

**General information**

Wellbore name	16/1-10
Type	EXPLORATION
Purpose	APPRAISAL
Status	P&A
Press release	link to press release
Factmaps in new window	link to map
Main area	NORTH SEA
Field	EDVARD GRIEG
Discovery	16/1-8 Edvard Grieg
Well name	16/1-10
Seismic location	:LMMQ16 innline 36106 &c crossline LMMQ16 128346
Production licence	338
Drilling operator	Lundin Norway AS
Drill permit	1191-L
Drilling facility	BREDFORD DOLPHIN
Drilling days	85
Entered date	13.11.2008
Completed date	05.02.2009
Release date	05.02.2011
Publication date	05.02.2011
Purpose - planned	APPRAISAL
Reentry	NO
Content	OIL
Discovery wellbore	NO
1st level with HC, age	JURASSIC
1st level with HC, formation	NO GROUP DEFINED
Kelly bushing elevation [m]	25.0
Water depth [m]	110.0
Total depth (MD) [m RKB]	2151.0
Final vertical depth (TVD) [m RKB]	2151.0
Maximum inclination [°]	1.3
Bottom hole temperature [°C]	89
Oldest penetrated age	EARLY JURASSIC
Oldest penetrated formation	NO GROUP DEFINED
Geodetic datum	ED50
NS degrees	58° 51' 14.61" N
EW degrees	2° 16' 30.85" E



NS UTM [m]	6524177.97
EW UTM [m]	458183.01
UTM zone	31
NPDID wellbore	5879

Wellbore history

**General**

Well 16/1-10 was drilled on the eastern margin of the South Viking Graben on the south-western part of the Utsira High in the North Sea. It was drilled to confirm the northern extent of the Luno oil discovery in Early Jurassic conglomerates made by well 16/1-8. The oil-water contact at 1965 m TVD RKB should be confirmed and a production test of the clean sand facies and conglomeratic facies should be conducted.

Operations and results

Appraisal well 16/1-10 was spudded with the semi-submersible installation 16/1-10 on 13 November 2008 and drilled to TD at 2151 m in conglomeratic sandstones of Early Jurassic age. As the site survey revealed a number of possible shallow gas zones the well started with a 9 7/8" pilot hole to check for shallow gas down to 400 m, TD of planned 26" section. No gas was seen in this interval. Due to a leak in the 20" casing the casing programme was significantly revised, with 13 3/8" casing set at 589 m, above a potential shallow gas zone at 634 m, and the 12 1/4" hole was drilled down into top Shetland Group. This slimmer-than-planned hole turned out to give easier drilling than in the previous well on the prospect (16/8-1). The amount of down time was however comparatively large, due mainly to wait-on-weather. Additional coring also added to a longer than planned time for this well. The well was drilled with seawater and hi-vis bentonite sweeps down to 411 m, with KCl/glycol enhanced mud from 411 m to 1860 m, and with Performadril water based mud with 5% glycol from 1860 m to TD.

The Utsira, Skade and Grid sandstone formations were penetrated by the well, all water bearing. The top of the Jurassic reservoir sequence was encountered at 1898 m (1872.9 m TVD MSL), 11.4 m TVD deeper than prognosed. The reservoir sequence was composed of oil bearing sandstones and conglomerates with an OWC at 1965 m. No gas cap was observed on the logs or could be inferred from the production testing. The first hydrocarbon shows in well 16/1-10 were observed in the core chips collected in the Shetland Group limestones that overlie the reservoir. Generally good hydrocarbon shows were observed in the reservoir from 1898 m down to 1911 m. From 1911 to 1928 m the hydrocarbon shows became more patchy due to widespread argillaceous infilling of the pore spaces within the sandstone matrix. More consistent shows were present in the interval from 1929 to 1940 m but below this depth only intermittent shows were observed.

A total of 7 cores were cut from 1868 to 1987.5 m. The first two cores were cut entirely within the Shetland Group. The third core penetrated top reservoir at 1898 m. The entire hydrocarbon bearing part of the reservoir interval was cored with the last core penetrating the oil-water contact. Four wire line logging runs were made including one MDT run for samples and pressures. Oil samples were taken at 1899.6 m and 1933.1 m and a water sample was taken at 2024.9 m. Fluid gradients were established for both water and oil zones, indicating an oil-water contact at 1965 m TVD, confirming the contact extrapolated in well 16/1-8.

The well was permanently abandoned on 5 February as an oil appraisal.

Testing

Two Jurassic intervals were production tested. DST 1A was performed in the interval 1919.92 to 1958.11 m in the conglomeratic sandstone facies.

DST 1B was performed in the interval 1897.00 to 1909.79 m in addition to 1919.92 to 1958.11. The test rate was 338 Sm³ oil per day and 35500 Sm³ gas per day through a 12.7 mm choke.

Maximum temperature recorded in the tests was 82.1 deg C.



Cuttings at the Norwegian Offshore Directorate

Cutting sample, top depth [m]	Cutting samples, bottom depth [m]
420.00	2151.00

Cuttings available for sampling?	YES
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Cores at the Norwegian Offshore Directorate

Core sample number	Core sample - top depth	Core sample - bottom depth	Core sample depth - uom
1	1868.0	1873.0	[m]
2	1873.0	1891.0	[m]
3	1891.0	1901.4	[m]
4	1901.5	1911.6	[m]
5	1914.6	1934.0	[m]
6	1934.0	1958.9	[m]
7	1960.5	1987.6	[m]

Total core sample length [m]	114.9
Cores available for sampling?	YES

Oil samples at the Norwegian Offshore Directorate

Test type	Bottle number	Top depth MD [m]	Bottom depth MD [m]	Fluid type	Test time	Samples available
DST		0.00	0.00			YES

Lithostratigraphy

Top depth [mMD RKB]	Lithostrat. unit
135	NORDLAND GP
756	UTSIRA FM
880	HORDALAND GP
954	SKADE FM
1494	GRID FM
1734	ROGALAND GP



1734	BALDER FM
1744	SELE FM
1772	LISTA FM
1848	VÅLE FM
1860	SHETLAND GP
1860	EKOFISK FM
1890	CROMER KNOLL GP
1898	NO GROUP DEFINED

Composite logs

Document name	Document format	Document size [MB]
5879	pdf	0.28

Geochemical information

Document name	Document format	Document size [MB]
5879 01 16 1 10 gch transfer 1	txt	0.00
5879 02 16 1 10 gch results 1	txt	0.60

Drill stem tests (DST)

Test number	From depth MD [m]	To depth MD [m]	Choke size [mm]
1.0	1920	1958	25.4
2.0	1897	1910	12.7

Test number	Final shut-in pressure [MPa]	Final flow pressure [MPa]	Bottom hole pressure [MPa]	Downhole temperature [°C]
1.0		16.200		80
2.0	6.000	17.000		82

Test number	Oil [Sm3/day]	Gas [Sm3/day]	Oil density [g/cm3]	Gas grav. rel.air	GOR [m3/m3]
1.0	2				
2.0	338	35500			105





Logs

Log type	Log top depth [m]	Log bottom depth [m]
CMR ADT ECS HNGS GR ACTS ECRD	1852	2150
FMI PPC MSIP PPC GR ACTS ECRD	1852	2150
HRLA PEX GR ACTS ECRD	1852	2143
MRPO MRPQQ MRPS LFA MRCS GR	1898	2033
MWD LWD - GR REMP	123	1862
MWD LWD - GR REMP DEN NEU AC	1850	2145
PGGT MH 22	1726	1847
USIT CBL GR ACTS CCL ECRD	1680	2100

Casing and leak-off tests

Casing type	Casing diam. [inch]	Casing depth [m]	Hole diam. [inch]	Hole depth [m]	LOT/FIT mud eqv. [g/cm3]	Formation test type
CONDUCTOR	30	211.0	36	211.0	0.00	LOT
SURF.COND.	20	404.0	26	411.0	1.49	LOT
INTERM.	13 3/8	589.0	17 1/2	595.0	2.05	LOT
INTERM.	9 5/8	1854.0	12 1/4	1860.0	1.38	LOT
LINER	7	2149.0	8 1/2	2151.0	0.00	LOT

Drilling mud

Depth MD [m]	Mud weight [g/cm3]	Visc. [mPa.s]	Yield point [Pa]	Mud type	Date measured
174	1.07			Spud Mud	
212	1.07			Spud Mud	
285	1.17	14.0		Performadril	
411	1.25			Spud Mud	
595	1.17	18.0		KCl/GEM	
1660	1.35	24.0		Performadril	
1872	1.20	32.0		PERFORMADRIL	
1915	1.20	27.0		PERFORMADRIL	
1933	1.20	28.0		PERFORMADRIL	
1983	1.21	31.0		PERFORMADRIL	



2151	1.20			NaCl Brine	
2151	1.21	50.0		PERFORMADRIL	

Pressure plots

The pore pressure data is sourced from well logs if no other source is specified. In some wells where pore pressure logs do not exist, information from Drill stem tests and kicks have been used. The data has been reported to the NPD, and further processed and quality controlled by IHS Markit.

Document name	Document format	Document size [MB]
5879 Formation pressure (Formasjonstrykk)	PDF	0.21

