PL794 Relinquishment report

Table of contents

1 Key Licence history

The PL794 was awarded in 2015 as part of the APA application. Originally, the acreage applied for comprises total area of 136.8 km^2; acreage awarded covers 67.5 km^2, located in part of Block 6407/10 in the Norwegian Sea (for more details see Chapter 4). The work commitment included acquisition of 3-D seismic over prospective area and decision to drill (DoD) one exploration well until 06.02.2017. The work commitment was fulfilled by purchasing part of newly acquired PGS14005, a 3-D broadband seismic survey and its PDSM version in 2015, and reaching DoD decision in November 2016.

Licence PL794 was operated by Statoil with variable partner equity. Full license history is summarised in Tables 1 - 3 below.

Table 1. License history

Licensee valid from date	Licensee valid to date	Company longname	Interest [%]
18.05.2016		Statoil Petroleum AS	40.000000
		VNG Norge AS	20.000000
		Faroe Petroleum Norge AS	20.000000
		DEA Norge AS	20.000000
13.01.2016	18.05.2016	Statoil Petroleum AS	40.000000
		VNG Norge AS	20.000000
		Faroe Petroleum Norge AS	20.000000
		Dea E&P Norge AS	20.000000
06.02.2015	13.01.2016	Statoil Petroleum AS	40.000000
		VNG Norge AS	20.000000
		Faroe Petroleum Norge AS	20.000000
		E.ON E&P Norge AS	20.000000

Table 2. License transfers

Valid from date	Transfer direction	Type of change	Company name	Transferred interest [%]
18.05.2016	FROM	MERGER/TAKEOVER	Dea E&P Norge AS	20.000000
	TO	MERGER/TAKEOVER	DEA Norge AS	20.000000
13.01.2016	FROM	CHANGE OF COMPANY NAME	E.ON E&P Norge AS	20.000000
	TO	CHANGE OF COMPANY NAME	Dea E&P Norge AS	20.000000

Table 3. Overview of the meetings held in the license

Meeting date	Meeting type
20.04.2015	EC/MC
10.11.2015	MC
19.05.2016	EC/Work meeting
22.11.2016	EC/MC

Reason for relinquishment

The acreage awarded for the PL794 comprises one prospect - Satus, with a maximum closure area of 26 km^2. Results of the prospect evaluation reveal that identification of robust closure for Satus prospect has been difficult. No DFIs have been observed. The prospect has a very high risk for reservoir presence and trap seal and marginal volumes.
Subsequently, the relinquishment application has been submitted to the authorities on the 15th December 2016 and licence was relinquished in January 2017.

2 Database

Initial common database in PL794 was approved at the combined EC/MC No. 1 in April 2015 and comprised the following: (a) wells 6406/12-1S; 6406/12-3(A&B); 6406/12-4(A&S); 6406/12-5S; 6406/12-2;6407/10-1; 6407/12-2, 6407/10-4 and (b) part of the PGS14005 seismic cube covering the license and the common database (Figure 1 and Figure 2). In later stage, the common database has been extended to include: 1) larger seismic coverage around south-western part of the license; 2) newly drilled well 6407/10-5 (Figure 1). Moreover, additional seismic data were utilized in the technical evaluation of PL794: part of the HT2007 seismic cube (not covering northernmost part the license acreage) and NH9701 seismic surveys over the Njord Field, along with the wells within, for seismic tie into the northern part of the license (Figure 1).

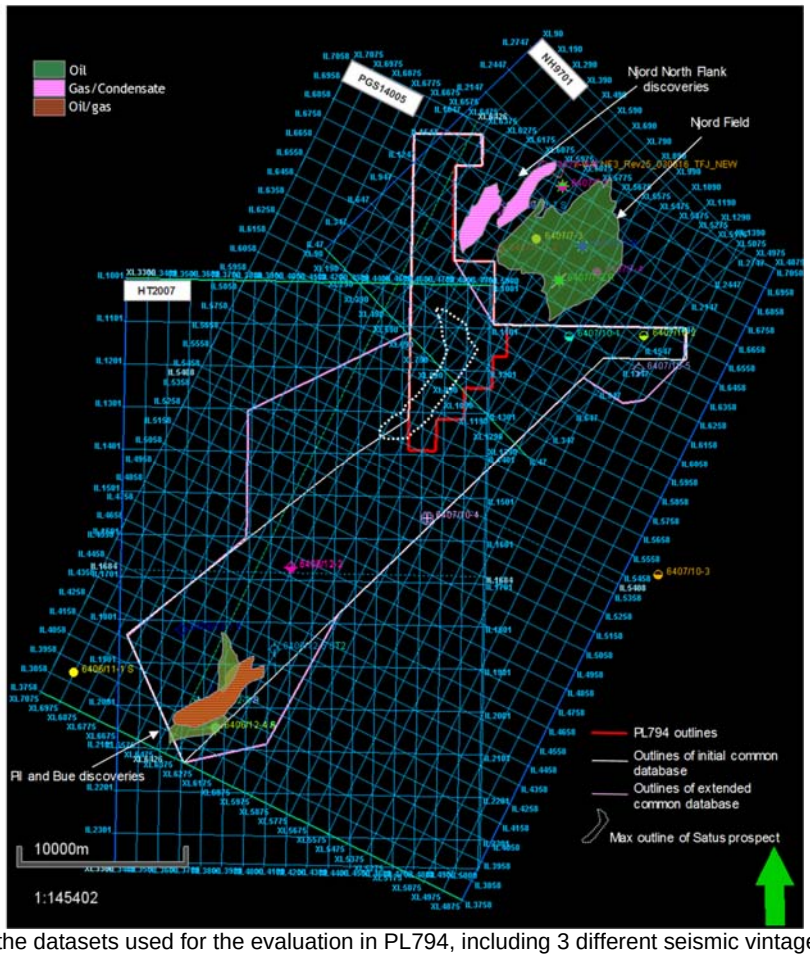


Figure 1. Overview of the datasets used for the evaluation in PL794, including 3 different seismic vintages, 12 wells within the common database (and additional 8 wells outside it, in the Njord field).

Mapping and evaluation for the common database have been performed on PGS14005 seismic cube, and included the various angle stacks as well as its PSDM version. Special studies undertaken are based on the wells in the common database and outside it, and include: 1) sedimentology study and depositional model based on compilation of seismic, core and log data; 2) Frequency Decomposition and RGB blending for reservoir levels - to identify geomorphic/ depositional elements; 3) fault seal analysis coupled with 4) semi-regional pressure data overview, 5) understanding of the behaviour of amplitudes in the area through extensive Rock physics/AVO/LFP work; and 6) review of published literature and other relevant special reports/studies (e.g., biostratigraphy).

3 Review of Geological and Geophysical studies

Nearly all the G&G work for PL794 was performed in connection to the common database, as there are no wells drilled within the area of the license (Figure 2). Prospect Satus is mapped in the Upper Jurassic play, located in the hanging wall adjacent to the Vingleia Fault Complex, directly southwest of the Njord Field (Figure 2). The Frøya High north of 64°N until Middle Jurassic times was, similar to the adjacent Halten Terrace and Froan Basin, part of a depositional basin. By then, a tectonic reorganization started, which resulted in uplift and erosion of the high during the Late Jurassic. Wells in within the common database that penetrated the sandstones in the Melke Formation (Figure 2) indicate that erosion of the Frøya High started at the Callovian - Oxfordian boundary. Consequently, syn-rift Rogn Formation sandstones and Intra Melke Formation sandstones were deposited in the hanging wall along to the Vingleia Fault Complex. These syn-rift deposits were the targets of the wells (Figure 2), among them Pil and Bue discovery (6406/12-3S and 6406/12-3A, respectively), and were expected to form a reservoir also in the area of the Satus prospect.

In all wells along the western margin of the Frøya High Upper Jurassic sandstones occur. Wells drilled immediately west of the Frøya High within the common database (Figure 2) confirm occurrence of Intra Melke Formation and Rogn Formation sandstones of varying thickness. Sandstones of Oxfordian age are encountered in wells 6406/12-2 and 6407/10-1 along the margin of the Frøya High. Lower Tithonian sandstones are penetrated in the 6406/12-1 S, 6406/12-2 and 6407/10-2 wells. The absence of Tithonian sandstones in well 6407/10-1 was suggested to be a result of erosion or non-deposition.

The Upper Jurassic sandstones in well 6406/12-1S, 6406/12-5S, 6407/10-1, 6407/10-2 and 6407/10-5 were deposited in a shallow-marine environment. They are intensively bioturbated, well sorted, and without intercalating mudstone layers. Gravity-flow deposition with insignificant wave-reworking can be deduced for the sandstones in wells 6406/12-2, 6407/10-2. They consist of rapidly alternating sandstone and mudstone layers with sharp boundaries. Bioturbation is absent or at most weak. Sorting and reservoir properties in these wells are generally poorer than for the shallow-marine environment.

The area of Pil and Bue discoveries (Figure 2), comprised of point sourced fan deltas along the Vingleia fault complex, isolated turbidite channels and potentially local point sourced slope aprons, is assumed to receive sand from the Sklinna Ridge and Frøya High. The sand from the Frøya High was possible transported and deposited in a zone with considerable subsidence, which increased towards the northeast and well 6406/12-2, where the basin was so deep that debris-flow deposition occurred with little wave-reworking. In the area covering the PL794, there is no evidence of drainage systems with sand input to the prospect area. The seismic interpretation indicates a comparatively thin Viking Group succession in parts of the prospect, suggesting that the deposition here took place in a shallow-marine setting or experienced shallow-marine influence.

Seismic responses and trends within the common database were compared to the well results, and revealed that given relative good reservoir quality in the Upper Jurassic sandstones at this depth and a clear cap rock (e.g., wells 6406/12-3A 6406/12-3B and 6406/12-3S), fluid effect is expected to be visible on seismic. However, in case of tight sand (e.g., well 6406/12-2), fluid separation is very poor.

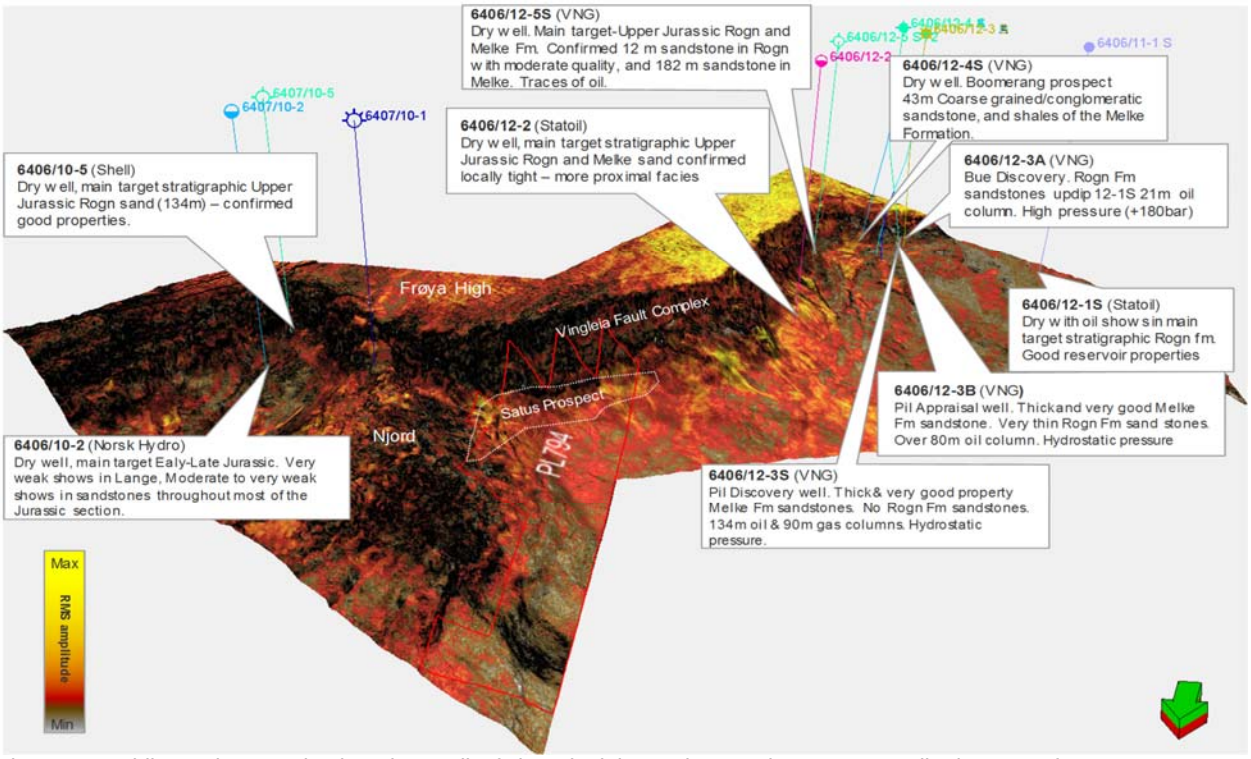


Figure 2a. Oblique view on the hanging wall of the Vingleia Fault Complex. RMS amplitude map of Base Cretaceous Unconformity, PL 794 limits and Satus prospect, and analogue wells in the hanging wall with Late Jurassic targets.

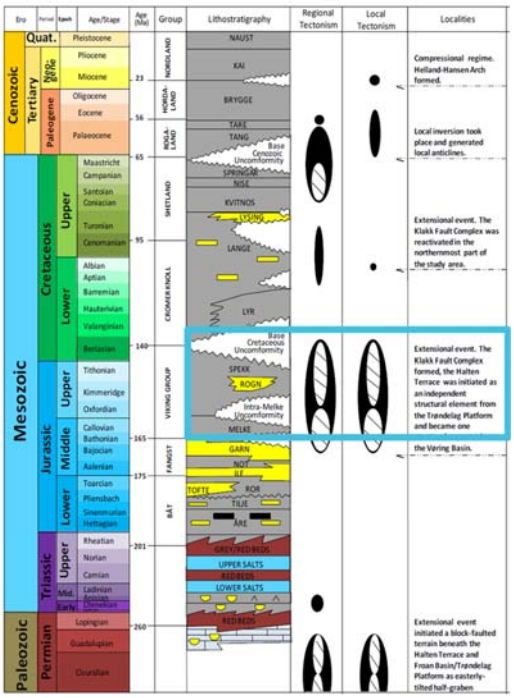


Figure 2b. Chronostratigrpahy with local techtonic events in the study area. Blue rectangle indicated the studied interval.

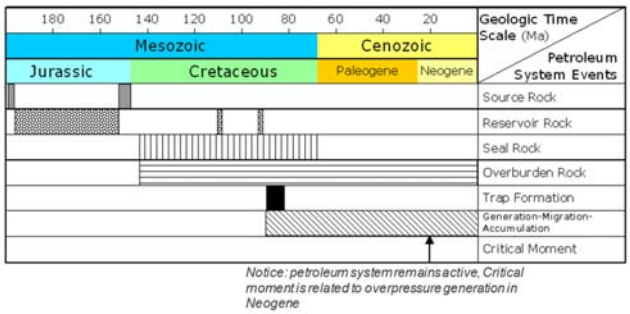


Figure 2c. Petroleum system event chart for the area. Hydrocrabon generation and expulsion occue mainly from upper Jurassic Spekk formation.

4 Prospect update report

PL794 was awarded based on the potential in the Satus prospect. Additional license prospectivity has been evaluated for the entire 3-D seismic data within the PL 794 boundaries in a course of G&G work.

Originally, the acreage applied for comprises part of the Frøya High and the area west and southwest of the Njord Field (Figure 3). One prospect and two leads were defined at two reservoir levels: Upper Jurassic and Triassic. The primary focus was on the Upper Jurassic Satus prospect, whereas secondary focus is on the Triassic Mini Blåhval and Grotte leads (located currently in PL 700B), total area of 136.8 km^2. The acreage awarded covers 67.5 km^2, where considering the maximum Satus prospect outline, 8% is located in the neighboring PL701 (Figure 3).

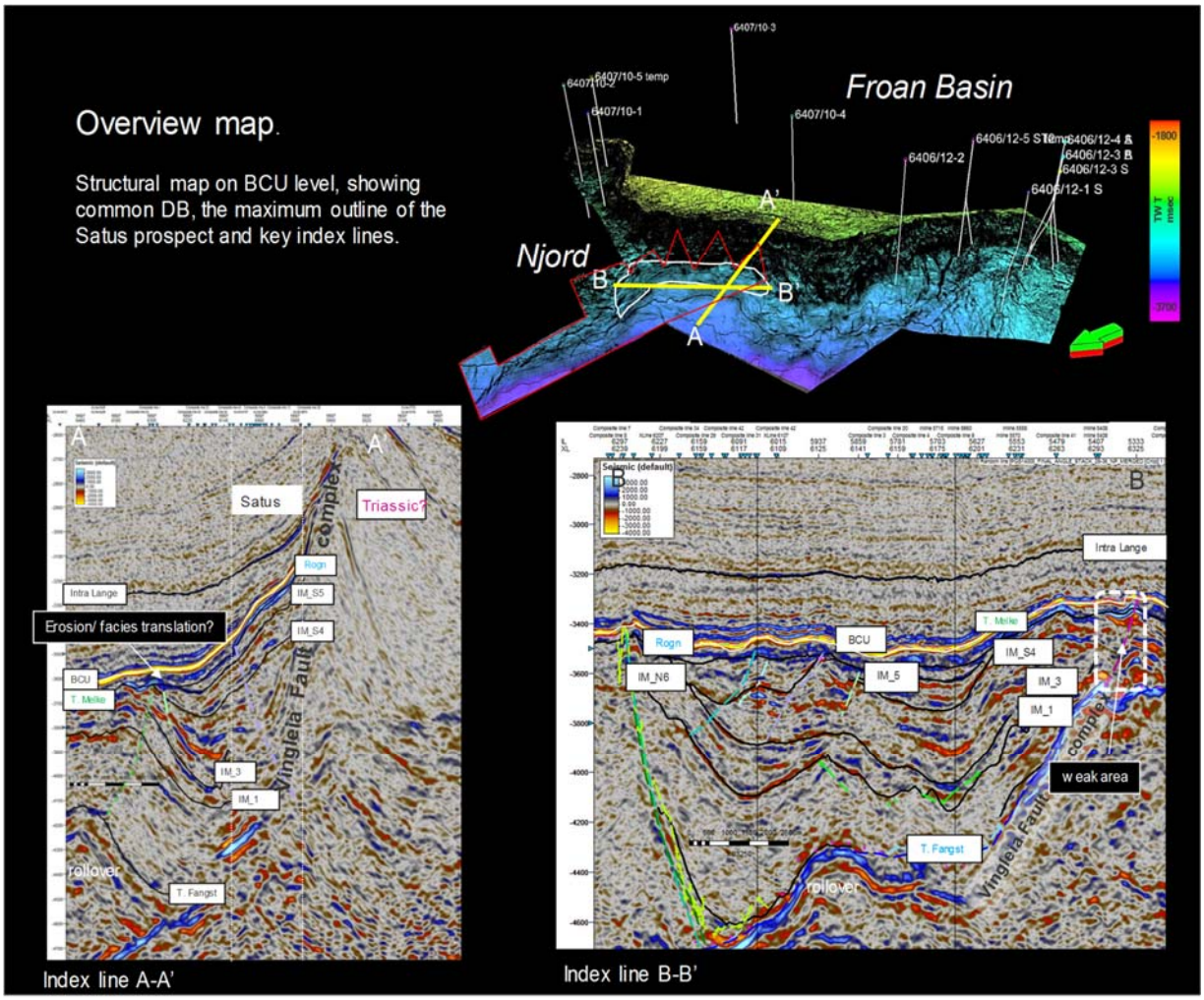


Figure 3. Oblique view to the hanging wall of the Vingleia Fault Complex (VFC) presented in the upper image (Structural time map of the BCU) and depositional concept for PL794 presented in dip (A-A') and strike (B-B') index lines; shown also VFC and local rollover structure controlling geometry of the Late Jurassic sediment deposits in the Satus prospect.

The Satus prospect is a hanging wall, syn-rift trap with a combined stratigraphic and structural trapping mechanism, forming a 26 km^2 closure area. Reservoir concept for the Satus prospect was based on the assumption that shallow marine Rogn sandstones deposited in the area are product of erosion of the high during the Late Jurassic. The prognosed Melke reservoir was based on a clear thickening seen in the seismic along the hanging wall, in immediate proximity to the Vingleia Fault Complex. The defined key risk for the prospect was trap seal, with additional risk on reservoir presence. Probability of success for Satus was 14,8% and calculated volumes were mean 3,84 MSm^3 recoverable oil.

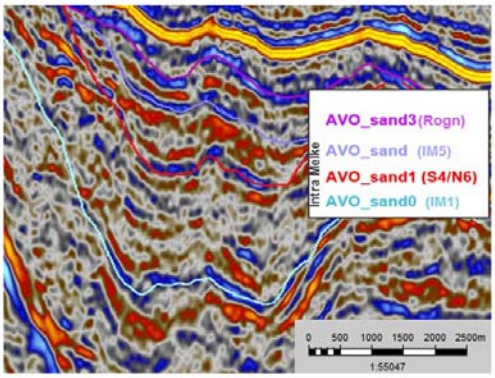
The structural elements in the PL794 area and around its main prospect Satus, are the result of a Mid- Jurassic – Early Cretaceous rift phase. A distinct rollover folding is recognized in the northern part of the Satus prospect (Figure 3), and is attributed to space problem during fault movement, causing local contraction. The existence of this rollover structure also affects the local geometry of the immediate hanging wall in the PL 794 area, dividing it into two mini-basins (Figure 3).

New mapping at the reservoir levels within the common database reveals that both the Melke and Rogn Formations show thick amalgamated successions of sediments (deposited from various gravity currents) in proximal position of the hanging-wall relative to the Vingleia Fault Complex (Figure 3). A lower stratigraphic wedge (Lower Melke Fm) that thins towards the fault records early fault-propagation, and an overlying, upper stratigraphic wedge (Upper Melke and Rogn Fms) that thickens towards the fault records at-surface faulting (Figure 3). During Late Jurassic, the Melke and Spekk Formations completed the pre-Cretaceous infill. Thick Melke reservoir confirmed in the wells of Frøya High/Vingleia Fault, suggesting that paleo-basin in syn-rift settings have accommodated large sediment infill.

In the current evaluation, the Satus prospect is thought to represent a short-head fan deltas/turbidite lobe deposits at the immediate hanging wall of the Vingleia Fault Complex (VFC) developed during Late Jurassic (Figure 2 and Figure 3). Main sediment supply route is assumed to be down the major fault system - VFC. Analysis of the material accounted in the 6406/12-3B and 6406/12-3A wells confirmed interval of late rift-aged deformed offshore material. However, reservoir quality, in particulary, sand presence and continuity pose key challenge along the entire proximal area of hanging-wall, including the Satus prospect.

Review of the Satus prospect after new mapping and dedicated depth conversion indicates: (a) apex of the prospect is at 3390 m, which is 42 m deeper than estimated initially; (b) a structural spillpoint has not been identified. The prospect is defined using hard bright reflection observed below Cretaceous Unconformity (BCU) (Figure 3). Structural dip of the prospect is to the north and to the west. Spekk Fm mudstones as thick as 40-60 m are interpreted to cap the Rogn Fm, providing the top seal. The base seal is provided by Melke Fm mudstones. To the north, the prospect is trapped by a combined structural stratigraphic mechanism; the trapping mechanism to the south is solely stratigraphic, dependent on a onlap onto a local high. Sealing here relies on sediment properties of the older (possibly Mid-Jurassic) strata, and as such, poses a high risk. Trap seal against the main/bounding fault (VFC) has also revealed high risk, as there is a high probability for: 1) juxtaposition against Triassic conglomerates accounted in the 6407/10-4 (Lorry) well; 2) juxtaposition against and possible communication with channels identified along the weathered basement.

Impedance layers within the Rogn and Melke sequences (Figure 4) were mapped and interpreted as sands, and AVO evaluated. Geophysical analysis confirmed sand presence in Rogn Fm, however, no fluid related anomalies were identified. Few thin sands (with no fluid related anomalies) were encountered in the thick Melke interval, suggesting that heterogenic sediments and not sandstones were deposited in the immediate hanging wall minibasins in the Satus prospect. It is, therefore, suggested that the proximal setting in relation to Vingleia Fault Complex may suffer from poor reservoir quality due to short sediment transport distance. These results imply that reservoir presence poses main risk for the prospect.



- Good layer definitions within the license. Mainly AVO class 1 type sands. Sand bodies observed and mapped based on impedance volumes, only sands mapped with good confidence have been AVO evaluated
- Sand0, Sand1 and Sand3: no fluid related anomalies
- Sand2: observed AVO class 2P in a small wedge with a possible 2 –way closure (area < 1 km^2).
- Deeper targets has been looked at but AVO evaluation is considered unreliable due to poor fluid effect

Figure 4. Summary of sand detection and consequent geophysical observations within Melke and Rogn Formations in Satus prospect.

Based on the overview of the regional pressure trend in the area coupled with high risk of reservoir presence in the Melke Fm in the Satus prospect, no conclusions can be drawn on the robustness of the trap or hydrocarbon charge into the closure. Consequently, updated prospect data is given in Table 4.

Screening for additional prospectivity shows depth conformant brightness and a possible 2-way closure at the Tilje level in the northern part of the license (Figure 5). This brightness may extend north- and west-wards outside the license borders. However, as it is located significantly deeper than recently drilled nearby (Njord Northflank wells) NF2 and NF3, it will imply substantially higher risk for reservoir quality. The nature of the brightness may also be related to might be related to changes in lithology and/or residuals.

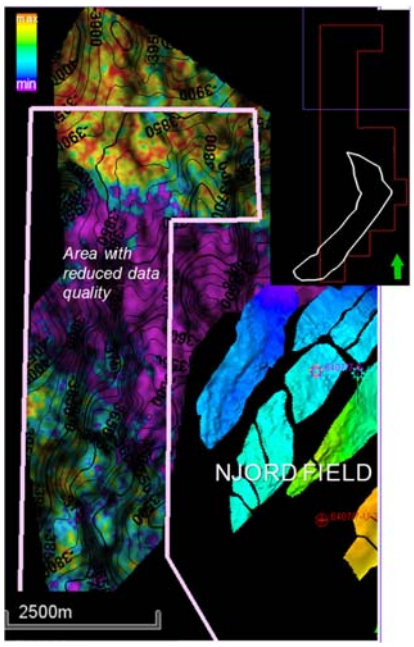


Figure 5. Overview map of the license and the rectangle indicating the Tilje Brightness in the Northern part of the PL794 in the upper right corner. Main map-Minimum amplitude map of Tilje Fm, where potential prospectivity has been mapped. Also shown the Njord Northflank 2 & 3 wells adjacent to the Njord Field.

Table 4: Prospect data (Updated)

Block	6407/7 & 6407/10	Prospect name	Satus	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 AS	Reference document	Relinquishment Report for PL794			Assessment year	2016
This is case no.:	1 of 1	Structural element	Frøya High	Type of trap	structural+stratigraphic	Water depth [m MSL] (>0)	330	Seismic database (2D/3D)	3D
Resources IN PLACE and RECOVERABLE									
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)	1,68	5,73	8,34	18,5				
	Gas [10^9 Sm^3] (>0.00)					0,25	0,86	2,39	2,76
Recoverable resources	Oil [10^6 Sm^3] (>0.00)	0,48	1,72	2,71	5,63				
	Gas [10^9 Sm^3] (>0.00)					0,074	0,25	0,37	0,87
Reservoir Chrono (from)	Tithonian	Reservoir litho (from)	Rogn Formation	Source Rock, chrono primary	Kimmeridgan	Source Rock, litho primary	Mudstones	Seal, Chrono	Tithonian
Reservoir Chrono (to)	Oxfordian	Reservoir litho (to)	Melke Formation	Source Rock, chrono secondary	Oxfordian	Source Rock, litho secondary	Mudstones	Seal, Litho	Shales
Probability [fraction]									
Technical (oil + gas + oil & gas case) (0.00-1.00)		Oil case (0.00-1.00)	0,80	Gas case (0.00-1.00)	0,20	Oil & Gas case (0.00-1.00)	0,00		
Reservoir (P1) (0.00-1.00)	0,60	Trap (P2) (0.00-1.00)	0,9	Charge (P3) (0.00-1.00)	0,90	Retention (P4) (0.00-1.00)	0,3		

Parametres:	Low (P90)	Base	High (P10)
Depth to top of prospect [m MSL] (> 0)		3390	
Area of closure [km^2] (> 0.0)	1,51	3,82	9,95
Reservoir thickness [m] (> 0)	31	52	80
HC column in prospect [m] (> 0)	118	203	352
Gross rock vol. [10^9 m^3] (> 0.000)			
Net / Gross [fraction] (0.00-1.00)	0,45	0,59	0,73
Porosity [fraction] (0.00-1.00)	0,13	0,14	0,16
Permeability [mD] (> 0.0)			
Water Saturation [fraction] (0.00-1.00)	0,22	0,30	0,38
Bg [Rm3/Sm3] (< 1.0000)			
1/Bo [Sm3/Rm3] (< 1.00)	0,67	0,68	0,69
GOR, free gas [Sm^3/Sm^3] (> 0)			
GOR, oil [Sm^3/Sm^3] (> 0)	133	157	181
Recov. factor, oil main phase [fraction] (0.00-1.00)	0,21	0,25	0,29
Recov. factor, gas ass. phase [fraction] (0.00-1.00)	0,21	0,25	0,29
Recov. factor, gas main phase [fraction] (0.00-1.00)			
Recov. factor, liquid ass. phase [fraction] (0.00-1.00)			

Comments:

1) Low and high values are P90 and P10, respectively, whereas Base is P50.
2) Retention (P4) implies risk on a Trap seal.
3) Upside recognized in the Melke Fm with Pg=4.5% for 4.22 MSm^3 mean recoverable.

For NPD use:						
Temperature, top res [^oC] (>0)	125	Innrapp. av geolog-init:	NPD will insert value	Registrert - init:	NPD will insert value	Kart oppdatert	NPD will insert value
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5 Technical evaluations

The Satus prospect located ca 5 km south of Njord Field and could have been of value to the Njord Field as a tie-back candidate in the event of a discovery. However, the geological probability of discovery is 12% for 2.71 MSm^3 mean recoverable. No technical economical evaluation has been performed on the Satus prospect due to the high risk and nonviable volume. Given a tie-in to the closest infrastructure, which is the Njord Field, the minimum economical volume would be 1.5-3.5 MSm^3 depending on the HC phase.

6 Conclusions

The prospect in the PL794 (40% Statoil equity) was the Satus prospect. The main risk for the Satus prospect is reservoir presence with additional risk on trap seal, no DFI observed. Due to the lack of prospects of economically viable size combined with the high risk, it has been decided to drop the license within 2017.