	2410.6	304.208	304.130	267.212	82.1	10.0	OK
15	Stø	2631.5	2411.6	304.275	304.270	267.279	82.1	16.0	OK
16	Stø	2632.9	2412.9	304.462	304.440	267.382	82.2	40.0	OK
17	Stø	2634.0	2413.9	304.588	304.540	267.448	82.2	8.0	OK
18	Stø	2636.0	2415.9	304.874	304.820	267.583	82.4	10.5	OK
19	Stø	2638.0	2417.8	305.140	305.060	267.728	82.6	18.7	OK
20	Stø	2640.0	2419.7	305.312	305.278	267.965	82.7	1.8	OK
21	Stø	2642.3	2421.9	305.625	305.570	268.164	82.8	7.0	OK
22	Stø	2647.6	2426.9	306.293	306.200	268.688	83.1	19.0	OK
23	Stø	2652.9	2432.0	306.950	306.820	269.237	83.3	36.0	OK
24	Stø	2657.3	2436.2	307.510	307.390		83.4	0.8	Super charged, tight
25	Stø	2662.8	2441.4	308.197	308.000	270.240	83.8	4.7	good, took test 3 times for QC
26	Stø	2676.9	2454.9	310.000	309.670	271.676	84.0	4.4	good, took test 3 times for QC
27	Nordmela	2689.2	2466.6	311.196	311.200		84.4	0.1	tight
28	Nordmela	2694.7	2471.9	311.940	311.930		84.4	0.4	tight
29	Nordmela	2700.0	2477.0	312.597	312.470		84.7	0.2	tight
30	Nordmela	2703.5	2480.3	312.991			84.7	0.3	tight
31	Nordmela	2705.8	2482.6	313.202	313.140		84.8		tight
32	Tubåen	2764.0	2538.8	319.980	319.960	280.988	86.2	0.9	Unstable pressure, repeat test, good
33	Tubåen	2802.2	2576.0	324.934	324.560	284.775	86.6	2.1	good, took test 3 times for QC
34	Tubåen	2848.9	2621.7	330.368	330.150	289.895	87.5	1.3	good, took test 3 times for QC
35	Tubåen	2874.5	2646.8	333.512	333.210	292.516	88.3	3.0	good, took test 2 times for QC
36	Snadd	3145.6	2915.6	366.315					lost seal, repeat, no pressure increase when setting probe
37	Snadd	3145.2	2915.2	366.280	366.240		94.4	0.1	tight
38	Snadd	3175.2	2945.2	369.988					tight
39	Snadd	3183.8	2953.8	371.141			96.0		tight
40	Snadd	3212.5	2982.4	374.320	374.330	330.774	97.5	29.0	good
41	stø	2618.3	2399.0	302.777	302.750	266.786	81.1	8.4	good

42	stø	2618.1	2398.8	302.901	302.811	266.783	82.2	6.4	good
RUN 2 MDT for XPT qualification									
1	Stø	2568.9	2352.0	297.230	297.090	266.038	82.7	2.0	Repeat test OK
2	Stø	2582.2	2364.7	298.786	298.640	266.106	83.5	7.4	OK
3	Stø	2584.4	2366.8	298.747	298.704	266.080	84.8	12.2	Repeat with 5cc
4	Stø	2601.7	2383.2	300.414	300.710	266.650	85.0	4.6	OK
5	Stø	2612.0	2393.0	302.130	301.920	266.617	85.7	91.4	OK
6	Stø	2618.0	2398.7	302.800	302.630	266.687	86.0	273.6	OK
7	Stø	2627.9	2408.4	304.048	303.795	266.947	86.4	194.0	OK
8	Stø	2632.9	2412.9	304.528	304.380	267.278	86.6	161.0	OK
9	Stø	2640.0	2419.7	305.392	305.220	267.830	87.2	100.8	OK
10	Stø	2662.8	2441.4	308.242	307.890	270.122	87.5	81.5	OK
Run 3 MDT pressure points and sampling									
1	Stø	2630.0	2410.5	306.877	303.910	267.120	87.5	125.0	Good
Run 4 Quicksilver MDT water sampling									
1	Stø	2676.9	2454.9	313.157	309.760	271.813	86.9	7.7	Good
4	Tubåen	2802.0	2575.8	324.722		284.595	90.9	22.1	Good
Run 5 MDT gas/oil sampling, VIT									
1	Stø	2615.0	2395.9	302.650	302.410	266.765	85.2	332.0	Good
2	Stø	2632.0	2412.0	304.410	304.346	267.329	87.7	106.0	Good
3	Stø	2636.0	2415.9	304.960	304.781	267.585	88.9	128.0	
4	**Stø**	2625.8	2406.3	303.718	303.500	266.969	88.5	1972.0	scanning
5	Stø	2625.3	2405.8	303.659	303.483	266.953	88.5		scanning
6	Stø	2624.8	2405.3	303.525	303.371	266.961	88.5		scanning
7	Stø	2626.3	2406.8	303.645	303.540	266.942	88.4	21.0	scanning
8	Stø	2627.5	2408.0	303.789	303.703	267.016	88.3	78.0	scanning and sampling
Run 6 MDT oil sampling									
1	Stø	2630.5	2410.6	304.121		267.256	86.0		sampling
2	Stø	2631.0	2411.1	304.092		267.139	86.8	68.0	sampling
Run 7 MDT gas/oil sampling									
1	Stø	2623.5	2404.0	303.501	303.182	266.800	88.4		
2	Stø	2625.8	2406.3	303.508		267.018			
3	Stø	2626.8	2407.3	303.570		267.017			
4	Stø	2627.3	2407.8	302.914		267.007			
5	Stø	2626.3	2406.8	303.592		266.990			

Table 4-9 List of samples collected

Sample depth (m MD)	Run No.	Formation	Chamber volume	Drawdown (bar)	Formation Pressure (Bar)	Pump volume (liters)	Mobility (mD/cp)
2630	1A	Stø	18 Gal	8.2	267.12	94.5	125
2630	1A	Stø	420 cc	7.1	267.12	176	125
2630	1A	Stø	420 cc	7.0	267.12	182.4	125
2630	1A	Stø	420 cc	7.0	267.12	188.8	125
2630	1A	Stø	420 cc	7.0	267.12	195.2	125
2630	1A	Stø	420 cc	7.0	267.12	202.5	125
2630	1A	Stø	420 cc	7.0	267.12	208.3	125
2630	1A	Stø	2 3/4 Gal	7.2	267.12	216.7	125
2630	1A	Stø	2 3/4 Gal	7.0	267.12	239	125
2630	1A	Stø	1 Gal	7.1	267.12	262.5	125
2676.9	1B	Stø	1 Gal	44.0	254.00	50	7.7
2802	1B	Tubåen	1 Gal	42.0	284.60	43.9	11
2615.7	1C	Stø	420 cc	11.2	266.84	23.7	81.8
2615.7	1C	Stø	1 Gal	10.1	266.84	29.5	81.8
2632	1C	Stø	420 cc	12.1	267.33	91	106
2632	1C	Stø	420 cc	11.9	267.33	95.9	106
2632	1C	Stø	1 Gal	12.1	267.33	99.5	106
2632	1C	Stø	2 3/4 Gal	11.6	267.33	106.7	106
2636	1C	Stø	420 cc	10.4	267.58	32.2	128
2636	1C	Stø	420 cc	9.8	267.58	37	128
2627.5	1C	Stø	420 cc	7.5	267.02	8.5	78
2631	1D	Stø	2 3/4 Gal	12.0	267.14	40	68
2631	1D	Stø	2 3/4 Gal	11.0	267.14	55	68
2631	1D	Stø	1 Gal	9.0	267.14	68	68
2631	1D	Stø	420 cc	9.0	267.14	77	68
2631	1D	Stø	420 cc	9.0	267.14	82	68
2631	1D	Stø	420 cc	8.0	267.14	86	68
2631	1D	Stø	420 cc	8.0	267.14	89	68
2631	1D	Stø	420 cc	8.0	267.14	92	68
2630.5	1D	Stø	420 cc	8.0	267.26	95	68
2623.5	1E	Stø	420 cc	1.6	266.80	35.9	
2625.8	1E	Stø	420 cc	2.7	267.02	29.3	
2626.8	1E	Stø	420 cc	6.9	267.02	58	
2627.3	1E	Stø	420 cc	12.6	267.01	72	
2626.3	1E	Stø	420 cc	7.7	266.99	18	

The hydrocarbon samples were of good quality, but the water samples were of various qualities. The water sample from the Tubåen sandstone was too contaminated to be used due to plugging of the probe, whereas the water sample from the Stø Formation had acceptable quality.

DRILLING FLUIDS PROGRAMME

Well: 7120/6-2 S
Field: Snøhvit Appraisal
Rig: Polar Pioneer

31.10.07

HOLE SIZE	HOLE TVD MD	CASING/LINER SIZE	CASING/LINER TVD MD	MUD TYPE	MW [SG]	LGS [KG/m³]	10 sec. [Pa]	10 min. [Pa]	Fann 100 rpm	Fann 3 rpm	O / W ratio	PV [mPa]	API FL [ml]	HTHP FL [ml]	MBT [KG/m³]	pH	Kcl [KG/m³]	Glyc. [%]	ES	Funnel Visc. [%]	Usage Volume [m³]
36"	411 411	30"	407 407	SW/ Bentonite Spec # 1 1.35 SG CaCl2 (Displ. fluid)	1.03 - 1.35											8 - 9				>100	298
				Before spudding there were prepared 80 m3 1.35 sg CaCl2/Polymer displacement mud in surface pits. This was made of saturated CaCl2 brine with 25 kg/m3 DiTrol polymer and 0.5 kg/m3 MagOx for fluid loss and 2 kg/m3 HEC for viscosity. About 100 m3 CMC Hi-Vis mud was prepared in pits for sweeps. At TD the hole was displaced to 60 m3 CaCl2/polymer displacement mud 150 m³ of 1.50sg. Formpro mud kept at rig as kill mud.																
17 1/2"	1225.3 1259	13 3/8"	1218,1 1251,3	SW/ Bentonite Spec # 1 1.35 SG CaCl2 (Displ. fluid)	1.03 - 1.35											8 - 9				>100	1881
				The section was programmed to be drilled with seawater and Hi-Vis pills. Before pulling out after having reached TD of the section the hole was to be displaced to 1.35 sg CaCl2/Polymer mud. Prior to starting drilling, the following mud was prepared in the pit room: 70m3 1.50 sg Formpro Kill mud, 130 m3 CaCl2/Polymers Displacement mud and 150 m3 Hi-Vis Bentonite mud. The displacement mud was mixed with extra high concentration of polymers so that it could easily be added more CaCl2 brine to get sufficient volume with the right concentrations of polymers. The Kill mud was mixed from 1.57 sg K-Formate brine with polymers. If not used as kill mud, this mud was planned to be utilized in the 12 ¼" section. When drilling, more bentonite sweeps were continuously mixed. Ideally the bentonite should be left hydrating for a couple of hours. This was not always possible as there was a limited amount of pit space available. This lead to a higher consumption of bentonite, and occasionally, the need to further thicken the mud with CMC Tech EHV polymers. The sweeps were made up to a funnel viscosity to well over 100 sec/quart as programmed. Also, a few bags of CMC were mixed in each batch of Hi-Vis sweeps to stretch the bentonite as it was uncertain that the rig could be re-supplied in time. When the hole packed off at about 800 metres it was speculated that the sweeps had not been sufficiently thick to clean the hole. The pills were further thickened so that, when testing the viscosity, the mud would not at all run through the Marsh Funnel. The problem with packing off reoccurred when the hi-vis pill around the BHA after reaming were unintentionally left out, indicates strongly that the pack-off problems were drilling or well bore stability related.When reaching TD for the section at 1259 metres the displacement mud was quickly prepared by adding CaCl2 brine to the high concentrated displacement mud. This gave a final concentration of Di-Trol of 25 kg/m3 and a concentration of HEC of 2 kg/m3. Sufficient volume was prepared by utilising the Active pit #1 that had been used for bentonite mud. The displacement mud seemed to effectively stabilise the hole until casing were set and cemented.																
12 1/4"	2374 2566	9 5/8"	2373 2564	FormPro	1.30 - 1.33	0 - 180	4.5 - 7	9 - 14		9 - 12		15 - 23	3.6 - 5.3		1 - 30	9 - 10,1	140 - 280				662
				The drilling fluid used in the section was Formpro WBM. Mud weight were maintained at 1.31 sg, and from 2100 MD it was gradually increased to 1,33 sg. As we were approaching the reservoir the CaCO3 content was brought up to 20 kg/m3. Due to the nature of the formation we observed quite a big influx of solids to the mud, adding to the mud weight. Even the 230 mesh installed on all shakers most of the section and the centrifuge running continuously, could not counteract this. The MBT rose up to 31 kg/m3 of which is rather high in this system. Of this reason the dilution rate in this section was obviously high, higher than normally seen. Due to the high dilution rates with low weight premix (lots of drill water), the K+ content decreased accordingly of which again probably effected inhibition, hence the high MBT and gels. Approaching TD of the section we also noticed that the gels were creeping up. It is not possible to keep mud weight, LGS content and gels down with such high dilution without a decreasing trend in K+ level. 160 m3 Frompro mud were backloaded to Polarbase, and additional 200 m3 were put on storage tank for the future Hydro operation.																
8 1/2"	3034.8 3242	7"	3033,8 3241	FormPro	1.22 - 1,26	136 - 160	5 - 6	10 - 18		6 - 9		14 - 16	3.8 - 7,8		20 - 22,5	8.8 - 10	80 - 800				500
				As this section was planned to drill with 1,22 sg mud, the 1,33 sg mud from 12 ¼" section was blended with drill water, and extra polymers to get the correct density. All together 285 m3 of 1,22 sg mud was made up in advance and displaced in to hole. The system was pre-treated with bicarbonate and citric acid as we were drilling out the cement inside the liner. Based on experience from last section and previous experience on other wells in the Barents sea, we focused on minimising fluid loss and accumulation of solids in the system by adding approx 5 kg/m3 Polypac polymer to the modified starch system and running as fine mesh screens as practicable. With less flow rate (2100 ltr/min), we managed to run both 270 mesh and 325 mesh together with the 230 mesh on the shakers. The mud weight was after the XLOT decided to be increased to 1,27sg. As a result of this we manage to keep the K+ content on the high side of the specification. After coring, a blend of CaCO3 medium and fine was mixed into the system while drilling ahead. Concentration was raised to 50 kg/m3, main purpose was to add bridging to the reservoir. This concentration was maintained throughout the section. Also radio-active tritium tracer was added to the circulating system as we started drilling. All tracer contaminated mud was held separated from the non polluted mud. The sulphate content was measured by a third-party company through out the section, and was averaging between 50 and 60 mg/ltr. The mix of CaCO3/Polypac and Trol FI reduced the filter loss to an acceptable level, though the main reason for the use of Polypac polymer was to help encapsulate and bring out the fine solids generated in these formations. Both API fluid loss test and the HTHP (85oC) permeability test performed with a 35µ ceramic disk were further improved. The API came down to +/- 4 ml and the HTHP dropped to +/-5 ml as we drilled to TD. This was considered to be sufficient and therefore the concentration of CaCO3 was maintained at 50 kg/m3 which contributed to controlling ECD. The K+ level slowly increased as we drilled the section. As mentioned earlier, the low dilution rate made it possible to put in more K-Format in the make up premix as increasing clays were anticipated as we drilled deeper. As we approached TD of the section the concentration of Duovis was increased in order to increase the 3 rpm reading prior to the extended logging program.																