PL835 Licence Status Report

Innhold

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1 Key licence history

Licence: PL835 – Parts of blocks 6407/2, 6407/3, 6407/6 and 6507/12 (Figure 1)

Awarded: 05.02.2016 (APA 2015)

Licence period: Expires 05.02.2023 (Initial period: 8 years)

Licence group:

Statoil Petroleum AS	60% (Operator)
Point Resources AS	40%

Licence area: 633.036km^2

Work programme:

Technical G&G work:	Fulfilled, confirmed by the NPD
Acquire 3D seismic:	Fulfilled, confirmed by the NPD

Drill or drop by 05.02.2018, two years after award

Work performed:

2016:	Licence awarded and licence start-up. The licence purchased approximately 956.11km^2 of 3D seismic data covering the greater PL835 licence area and around in 2016, the PGS14002/14005 survey acquired by PGS. CSEM feasibility study carried out for the Lanterna prospect.
2017:	Seismic interpretation, evaluation of the licence prospectivity. AVO analysis, PVT evaluation and litho-fluid prediction.

Meetings:

EC/MC - Start-up of licence:	06.04.2016
EC/MC - Status interpretation:	09.11.2016
EC/MC – work meeting:	22.08.2017
EC/MC – work meeting:	31.08.2017
EC/MC – prospect summary:	23.11.2017

Reason for relinquishment

The main prospect within the PL835 licence is Lanterna. This prospect was also shared with the PL796 licence. A drill on this prospect was decided in the PL796 and the Operator proposed to join the PL796 licence to drill the Lanterna prospect as a joint well for the two licences. However, the partnership in PL835 did not agree. The Operator was not willing to take on a 100% share and so it was decided to drop the licence.

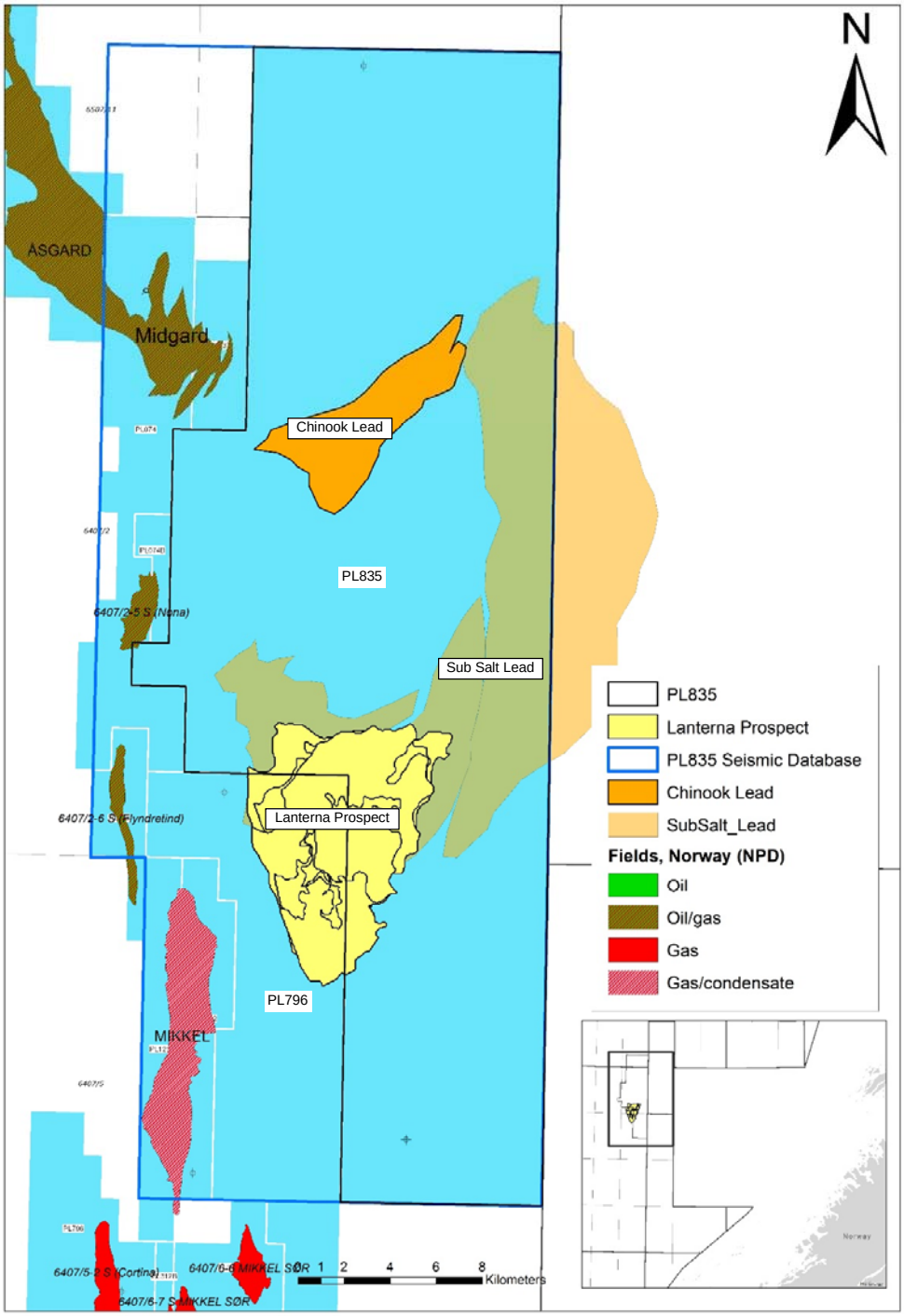

Figure 1: *Area map with licences*

2 Database

Wells

The well database in PL835 is given in Table 1.

Well	Year	Operator	Status	Purpose
NO 6407/1-6 S	2013	Wintershall Norge AS	G/C	
NO 6407/2-1	1982	Saga Petroleum ASA	S	DC
NO 6407/2-2	1983	Saga Petroleum ASA	G/C	PE/DC
NO 6407/2-3 T2	1987	Saga Petroleum ASA	G/C	PE
NO 6407/2-4	2009	Det norske oljeselskap ASA (old)	D	DC
NO 6407/2-5 S	2009	StatoilHydro Petroleum AS	O/G	PE/PVT
NO 6407/2-6 S	2010	Statoil Petroleum AS	O/G	PE/DC/PVT
NO 6407/3-1 S	2011	Statoil Petroleum AS	D	PE/DC
NO 6407/5-1	1988	Mobil Exploration Norway INC	S	DC
NO 6407/5-2 S	2011	OMV (Norge) AS	G	PE/DC
NO 6407/6-1	1984	Den norske stats oljeselskap a.s	D	PE/DC/WT
NO 6407/6-3	1987	Den norske stats oljeselskap a.s	G/C	PE/DC
NO 6407/6-4	1990	Mobil Exploration Norway INC	OS	PE/DC
NO 6407/6-5	1999	Den norske stats oljeselskap a.s	G	PE/DC/PVT
NO 6407/6-6	2008	StatoilHydro ASA	G	PE/DC
NO 6407/6-7 S	2009	StatoilHydro ASA	G	PE/DC
NO 6407/9-2	1985	A/S Norske Shell	O	PVT
NO 6407/9-4	1985	A/S Norske Shell	O	PVT
NO 6407/9-7	1988	A/S Norske Shell	D	
NO 6408/4-1	1988	Conoco Norway Inc.	D	PE/DC
NO 6507/11-1	1981	Saga Petroleum ASA	G/C	PE/DC
NO 6507/11-2	1982	Saga Petroleum ASA	D	DC
NO 6507/11-3	1985	Saga Petroleum ASA	O/G	PE
NO 6507/11-4	1987	Saga Petroleum ASA	D	PE
NO 6507/11-5 S	1997	Den norske stats oljeselskap a.s	O/G	
NO 6507/11-6	2001	Norsk Hydro Produksjon AS	G/C	
NO 6507/11-8	2007	Statoil ASA (Old)	G	PE/DC
NO 6507/12-1	1980	Saga Petroleum ASA	D	PE/DC
NO 6507/12-2	1981	Saga Petroleum ASA	S	PE/DC/WT
NO 6507/12-3	1985	Saga Petroleum ASA	D	PE/DC

Table 1 *Common well database for PL835 licence. Purpose: DC: depth conversion, PE: Petrophysical evaluation, PVT: PVT data, WT: Well Tie.*

Seismic

The common licence database was approved at the ECMC meeting No 1. The seismic data that was utilized in the technical evaluation of PL835 is shown in Table 2 and comprises the PGS14002 dataset that was later merged with the PGS14005 dataset.

Survey name	NPDID	Survey year	Seismic type	Seismic operator	Market available
PGS14002	7993	2014	3D	PGS	Yes

Table 2 *List with seismic datasets used in PL835 licence*

3 Review of the geological framework

The detailed regional geological framework is described in the APA 2015 application for parts of blocks 6407/2, 6407/3, 6407/6 and 6507/12. The PL835 licence is located along the western margin of the Trøndelag Platform and towards the east and southeast of the Mikkel and Midgard fields respectively.

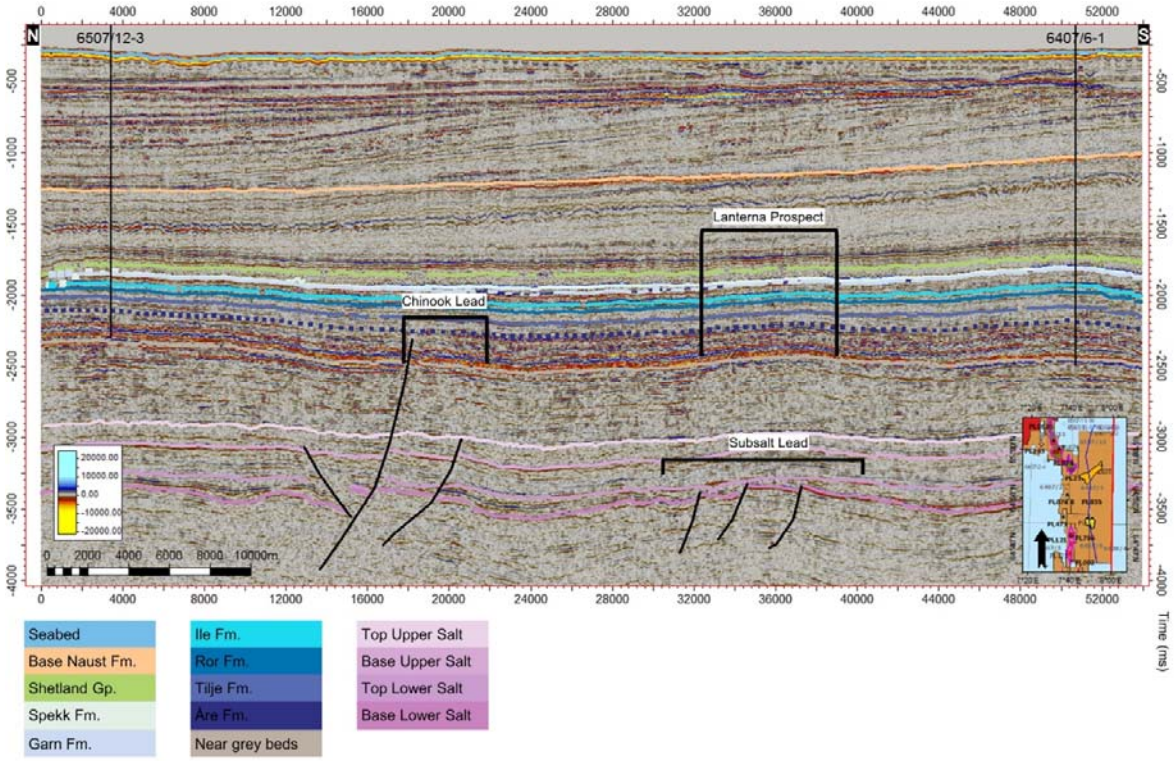

Figure 2 *N-S seismic profile (random line PGS14005) showing key wells, horizons and evaluated prospects and leads.*

The focus of the licence was the prospectivity along the western margin of the Trøndelag Platform with the Lanterna prospect, a subtle four-way closure, as a driving opportunity. A lower Jurassic lead (Chinook) was originally identified in the northern part of the licence, and was to be verified on newly acquired 3D dataset.

All key horizons were mapped out for regional and prospect evaluations (*Figure 2*). In the new 3D dataset, the change in structural style between the middle Jurassic, lower Jurassic and Triassic becomes apparent (*Figure 3*). The deeper horizons clearly show the impact of the Triassic rifting phase while, especially along the margin (i.e. footwall block of the Bremstein Fault Complex), while the effect of the late Jurassic rift phase is minor.

During the late Jurassic rifting phase some of the main Triassic faults where reactivated which resulted in a low relief topography which the Lanterna prospect is a part of.

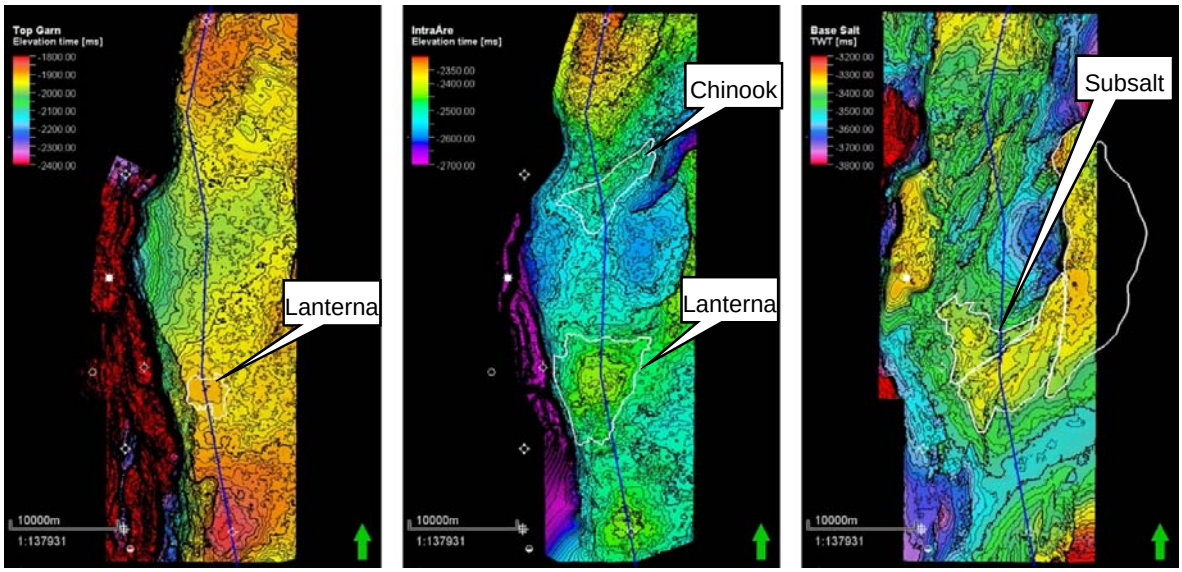

Figure 3 *Key stratigraphic horizons (time, ms) in the PL835 licence with prospect/lead outline. From left to right: top Garn Fm., Intra Åre coal, Base Salt. The blue line indicates the location of the seismic section (Figure 2).*

The impact of a different structure is seen in the Lanterna prospect (*Figure 3*, *Figure 5*), where in the present-day configuration the spill point is towards the 6407/6-1 well within the lower to middle Jurassic strata (upper Åre, Tilje, Ile and Garn fms) whilst a spill towards the NE is seen in the late Triassic to lower Jurassic strata (Grey Beds and lower Åre Fm.). This implies that a different petroleum system may be seen within the deeper stratigraphy. It should be noted that along the Bremstein Fault Complex the deepest fault juxtapositions occur between the Garn carrier bed on the hanging wall side and the lower Åre on the footwall side.

Below the Lanterna prospect, underneath the base of the lower Carnian aged salt, large permo-triassic fault blocks were mapped out that may include elements of a deeper petroleum system including a Permian or Triassic source, sealed by the Triassic Salt.

4 Prospect update

The Lanterna prospect is the main driving opportunity within the licence. The premise for the northern end of the licence was to screen the area for additional prospectivity and upsides in the new 3D seismic dataset. The lower Jurassic lead (Chinook) that was mapped out on an older 2D dataset was not confirmed in its full extent on the 3D seismic dataset. Hence those volumes were reduced. An updated overview of the volumes is presented below (*Table 3*).

Discovery/ Prospect/ Lead name [1]	D/ P/ L [2]	Case (Oil/ Gas/ Oil&Gas) [3]	Unrisked recoverable resources [4]						Probability of discovery [5] (0.00 - 1.00)	Resources in license [%] [6] (0.0 - 100.0)	Reservoir	
			Oil [10^6Sm^3] (>0.00)			Gas [10^9Sm^3] (>0.00)					Litho-/ Chrono-stratigraphic level [7]	Reservoir depth [m MSL] (>0)
			Low (P90)	Base (Mean)	High (P10)	Low (P90)	Base (Mean)	High (P10)				
Lanterna	P	Oil	1,27	8,22	19,30	0,03	0,66	1,49	0,32	50,0	Båt and Fangst Gp./ Lower-Middle Jurassic	1929
Chinook	L	Oil	0,20	0,88	1,78	0,02	0,11	0,22	0,17	100,0	Åre Fm./ Hettangian	2763

Table 3 *Volume overview of the Lanterna prospect and Chinook lead*

4.1 Lanterna Prospect

The Lanterna prospect consists of six vertically stacked reservoir intervals forming four-way dip closures at all Triassic to middle Jurassic levels (*Figure 4, Figure 5*). The shallow marine reservoir sections within the Garn, Ile and Tilje Fms, are separated and sealed by regional flow barriers from the Melke, Not and Ror Fms (*Figure 4*). The fluvial reservoir sections within the Lower Åre Fm. and Grey Beds require internal shale barriers to seal. The updated prospect evaluation includes the upper Åre Fm. as an additional reservoir segment. The upper Åre Fm. marks the transition from a fluvial system to a marginal marine bay fill succession. The latter is sealed by a semi regional shale. The extent and seal capacity of this shale within the Lanterna area is however uncertain. All prospect segments have small changes in volumes compared with the cases described in the APA application. Updated prospect details for all segments are grouped in the appendix at the end of the report.

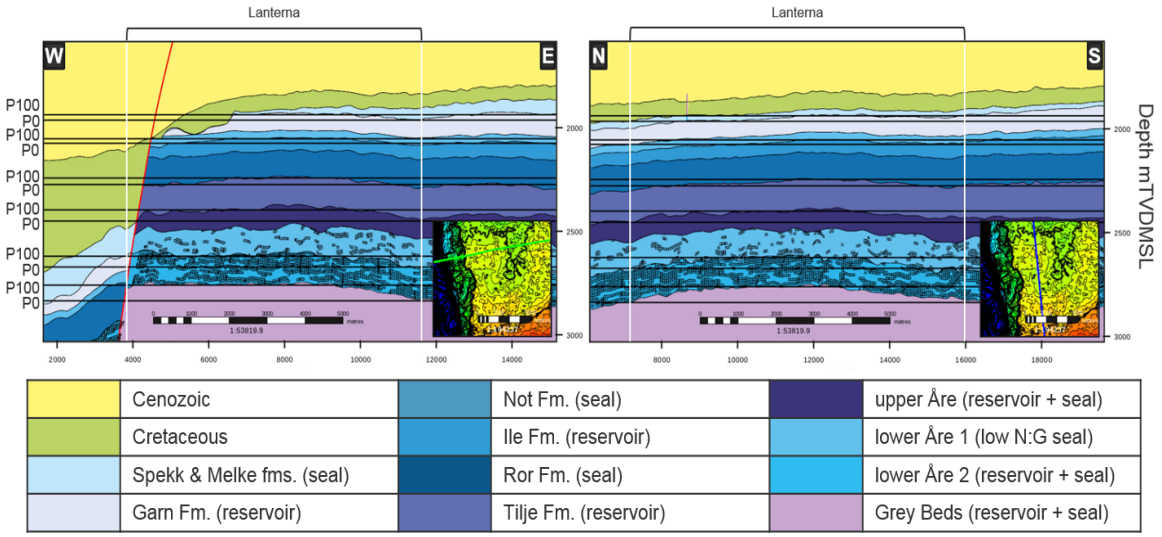

Figure 4 *W-E and N-S geo-seismic section across the Lanterna prospect (see maps for location). Solid lines show minimum and maximum contact in each reservoir segment. See Figure 5 for structural maps of the six reservoir segments.*

Migration is the main risk since the prospect is located on the platform area near several dry wells. Structural seismic mapping (TWT) is of high confidence because of Lanterna being a simple structure with reasonably good seismic imaging. However, depth-conversion is uncertain due to the relative flat structure and moderate uncertainties in the velocity field. This uncertainty in depth-conversion has a large impact on defining the structural closure of the prospect and the Gross Rock Volumes (GRV) at all six reservoir intervals.

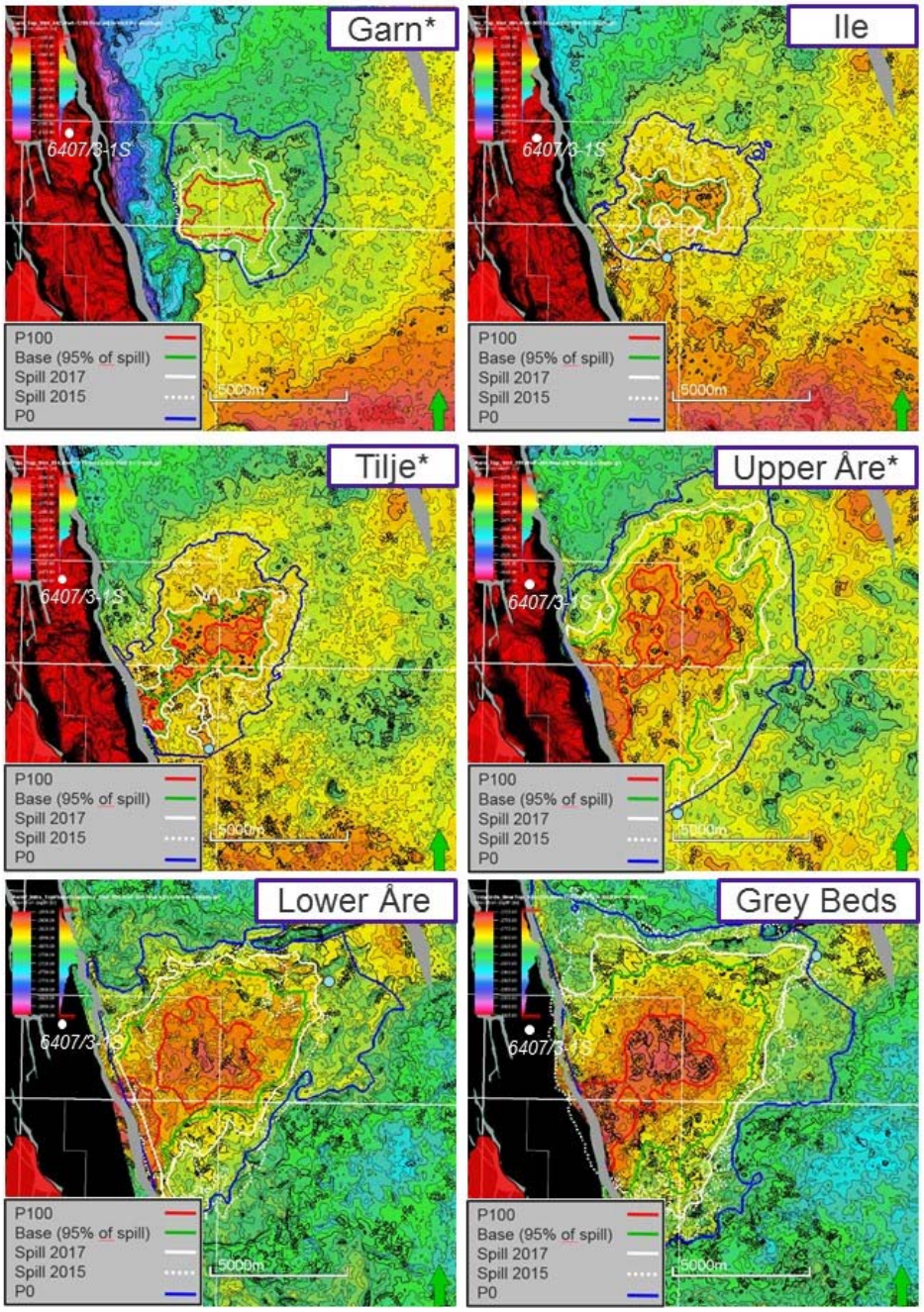

Figure 5 *Top reservoir depth maps of the Lanterna prospect with contact polygons for P100 (red solid), base case (green solid), spill point 2017 (white solid), spill point 2015 (white dashed), spill point 2017 (white solid) and P0 (blue solid). The mapped spill point for the structure is marked by a blue dot. Reservoir segments included in business cases for economical evaluation are marked with an asterix.*

The Lanterna prospect is not supported by DHI observations as no clear AVO responses indicating presence of hydrocarbons were observed. One of the main arguments to why a strong fluid indicator is lacking is the presence of a relatively heavy oil type with lower GOR. Based on these assumption, the PVT parameters for the prospect were revised and synthetic modelling of the expected AVO responses indicates that: (i) brine and heavy oil with low GOR are difficult to differentiate since both phases would produce similar responses on real seismic data, and (ii) potential AVO effects will be difficult to observe due to thin oil columns.

A CSEM feasibility study was carried out to verify if the Lanterna prospect is visible on a CSEM survey. The results of the study showed that for most cases (individual filling of segments and multiple segments filled), only the P10 cases will be detectable with a sufficient degree of confidence. As columns would be relatively thin, there is a high chance that the minimum economic cases still would not be detectable.

4.2 Chinook Lead

The Chinook lead as mapped on the acquired 3D dataset is defined as a small fault bounded dip closure (*Figure 2*, *Figure 3*). The previously mapped lead indicated a potential large closure that was dependent on the presence of a large fault to seal it from the dry 6507/12-3 well. Such a fault was not confirmed on the newly acquired 3D seismic dataset. As such, the size of the lead was significantly reduced.

4.3 Lanterna Subsalt Lead

During the mapping process of the PL835, a fault bounded dip closure was mapped out at the top and base of the Triassic evaporite sequence underneath the Lanterna structure (*Figure 2*, *Figure 3*). The filling of such a structure is strongly depended on the presence and maturity of a deeper, tentative Permian or Triassic aged source rock. The depth of this structure is similar to the same Triassic interval in the 6507/12-2 well. Petrographical evaluations indicate presence sandstones underneath the evaporites with almost no porosity due to abundant cementation (quartz and carbonate). This implies that despite the existence of a large subsalt closure, the presence of sand with reservoir quality is highly uncertain.

5 Technical evaluations

The Lanterna prospect is located c.45km north of Draugen and c.62km north-east of Njord. The technical economical evaluation contains multiple segments with the Garn, Tilje and Upper Åre Fms. The segments are vertically stacked. Only pure oil cases are possible scenarios. The valuation is performed on a segment level to cover the wide span of outcomes. The field development solution is a subsea tie-back directly to the Draugen platform. The drainage strategy is water injection and the number of production wells vary from 2–7 depending on the number of hydrocarbon-bearing formations that are encountered. With an exploration well in 2019, the production start is assumed in 2025. As the Draugen field is in the tail production, no major topside modifications are assumed to be necessary to produce Lanterna.

6 Conclusions

The Lanterna prospect was looked at as the main drilling candidate for the PL835 licence. The prospect is shared with the neighbouring PL796 licence, where a positive decision towards a drill has been taken. The absence of a clear DHI in the prospect and high migration risk regarding the prospect's locations made the partnership not reaching a consensus on how to distribute the financial exposure.

Both partners in PL835 are also represented in PL796 and since a drill decision on the Lanterna prospect was taken in the PL796 licence, one of the prerequisites for dropping the PL835 licence will be to apply for a PL796 licence extension covering the Lanterna prospect in the forthcoming APA round.

7 References

Statoil 2015. Application for Part of blocks 6407/2, 6407/3, 6407/6 and 6507/12. APA2015 Application, 61 pp.

8 Appendix: Table 5: Prospect details

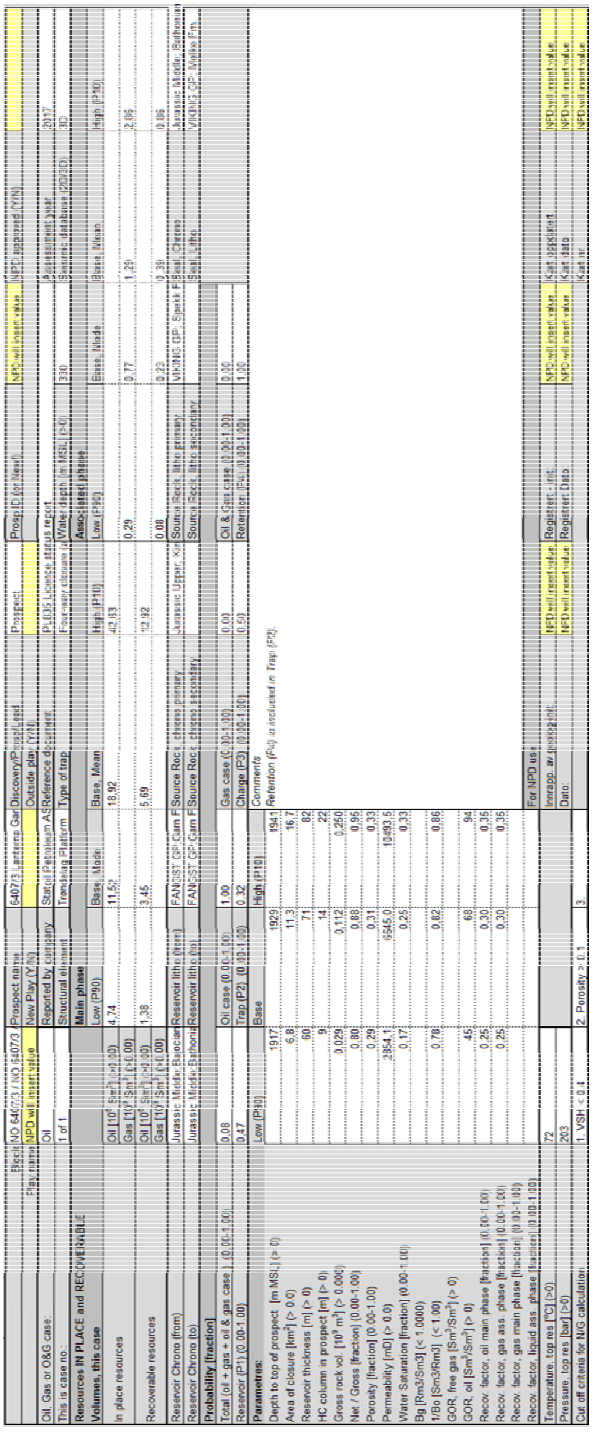

Table 4 *Lanterna prospect data of the Garn Fm.*

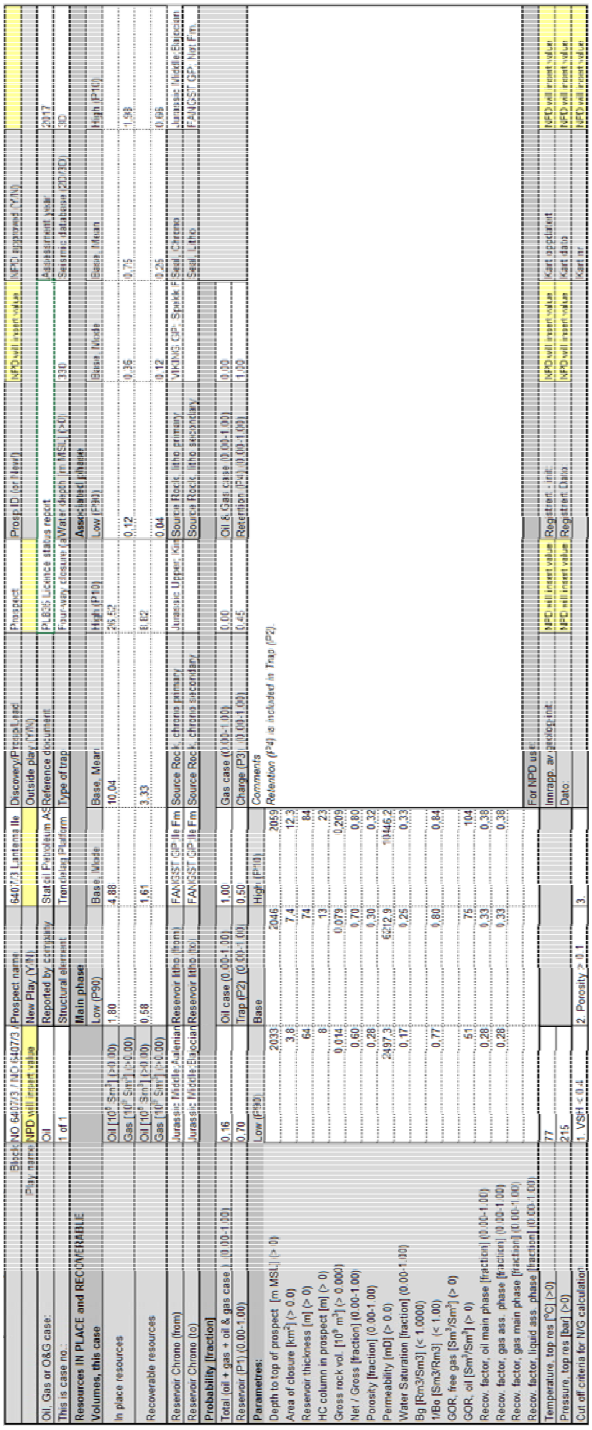

Table 5 *Lanterna prospect data of the Ile Fm.*

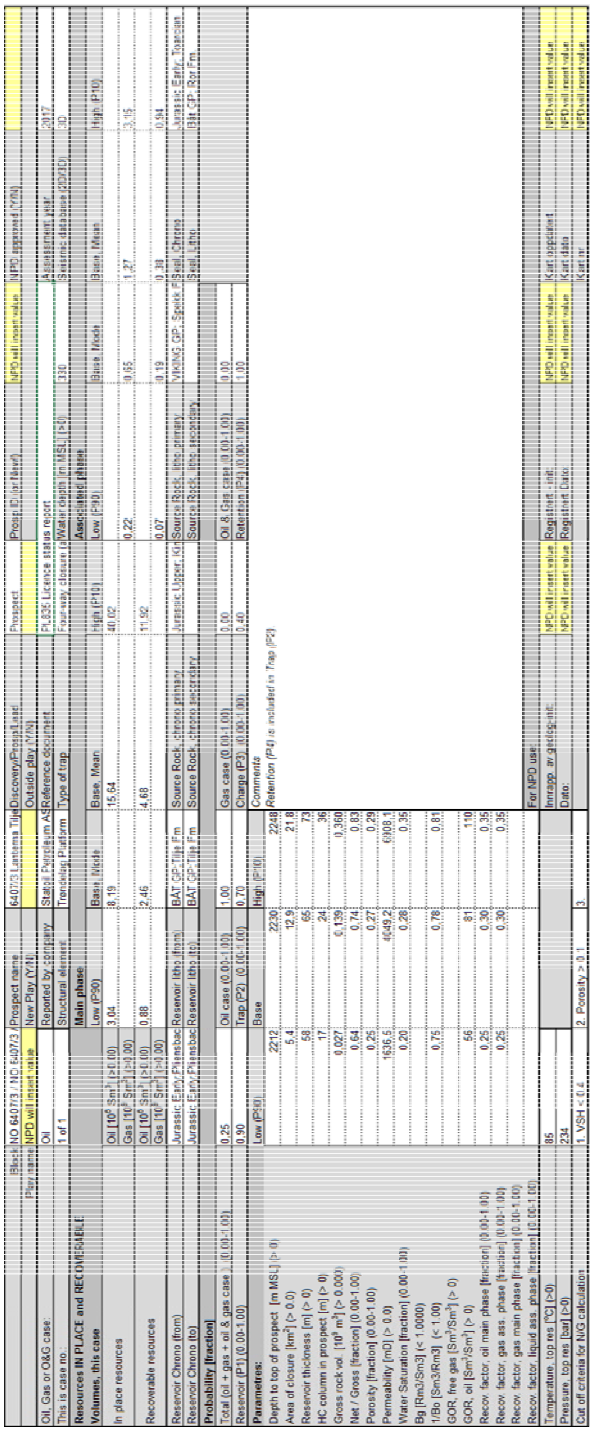

Table 6 *Lanterna prospect data of the Tilje Fm.*

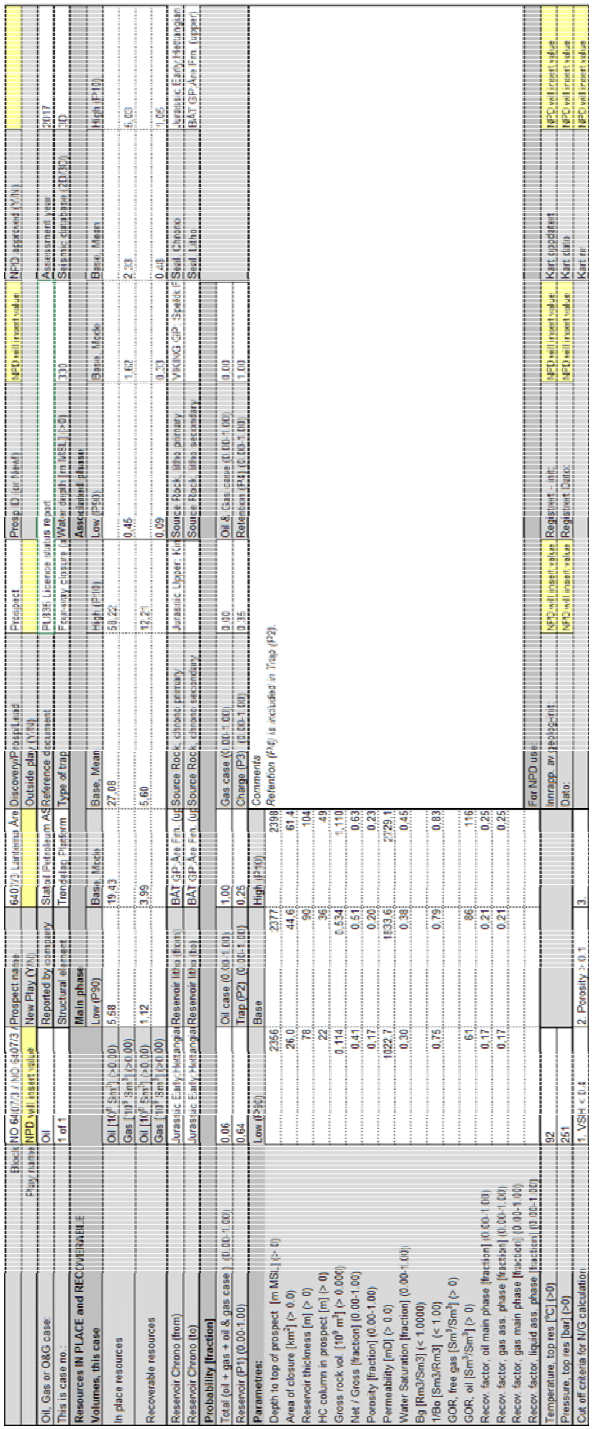

Table 7 *Lanterna prospect data of the Upper Åre Fm., New Evaluation*

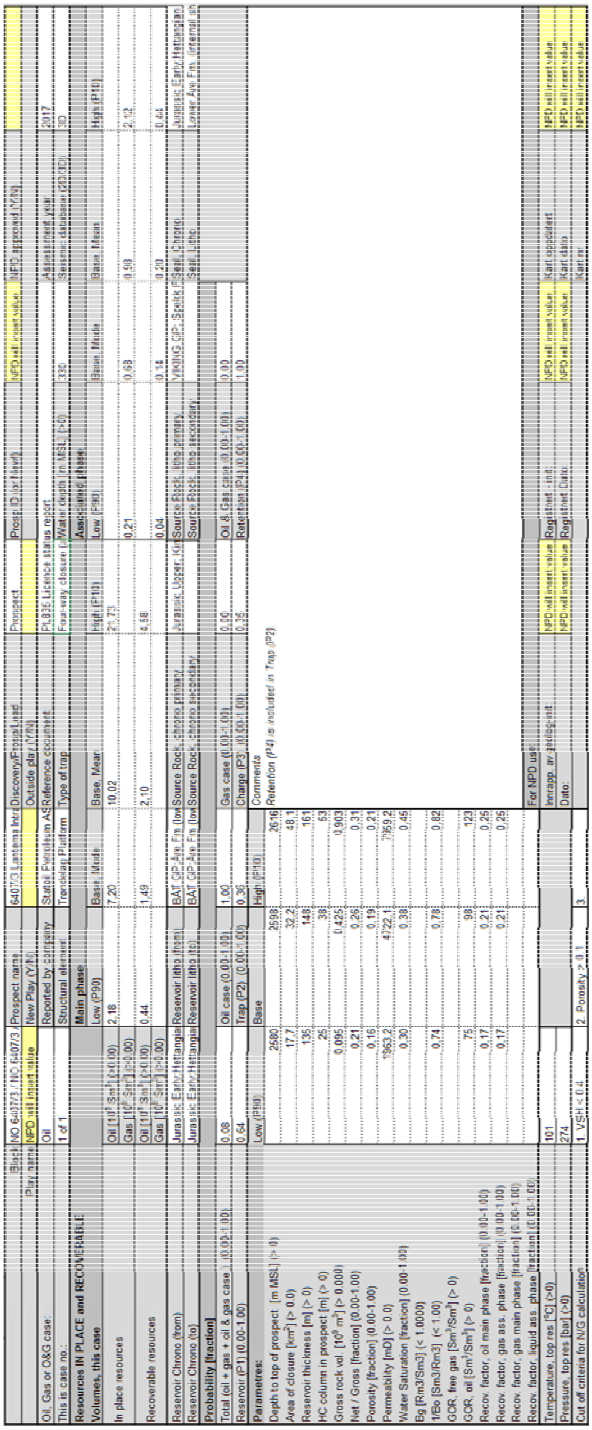

Table 8 *Lanterna prospect data of the Intra Lower Åre Fm.*

Block	NO 6407/3 / NO 6407/	Prospect name	6407/3 Lanterna Tr	Discovery/Prosp/Lead	Prospect	Prosp ID (or New!)	NPD will insert value	NPD approved (Y/N)	
Play name	NPD will insert value	New Play (Y/N)		Outside play (Y/N)					
Oil, Gas or O&G case:	Oil	Reported by company	Statoil Petroleum A	Reference document	PL835 Licence status report			Assessment year	2018
This is case no.:	1 of 1	Structural element	Trøndelag Platform	Type of trap	Four-way closure	Water depth [m MSL] (>0)	330	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)
In place resources	Oil [10^6 Sm^3] (>0.00)	2,96	11,67	15,57	32,71				
	Gas [10^9 Sm^3] (>0.00)					0,29	1,17	1,60	3,39
Recoverable resources	Oil [10^6 Sm^3] (>0.00)	0,67	2,76	3,73	7,94				
	Gas [10^9 Sm^3] (>0.00)					0,07	0,28	0,39	0,83
Reservoir Chrono (from)	Triassic Late;Rhaetian	Reservoir litho (from)	Grey beds	Source Rock, chrono primary	Jurassic Upper; K	Source Rock, litho primary	VIKING GP; Spekk F	Seal, Chrono	Triassic Late;Rhaetian
Reservoir Chrono (to)	Triassic Late;Rhaetian	Reservoir litho (to)	Grey beds	Source Rock, chrono secondary		Source Rock, litho secondary		Seal, Litho	Grey beds
Probability [fraction]									
Total (oil + gas + oil & gas case) (0.00-1.00)	0,02	Oil case (0.00-1.00)	1,00	Gas case (0.00-1.00)	0,00	Oil & Gas case (0.00-1.00)	0,00		
Reservoir (P1) (0.00-1.00)	0,16	Trap (P2) (0.00-1.00)	0,36	Charge (P3) (0.00-1.00)	0,30	Retention (P4) (0.00-1.00)	1,00		
Parametres:	Low (P90)	Base	High (P10)	*Comments* *Retention (P4) is included in Trap (P2).*					
Depth to top of prospect [m MSL] (> 0)	2712	2730	2748						
Area of closure [km^2] (> 0.0)	29,5	49,8	70,1						
Reservoir thickness [m] (> 0)	95	100	105						
HC column in prospect [m] (> 0)	35	56	77						
Gross rock vol. [10^9 m^3] (> 0.000)	0,133	0,691	1,445						
Net / Gross [fraction] (0.00-1.00)	0,21	0,26	0,33						
Porosity [fraction] (0.00-1.00)	0,16	0,18	0,21						
Permeability [mD] (> 0.0)	1855,6	4586,0	7737,3						
Water Saturation [fraction] (0.00-1.00)	0,30	0,38	0,45						
Bg [Rm3/Sm3] (< 1.0000)									
1/Bo [Sm3/Rm3] (< 1.00)	0,73	0,76	0,79						
GOR, free gas [Sm^3/Sm^3] (> 0)									
GOR, oil [Sm^3/Sm^3] (> 0)	80	103	129						
Recov. factor, oil main phase [fraction] (0.00-1.00)	0,19	0,24	0,30						
Recov. factor, gas ass. phase [fraction] (0.00-1.00)	0,19	0,24	0,30						
Recov. factor, gas main phase [fraction] (0.00-1.00)									
Recov. factor, liquid ass. phase [fraction] (0.00-1.00)				For NPD use:					
Temperature, top res [°C] (>0)	107			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)	290			Dato:	NPD will insert value	Registrert Dato:	NPD will insert value	Kart dato	NPD will insert value
Cut off criteria for N/G calculation	1. VSH < 0.4	2. Porosity > 0.1	3.					Kart nr	NPD will insert value

***Table 9** Lanterna prospect data of the Grey Beds*