



Neptune Energy Norge AS

PL828 Status Report -Licence Surrender

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PL828 Status Report -Licence Surrender Report



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1. Key licence history

Production licence 828 is situated in the Måløy slope, along the eastern margin of the late Jurassic North Sea extensional basin and is parts of Block 36/4. (Figure.1)

PL828 operatorship was awarded to then Statoil Petroleum AS (now Equinor Energy AS) on the 05.02.2016 with licence partner Capricorn Norge AS (now Sval Energi AS) with 60% and 40% equity, respectively. Engie E&P Norge AS (now Neptune Energy Norge AS) joined the partnership in 2017 by acquiring 10% interest from Statoil Petroleum AS. Eventually, Neptune Energy Norge AS took over the remaining shares & operatorship from Equinor in Q1 2020 & the final partnership status at the drill or drop decision point is as below.

- Neptune Energy Norge AS 60% (Operator)
- Sval Energi AS 40%

The production licence 828 spanned over an area of 446.605Km2. The original licence commitments were to purchase 3D seismic data and perform G&G studies to evaluate and to reach a drill or drop decision within 2 years of award by 05.02.2018. The details of licence timeline are given in table 1.

Table 1 Licence Information

Licence Milestones	Key dates
Date of Award	05.02.2016
Drill or drop (DOD) Initial	05.02.2018
DOD Extended	10.05.2021
Decision to Concretize (BoK)	05.11.2021
Licence Period Expire	05.02.2023

Four extensions to the licence deadlines have been applied for. The first extension was due to a delay in the final seismic delivery. Subsequent extensions were asked to incorporate 36/7-4 (Cara) and 36/1-3 (Presto) well results as they were the key data for quantitative seismic interpretation.

After re-evaluations, the partnership reached a unanimous decision to surrender the licence at the drill or drop deadline 10.05.2021 based on the conclusion that PL828 has no identified prospects with an acceptable combination of volume, risk, and commercial potential that can justify drilling the exploration well. The technical work concluded that all the leads carry a very high risk due to the charge/migration as well as retention.



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1.1 Licence Meetings

Eleven meetings in total, have been held in this licence. Seven combined Exploration Committee and Management Committee meetings, two Management Committee meetings, one Exploration Committee meeting & one Work (EC) meeting.

Table 2 Licence Meetings

Date	Licence Meetings
11.04.2016	EC/MC Meeting: Licence initiation & Database
15.11.2016	EC/MC Meeting: G&G screening of Leads & CSEM-1D
06.11.2017	EC/MC Meeting: Final CGG seismic and AVO update
11.12.2019	EC/MC Meeting: AVO & Biostratigraphy results
11.3.2019	EC Workshop: Includes core viewing
14.08.2019	EC/MC Meeting: Volume-Risk
04.11.2019	MC Meeting
13.03.2020	EC Meeting: Agat Prospectivity
30.04.2020	EC Meeting: Geophysical updates & way forward
30.11.2020	EC/MC Meeting: SDA and Basin modelling
12.04.2021	EC/MC Meeting: Final Volume-Risk and recommendation

2. Database

A common licence database was established consisting of 21 offset wells and CGG17M01 3D Horda broadband seismic survey.

The CGG17M01 Fast-Track was available to work with until the final data delivered in August 2017.

The seismic and well database is illustrated in Figure 1. The seismic survey is listed in Table 3 and the well database in Table 4.





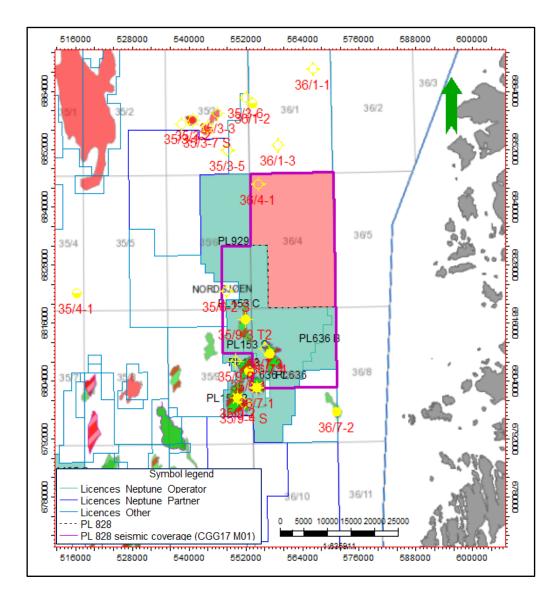


Figure 1: Map showing Block 36/4, PL828 location, 3D seismic and wells database.

Fable 3: Licence Seismic database									
Geophysical survey	NPD ID	Type of Survey	Market availability	Area km2	Comments				
CGG17M01	Merge of 7984; 8128; 8179; 8194- 8196; 8252; 8332	3D seismic	Multi-client	927.72 (PL828 AOI)	CGG North Viking Graben. BroadSeis – BroadSource, Merged PSTM dataset (CGG 14,15,16 vintages)				

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Table 4: Licence Well database

Well Name	NPD ID	Year	Result
35/3-1	432	1976	Dry
35/3-2	136	1980	Gas/Condensate
35/3-3	491	1980	Dry
35/3-5	433	1982	Dry
35/3-6	4492	2002	Dry
35/3-7 S	6154	2009	Gas
35/4-1	2993	1997	Shows
35/6-1 S	6000	2009	Dry
35/6-2 S	6063	2009	Dry
35/9-1(Gjøa)	1375	1098	Oil/Gas
35/9-2(Gjøa)	1600	1991	Oil/Gas
35/9-3 T2	3206	1997	Oil/Gas
35/9-4 S	3524	1998	Dry
35/9-9	7257	2013	Dry
36/1-1	435	1975	Dry
36/1-2	436	1975	Shows
36/1-3	8631	2019	Dry
36/4-1	2847	1996	Dry
36/7-1	1794	1996	Oil/Gas
36/7-2	2990	1997	Oil
36/7-3	4427	2001	Shows
36/7-4 (Duva)	7988	2016	Oil/Gas

3. Review of Geological and Geophysical studies

Several leads were identified for the APA application at multiple stratigraphic levels. The significant ones were Jonathan (Jurassic) and Havhest-Meta (Agat & Kyrre Fms.). The Jonathan lead is a footwall trap with possibility of stacked reservoirs from Oxfordian & older. The Havhest lead is a stratigraphic trap in Agat Fm sand fairway, onlapping against basement high. The HC migration concept is based on mature Heather Fm Source rock from west and northwest of PL828 by up-dip lateral migration towards east. The sealing of the leads is by Jurassic and Cretaceous shales respectively for Jonathan and Havhest.

Since the licence award, additional data have been analysed and studies have been performed. The main activity has been reinterpretation of 3D seismic data utilising the newer CGG17M01 (HORDA NVG - broadband PSTM) surveys including several offset cubes and integrating the key well results. The summary of all the work done is listed below.

- Seismic interpretation for all relevant surfaces
- G&G screening of all prospective intervals
- Sedimentological model for Agat Fm incorporating petrology and reservoir quality study.



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- Source/expulsion studies
- AVO for all prospective level
- EEI for Agat Fm level
- Biostratigraphy update on 36/4-1.
- CSEM 1D feasibility study
- Volume and Risk analysis

Figure 2 outlines all the evaluated prospectivity in PL828.

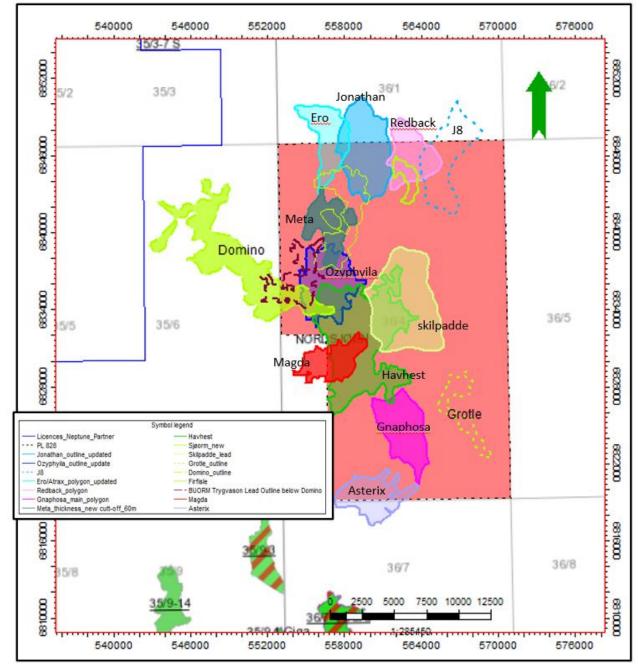


Figure 2: Mapped prospectivity in PL828



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Geophysical studies

The main survey utilised in APA was 3D seismic cube- ST98M8. In addition, the applicants had access to the regional MC3D-NNS-MEGA 3D from PGS.

For the detailed and final interpretation of faults and surfaces the full offset cube of CGG17M01 was used. The prospects were interpreted in fast-track data (post-stack time migration) & later in the final cube (prestack time migration). The final data has more details in velocity field, particularly lower velocity towards east, thus giving some time and lateral shift. Otherwise, did not uplift the quality significantly.

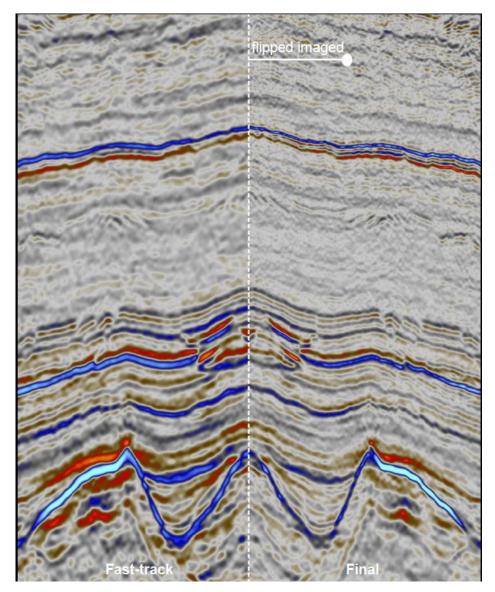


Figure 3 Seismic comparison between fast-track and final data.

Quantitative seismic interpretation was also carried out to de-risk presence of reservoir and fluid. Using the base seismic and the key wells, forward modelling was done to understand seismic signature of fluid filled



reservoir. Several conditioned cubes were worked on thereafter. Extended elastic inversion (EEI) cube and relative acoustic impedance cube (RAI) were comprehensively studied to understand fluid and lithology effect.

AVO anomaly in relation to Agat Fm thickness shows that the basement clearly has influence on the amplitude strength when the thin Agat sand is directly deposited on top of it. The AVO anomaly in cretaceous leads are in general weaker compared to Duva and 35/9-3T2. The conclusion from this work for cretaceous level suggests that the leads are most likely of moderate reservoir with low HC saturation. There was no strong AVO response found in Jurassic leads.

1D CSEM feasibility study was carried out in the licence for selected leads. Upper Cretaceous Sjøorm and Jurassic level Jonathan leads showed partial feasibility. The Lower Cretaceous Sjøpølse and Havhest leads showed insufficient resistivity contrast than background. 3D feasibility study was therefore not carried out.

Geological Studies

The target intervals for this licence were mainly Jurassic and Cretaceous. The trap styles are truncational stratigraphic traps and structural traps. The main risk was migration relative to trap formation and effective sealing. The license performed basin modelling study to understand the fill route. Detailed well analysis were done including core study, petrophysics, petrography and stratigraphic study to assess the reservoir quality and depositional motif.

Biostratigraphic study of well 36/4-1 was conducted to evaluate Jurassic reservoir presence in PL828. The study suggests that the oldest sediments in this well belongs to Early Bajocian age & assigned as Heather Fm. The overlying Early Bathonian to late Callovian (Heather Fm) is conformable and thickest part was deposited during Late Bathonian. The Krossfjord Fm sands of Late Bajocian to Mid-Bathonian age in the well 36/1-1, reduced significantly in thickness to nearly non-existing in 36/4-1 well. The study implies to an increased reservoir risk for Jurassic level.

A semi-regional 3D basin modelling study was done by Exploro. The model exhibits high sensitivity towards sand thicknesses and stratigraphic tilts. The present-day saddle area to west could have allowed some migration to the licence area during the late upliftment, however, the leads, are mostly in migration shadow. The study suggests a fair possibility of direct charging from the marginally matured sub basin to the west. But the expelled HC from this sub-basin is very limited in volume.

4. Prospect update

The focus during the licence period has been on re-evaluating all the leads in detail. Following leads were evaluated during licence work. Geological maps related to these leads are shown in figure 4.

- Jurassic (Fault bound, high dip structures)
 - o Ero
 - o Jonathan
 - o Redback
 - o **J8**
 - o Ozyptila
- Lower Cretaceous (Up-dip pinch-out trap)
 - o Havhest
 - o Meta
 - o Asterix
 - Magda (Part of Havhest)
 - Upper Cretaceous (Stratigraphic pinch-out traps combined with injection features)
 - o Domino



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- o Buorm
- o Skilpadde
- o Sjørm
- o Firfisle

Summary of evaluation:

Equinor as the operator from 2016 to 2020 evaluated the volume potential and risk for most of the above listed leads and the results presented in Table 4. Neptune Energy evaluated the Agat Fm leads Magda and Asterix during their operatorship.

Age	Lead	P90 (MSm3 OE)	Pmean (MSm3 OE)	P10 P90 (MSm3 OE)	Pg %
		Jurassic			
Post Callov-Titho	Ero	1.14	6.33	14.9	08
Oxfordian& older	Jonathan	1.2	4.83	10.5	06
Post Callov-Titho	Redback	0.3	1.2	2.5	10
Oxfordian& older	J8	1.84	6.28	12.8	04
Oxfordian& older	Oxfordian& older Ozyptila		0.6	1.44	04
		Lower Cretaceou	S		
Agat Fm.	Havhest	1.87	7.04	16.9	04
Agat Fm.	at Fm. Meta		3.57	9.21	08
		Upper Cretaceou	S		
Intra Trygvasson	Domino	3.2	8.6	16.5	09
Intra Trygvasson	Firfisle	2.1	5.9	11.4	09
Intra Kyrre	Skilpadde	0.7	4.1	10.0	05
Intra Kyrre	Sjørm	0.8	1.8	3.2	17
Intra Trygvasson	Buorm	1.0	5.2	10.9	09

Table 5: Volume and Risk for leads mapped during Equinor's Operatorship

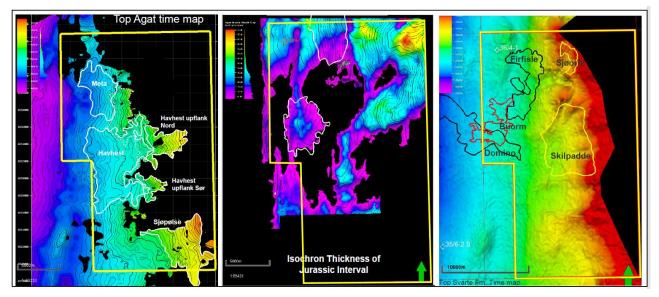


Figure 4 Geological Maps showing leads in PL828.



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Jurassic Prospectivity Summary

The Jurassic leads are high dip fault block related structures (Figure 5). The well correlations of Jurassic level suggest significant reduction in sand intervals towards east and south. The reservoir presence thus, is a key risk (no net Jurassic reservoir was found in 36/4-1 well), especially for Jonathan & Ozyptila. Apart from that, the leads would require larger volume to fill the high columns (steep structures). The structures are dependent on the Jurassic migration pathways & are difficult to establish. Jurassic leads are devoid of any AVO signature, emphasizing on the two big risk factors, reservoir, and charge.

The traps have medium to high risk for retention, due to possible leakage via sand stringers in Cretaceous level that are onlapping at the apex of these structures. Overall, these leads yield low volume with very high risk.

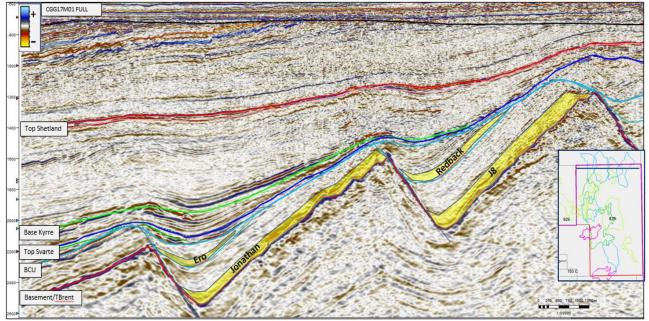


Figure 5 Arbitrary seismic line (TWT) through Jurassic leads

Cretaceous Prospectivity Summary

The lower Cretaceous leads are more subtle, and seismic amplitude driven. Seismic attributes were key for this evaluation. Despite some AVO indications, uncertainty remains in concluding, due to heterogeneity of the reservoir and tunning issues pertaining to thin Agat Fm deposition on hard basement. The traps also have up-dip sealing risks as they are onlapping features on basement and possibly some sub seismic Jurassic sediments juxtaposing at the apex part of these leads (Figure 6). Some fluid escape features were also noted on top of these leads indicating post depositional tectonic reactivations. Added risk of migration is also considered due to the failure of Presto (36/1-3) well and 36/4-1 well.



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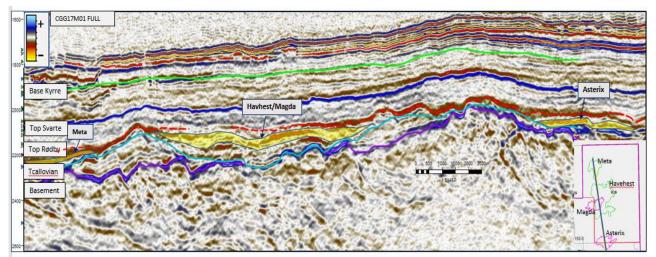


Figure 6 Arbitrary seismic line (TWT) through Lower Cretaceous leads

In the upper Cretaceous level, the trap seal risk is critical as the leads are up-dip truncated traps with signature of sand remobilisation (Figure 7). Analogue to these soft amplitude injection features were drilled in 36/4-1 and 35/6-2S. The wells encountered very good sands with excellent properties, but dry. In the geophysical evaluation, most of the leads bleed out of the outline and non-conformant to depth. Since these leads are associated with polygonal faults and injection wings, retention is a critical concern.

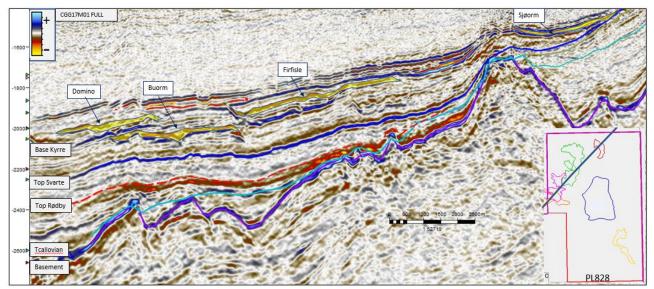


Figure 7 Seismic section (TWT) illustrating Upper Cretaceous leads.

Post evaluation of the leads, it was concluded by Equinor that the volume potential does not appropriate a drill decision.



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Neptune Energy along with Sval Energi opted to continue the work in the licence. The focus was to explore and mature some of the concepts around Agat prospectivity. Additional seismic acreage was added to do semi regional seismic data analysis and 3D basin modelling focusing on Agat Fm level.

Asterix and Magda (figure 8 & 9), are the two Agat Fm leads that was worked in details since 2020. Both are stratigraphic pinch-out traps where, Agat Fm sand terminates against faulted basement.

Asterix was mapped as a single, continuous Agat Fm sand body with clear pinch-out to southeast and a clear base. The lead is bounded by Heather shales laterally and capped by Rødby Fm shale. The spectral decomposition study indicates a north-easterly confined fairway feeding the sediments to this lead. The polygon is based on the minimum amplitude attribute, extracted on full stack. However, in the far stack, the amplitude is more confined to the central part of the lead.

In Magda lead, one clear sand body was mapped based on bright amplitude. There is possibility of heterolithic package underneath. A clear pinch-out of the mapped sand is critical but couldn't be established. The sand input to this lead is through unconfined fairways as seen from spectral decomposition study, leading to lateral seal risk. Minimum amplitude extracted for Magda shows dimming of amplitude with offset. The brightest amplitude part is in the neighbouring licence.

The seismic attribute work for Agat Fm level used four key wells for the evaluation, 36/1-3 (Presto). 36/7-4(Duva), 35/9-3T2 and 35/6-2S. The focus was to predict seismic response for brine and gas cases and investigate effect of porosity variations for Agat sands. The modelled gas case scenario at top Agat Fm with good reservoir property would shows a weak class 4 AVO with large deviation from the background trend. With reduce porosity, the intercept will be more negative giving a moderate class 3/2n AVO response and moderate deviation from background trend.

The study concluded that Asterix has high probability of reservoir presence, of medium to good quality. The fluid response was patchy and of low strength compared to 36/7-4 Duva and 35/9-3 well. A small area in the southwest part has some indications of gas presence, but the reservoir quality becomes poorer.

There was no indication of good reservoir within Magda lead in the RAI cube. Patchy fluid response seen within the polygon, bleeding to east.

Both the leads have high chances of leakage via juxtaposed Jurassic sands below and/ or cretaceous sand stringers above. Magda has additional risk of reservoir presence. Part of these leads are also extending to neighbouring licences.

The Agat Fm play is proven in this area. The fluid found in nearby discoveries have both oil and gas. So, the volume calculation was done for multi-phase with HC phase risk. Both leads carry a dry hole risk of 91%.

Details on volume and risk for Asterix and Magda are given in table 5 & 6.



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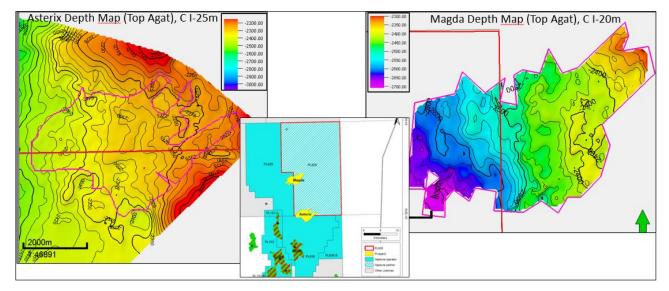


Figure 8 Depth Maps of Asterix and Magda leads.



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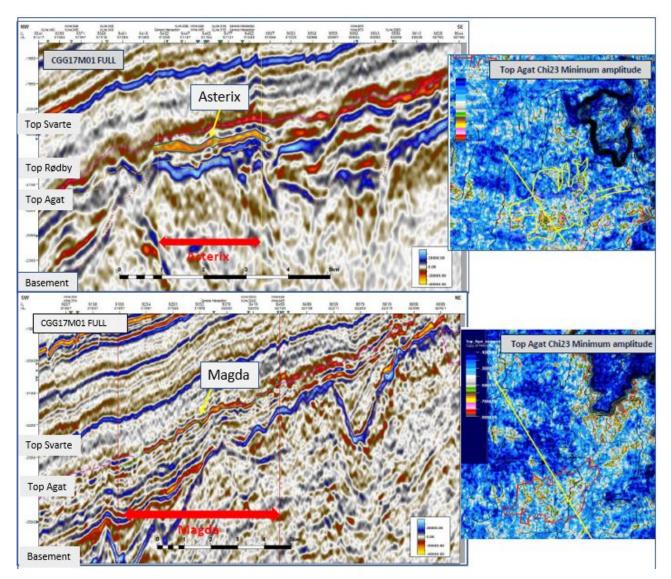


Figure 9 Seismic sections (TWT) and attribute maps illustrating Asterix and Magda in Agat level.



Table 6: Volume and Risk for Asterix (NPD Table5)

able of Freepoor and (Enclose map)	1		1		1				
	k 36/4	Prospect name		Discovery/Prosp/Lead	Lead	Prosp ID (or New!)	NPD will insert value	NPD approved (Y/N)	
	e NPD will insert value	New Play (Y/N)		Outside play (Y/N)					
Oil, Gas or O&G case:	Oil&Gas	Reported by company	Neptune	Reference document				Assessment year	2021
This is case no.:	1 of 1	Structural element		Type of trap	Stratigraphic	Water depth [m MSL] (>0)		Seismic database (2D/3D)	3D
Resources IN PLACE and RECOVERABLE		Main phase				Associated phase			-
Volumes, this case	-	Low (P90)		Base, Mean	High (P10)	Low (P90)	Base, Mode	Base, Mean	High (P10)
n place resources	Oil [10 ⁶ Sm ³] (>0.00)	4.50		11.90	20.00	0.09	0.21	0.22	0.39
		1.29		3.39	5.68				
Recoverable resources		0.80		1.94	3.18	0.02	0.03	0.03	0.06
	Gas [10 ⁹ Sm ³] (>0.00)	0.54	1.27	1.34	2.19				
Reservoir Chrono (from)	Albian	Reservoir litho (from)		Source Rock, chrono primary	Oxfordian	Source Rock, litho primary	Heather	Seal, Chrono	Albian
Reservoir Chrono (to)	Albian	Reservoir litho (to)	Agat	Source Rock, chrono secondary	Kimmeredgian	Source Rock, litho secondary	Draupne	Seal, Litho	Albian
Probability [fraction]	_				_				
Total (oil + gas + oil & gas case) (0.00-1.00)		Oil case (0.00-1.00)	0.40	Gas case (0.00-1.00)	0.60	Oil & Gas case (0.00-1.00)			
Reservoir (P1) (0.00-1.00)	0.70	Trap (P2) (0.00-1.00)	0.70	Charge (P3) (0.00-1.00)	0.60	Retention (P4) (0.00-1.00)	0.30		
Parametres:	Low (P90)	Base	High (P10)	Comments					
Depth to top of prospect [m MSL] (> 0)		2200							
Area of closure [km ²] (> 0.0)	4.4	7.8	11.3						
Reservoir thickness [m] (> 0)	22		33						
HC column in prospect [m] (> 0)	87	137	195						
Gross rock vol. [10 ⁹ m ³] (> 0.000)	433.000	470.000	505.000						
Net / Gross [fraction] (0.00-1.00)	0.40	0.52	0.70						
Porosity [fraction] (0.00-1.00)	0.16	0.19	0.21						
Permeability [mD] (> 0.0)				-					
Nater Saturation [fraction] (0.00-1.00)	0.43	0.35	0.28						
Bg [Rm3/Sm3] (< 1.0000)	0.0080	0.0046	0.0044						
1/Bo [Sm3/Rm3] (< 1.00)	0.80	0.74	0.69						
GOR, free gas [Sm ³ /Sm ³] (> 0)	87	107	131	-					
GOR, oil [Sm ³ /Sm ³] (> 0)	87	107	131						
Recov. factor, oil main phase [fraction] (0.00-1.00)	0.20	0.25	0.30						
Recov. factor, gas ass. phase [fraction] (0.00-1.00)	0.20								
Recov. factor, gas main phase [fraction] (0.00-1.00)	0.50			1					
Recov. factor, liquid ass. phase [fraction] (0.00-1.00)	0.40	0.49	0.60	For NPD use:					
				Innrapp. av geolog-init:	NPD will insert value	Registrert - init:	NPD will insert value	Kart oppdatert	
Temperature, top res [°C] (>0)	80								
[emperature, top res [°C] (>0) Pressure, top res [bar] (>0)	260	-		Dato:	NPD will insert value		NPD will insert value	Kart dato	NPD will insert value NPD will insert value

Table 7: Volume and Risk for Magda (NPD Table5)

Bloc	k 36/4	Prospect name	Magda	Discovery/Prosp/Lead	Lead	Prosp ID (or New!)	NPD will insert value	NPD approved (Y/N)	
Play nam	e NPD will insert value	New Play (Y/N)		Outside play (Y/N)					
Oil, Gas or O&G case:	Oil&Gas	Reported by company	Neptune	Reference document				Assessment year	2021
This is case no.:	1 of 1	Structural element		Type of trap	Stratigraphic	Water depth [m MSL] (>0)		Seismic database (2D/3D)	3D
Resources IN PLACE and RECOVERABLE		Main phase				Associated phase			
Volumes, this case		Low (P90)	Base, Mode	Base, Mean	High (P10)	Low (P90)	Base, Mode	Base, Mean	High (P10)
n place resources	Oil [10 ⁸ Sm ³] (>0.00)	4.02	11.50	13.20	24.70	0.08	0.21	0.25	0.47
in place resources	Gas [10 ⁹ Sm ³] (>0.00)	1.13	3.26	3.73	6.91				
Recoverable resources	Oil [10 ⁸ Sm ³] (>0.00)	1.01	2.86	3.13	5.58	0.01	0.05	0.06	0.11
(ecoverable resources	Gas [10 ⁹ Sm ³] (>0.00)	0.69	1.96	2.15	3.81				
Reservoir Chrono (from)	Albian	Reservoir litho (from)	Agat	Source Rock, chrono primary	Oxfordian	Source Rock, litho primary	Heather	Seal, Chrono	Albian
Reservoir Chrono (to)	Albian	Reservoir litho (to)	Agat	Source Rock, chrono secondary	Kimmeredgian	Source Rock, litho secondary	Draupne	Seal, Litho	Albian
Probability [fraction]									
Total (oil + gas + oil & gas case) (0.00-1.00)		Oil case (0.00-1.00)	0.40	Gas case (0.00-1.00)	0.60	Oil & Gas case (0.00-1.00)			
Reservoir (P1) (0.00-1.00)	0.70	Trap (P2) (0.00-1.00)	0.70	Charge (P3) (0.00-1.00)	0.60	Retention (P4) (0.00-1.00)	0.30		
Parametres:	Low (P90)	Base	High (P10)	Comments					
Depth to top of prospect [m MSL] (> 0)		2300		I					
Area of closure [km ²] (> 0.0)	3.8	6.2	8.8	1					
Reservoir thickness [m] (> 0)	10								
HC column in prospect [m] (> 0)	140	216	309						
Gross rock vol. [10 ⁹ m ³] (> 0.000)	1217.000	1320.000	1421.000						
Net / Gross [fraction] (0.00-1.00)	0.30	0.40	0.50						
Porosity [fraction] (0.00-1.00)	0.14	0.16	0.18	1					
Permeability [mD] (> 0.0)]					
Nater Saturation [fraction] (0.00-1.00)	0.43	0.35	0.28	5					
Bg [Rm3/Sm3] (< 1.0000)	0.0080	0.0046	0.0044	l.					
1/Bo [Sm3/Rm3] (< 1.00)	0.80	0.74	0.69						
GOR, free gas [Sm ³ /Sm ³] (> 0)	87		131]					
GOR, oil [Sm ³ /Sm ³] (> 0)	87	107							
Recov. factor, oil main phase [fraction] (0.00-1.00)	0.20								
Recov. factor, gas ass. phase [fraction] (0.00-1.00)	0.20								
Recov. factor, gas main phase [fraction] (0.00-1.00)	0.50	0.59	0.70	i i i i i i i i i i i i i i i i i i i					
Recov. factor, liquid ass. phase [fraction] (0.00-1.00)	0.40	0.49	0.60	For NPD use:					
Temperature, top res [°C] (>0)	80			Innrapp. av geolog-init:	NPD will insert value	Registrert - init:	NPD will insert value	Kart oppdatert	NPD will insert value
Pressure, top res [bar] (>0)	260			Dato:	NPD will insert value	Registrert Dato:	NPD will insert value	Kart dato	NPD will insert value
Cut off criteria for N/G calculation	VCL0.4	Phie 0.1	Sw0.65					Kart nr	NPD will insert value

5. Technical evaluation

Due to the small volumes and low geological chances of success, none of these leads live up to the technical evaluation. No new technical evaluations have been performed since the application for the APA.



PL828 Status Report -Licence Surrender

6. Conclusion

The work program for PL828 has been fulfilled by the partnership. The revised interpretation and geological studies have led to conclude that the leads mapped in PL828, do not have a combination of risk and volume potential that can justify the drilling of exploration well.

The licence partners unanimously concluded on a drop decision based on small volumes combined with a significant risk associated with traps and the licence was surrendered at the Drill or Drop decision gate 10.05.2021.