PL255B/C Licence Status Report

Summary

PL255B/C is in the Norwegian Sea on straddling the transition from the Sklinna Ridge and the southwestern Halten Terrace approximately 25 km south of the Kristin Field. The area has a long history and was originally applied for during the 16th NCS Concession Round and awarded, with A/S Norske Shell as Operator, as part of PL255 in 2000. PL255 contained several large Jurassic structures that have been tested by multiple wells with mixed results. A carve-out of the licence area outside the Linnorm discovery in 2016 lead to the formation of PL255B with Total E&P Norge AS as Operator. Equinor took over operatorship of PL255B in 2020 and a formal drill decision was taken on Tott West in 2021. Partial relinquishment in the wake of several disappointing well results of the remaining prospectivity in PL255B left only an area covering the untested Tott West prospect remaining.

Tott West was drilled in 2023 with exploration well 6406/5-2 ST2. The primary well objective was to test the Middle and Lower Jurassic Fangst and Båt Group sandstone reservoirs of the Garn, Ile and Tofte Formations. The well proved a gas/condensate column of 24 meters in the Garn Formation, with a gas water contact at 4170 m TVDSS. One 36 m core was acquired within the Garn Formation. The underlying Ile and Tofte formations were water-filled. Analysis of the acquired data and volume update of the Garn Fm. discovery indicated significant underfilling of the Tott West structure. Trap failure via leakage is considered the most significant contributor to underfilling. Whilst the Tott West discovery can be regarded a technical success, the proven resources are below the minimum commercial threshold to warrant development. With no other significant prospect potential identified within the PL255B/C area, the licence is seeking relinquishment of the acreage.

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1 Key Licence History

PL255B and PL255C are in the Norwegian Sea on straddling the transition from the Sklinna Ridge and the southwestern Halten Terrace approximately 25 km south of the Kristin Field (Figure 1-1). PL255B and PL255C cover 41 km^2 and 49 km^2 respectively in block 6406/5 and were awarded on 19.05.2016 and 10.02.2017 respectively. The partnership comprises Equinor Energy AS (35%, Operator), Total Energies EP Norge AS (35%) and Petoro AS (30%).

The licensed area has a long history. The area was originally applied for during the 16th NCS Concession Round and awarded, with A/S Norske Shell as Operator, as part of PL255 in 2000. PL255 contained several large prospective Jurassic structures, including the fault-bound Tott West structure in the current PL255B area. Shell drilled the first well 6406/5-1 T2 in PL255 to test the neighbouring Tott East (formerly Presidenten) structure in 2001/2, but the results were below expectations, encountering a minor underfilled accumulation in the Garn Fm. More successful results in PL255 were met in well 6406/9-1 with the Linnorm discovery in 2005, and subsequent appraisal wells 6406/9-1 A and 6406/9-2.

In 2016 the license voted to carve out the remaining prospective area outside of the Linnorm discovery from PL255, forming PL255B. Shell voted to exit the PL255B area later in 2016 and then Total E&P Norge AS took over operatorship of PL255B, with then Statoil Petroleum AS and Petoro AS as partners. A license extension to secure full licensed acreage coverage of the Tott West structure was applied for in APA2016 by the partnership and awarded in 2017 as PL255C. Partial relinquishment of the PL255B license occurred following the test of the Jasper structure by Total in 2018 leaving only an area covering the untested Tott West remaining in PL255B.

Equinor Energy AS took over operatorship of the license in 2020, and a formal drill decision was taken in PL255B on Tott West in 2021. Exploration well 6406/5-2 ST2 was drilled in 2023 by Equinor in PL255B, with the primary well objective to test the Middle and Lower Jurassic Fangst and Båt Group sandstone reservoirs in the Tott West prospect. The well made a minor gas/condensate discovery in the Garn Fm. and encountered the remaining reservoirs to be dry.

1.1 Licence Information

Licence:	PL255B	PL255C
Award Date:	19.05.2016	10.02.2017
Licence Expiry:	12.05.2038	15.05.2025
Licence Phase:	Production	Initial
Licensees:	Equinor Energy AS TotalEnergies EP Norge AS Petoro AS	35% (Operator) 35% 30%
Licence Area:	41 km^2	49 km^2

Conditions:	Study of geology and geophysics		Approved
		Decision to drill (Tott West)	01.11.2021
	Drill exploration well		
		(BoK) Decision to concretize	15.05.2024
		(BoV) Decision to continue	15.05.2024
	Conceptual studies		
	(PDO) Prepare plan for development		

1.2 Licence Meetings Held

Table 1-1: Licence meetings held

Date	License Meeting
15.06.2016	EC Meeting
11.08.2016	EC-MC Meeting No. 1
25.10.2016	EC-MC Meeting No. 2
16.02.2017	EC Work Meeting
25.04.2017	EC Work Meeting
15.05.2017	EC Work Meeting
01.06.2017	EC-MC Meeting No. 3
02.11.2017	EC-MC Meeting No. 4
15.12.2017	EC Work Meeting
13.03.2018	EC-MC Meeting
24.05.2018	EC-MC Meeting
30.07.2018	Major Accident Risk Workshop
14.08.2018	Drill Well on Paper / Spud Meeting
12.06.2018	EC-MC Meeting
18.01.2019	EC Work Meeting
17.06.2019	EC-MC Meeting
06.11.2019	EC-MC Meeting
11.11.2019	EC-MC Meeting
25.03.2020	EC Work Meeting
10.06.2020	EC-MC Meeting
08.10.2020	EC-MC Operator Handover Meeting
27.10.2020	Meeting with MPE
11.03.2020	EC-MC Meeting
16.03.2021	EC Working Meeting
13.04.2021	EC Work Meeting
28.06.2021	EC Work Meeting Site Survey
10.11.2021	EC-MC Meeting
04.04.2022	EC Work Meeting
07.06.2022	EC Work Meeting
15.11.2022	EC-MC Meeting
09.02.2023	EC Work Meeting
31.05.2023	EC Work Meeting

27.11.2023	EC-MC Meeting (Core Viewing)

1.3 Reason for surrender

The proven resources in PL255B are below the minimum commercial threshold to warrant development. A positive decision to concretize/continue (BoK/BoV) therefore cannot be taken by the license partnership. With no other significant prospect potential identified within the PL255B/C area the license is seeking relinquishment of the acreage.

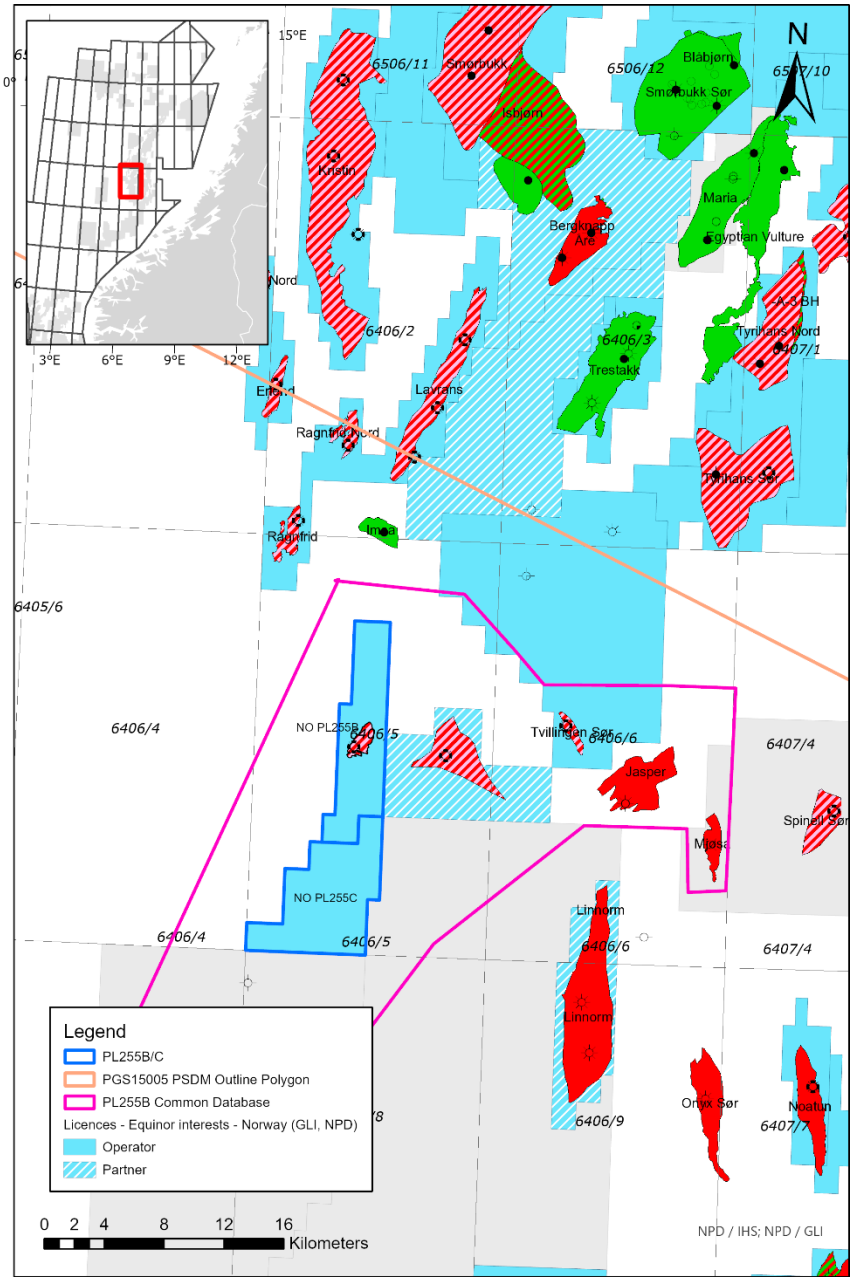

Figure 1-1: Location map for PL255B/C with discoveries, fields and exploration wells.

2 Database Overview

2.1 Seismic Data

The seismic data consists of 730 km^2 of the PGS15005 PSTM and PSDM data including full stack, angle stacks, pre- and post-migrated gathers (Figure 1-1). The vintage HWE95 seismic survey existing in the PGS15005 database area were also included into the common license database.

Table 2-1: 3D Common Seismic database

Survey	Year	Acquisition	Processing	Migration	Domain	Stacks	Area (km^2)	Quality
PGS15005	2015	PGS Geostreamer	PGS	Q PSDM	Time / Depth	Final full and angle stacks	730	Good
HWE95R01	2000	PGS	Shell	PreSDM	Time	Near, Full, Far	730	Moderate

2.2 Well Data

11 wells were included in the common well database (Table 2-2). These wells were used to understand the fluid and reservoir properties for the prospects in PL255B and to calibrate seismic data (including AVO) for prospect evaluation. Three additional wells have been drilled by the licence and are included in the table below.

Table 2-2: Common well database

Well	NODID	Completion Date	Content	Content Formation	TD Formation
6406/2-6	3407	07.11.1998	Gas/condensate	Ile, Tofte	Åre
6406/2-6A	4094	06.07.2000	Gas/condensate	Tofte	Tofte
6406/2-8	7618	05.05.2015	Oil	Tilje, Åre	Åre
6406/5-1 T2	4451	30.04.2002	Gas/condensate	Garn	Tilje
6406/5-2 ST2	9806	01.05.2023	Gas/condensate	Garn	Ror
6406/6-1	486	30.12.1985	Dry		Tilje
6406/6-2	5359	31.01.2007	Dry		Tilje
6406/6-3	7156	09.07.2013	Gas	Garn	Åre
6406/6-4 S	7658	30.10.2015	Gas/condensate	Garn	Tilje
6406/6-6 S	8550	16.11.2018	Gas	Ile	Ror
6406/6-6 A	8623	05.01.2019			Ror
6406/8-2	5435	08.04.2007	Dry		Tilje
6406/9-1	4927	02.06.2005	Gas	Ile, Tofte, Tilje	Åre
6406/9-2	5454	01.07.2007	Gas	Ile, Tofte, Tilje	Åre

3 Results of Geological & Geophysical Studies

The following G&G studies were carried out in the license evaluation:

- Seismic interpretation and mapping
- Geophysical observations and AVO assessment
- Prospect evaluation

3.1 Seismic Interpretation and Mapping

The PGS15005 PSDM DENOISED formed main 3D seismic dataset used for interpretation of the Tott West prospect and for pre-well volume/risk assessment and preparation for well placement. Seismic interpretation was carried out in the time domain. The nearby well 6406/5-1 T2 (Tott West) on the adjacent Jurassic horst block formed the basis for seismic interpretation of the reservoir intervals at Tott West. Four vertically stacked reservoir intervals were prognosed (Garn, Ile, Upper Tofte and Lower Tofte formations). The structural configuration of the horst blocks is such that it is possible to construct an unfaulted seismic tie-line to the nearby Tott East traversing to the south and around the graben that separates the two structures. The main seismic events shown to be continuous between Tott East and Tott West, thus allowing for a confident tie, were interpreted, including the Base Cretaceous Unconformity, Top Garn Formation, Top Ile Formation. Similarly, a seismic tie-line constructed to the 6406/8-2 (Hans) well along strike of the Tott West horst to the south was used to corroborate interpretations. At Hans however, the upper part of the Jurassic section, including the Garn Formation, is eroded by the BCU down to the Not Formation. This erosion influences the strength of both the BCU and Top Garn reflectors, and thickness of preserved Upper Jurassic sediments. At Tott East a thicker section of Upper Jurassic is preserved and the BCU reflector is relatively strong, but gradually weakens to the south and the Tott West area, disappearing in some places as the Upper Jurassic is thinned by visible erosion and truncation.

Key overburden seismic horizons to the seabed were also interpreted for velocity model building and pre-well geological prognosis. Overburden seismic horizons were tied to nearby offset reference wells. Horizons were depth converted using a horizon-based layered velocity model. This model was a merge of PSDM velocities down to Top Shetland, followed by well-derived interval velocities from multi-regression velocity analysis down to BCU, then constant interval velocities between BCU-Top Garn and Top Garn-Top Ile and the base of the model. The depth converted reservoir horizons were used as input for volume assessment of Tott West structure. The Base Garn Formation, Base Ile Formation, and Upper and Lower Top and Base Tofte Formation horizons were created using isochore relationships based on the observed thicknesses in the Tott East well, due to lack of strong seismic reflection character consistent across the area.

3.2 Geophysical observations and AVO assessment

Fluid substitution modelling using the Tott East well showed reflectivity to be similar independent of reservoir fluid content due to the high depth of burial. Only at the Top Garn level there is some difference between the brine and the gas/oil case. The difference between gas and oil is however too small to be able to distinguish between. Hence pre-well fluid AVO effects were not expected for Tott West.

3.3 Prospect Evaluation

4 Well Results and Post-Well Update Report

4.1 6406/5-2 ST2 Tott West

Exploration well 6406/5-2 ST2 targeted the Tott West prospect in PL255B. The primary well objective was to test the Middle and Lower Jurassic Fangst and Båt Group sandstone reservoirs of the Garn, Ile and Tofte Formations. The Tott West prospect comprised a large Jurassic horst block bound to the east and west by N-S striking faults and with a gentle dip to the south defining a structural 4-way dip closed trap. The main geological risk on the prospect was trap seal and reservoir quality, with a pre-well probability for hydrocarbons (gas or oil) in one or multiple reservoirs of 55%. The risk on trap seal was related to the expected high pressures and possibility for hydraulic fracturing in the immediate top seal resulting in leakage. Furthermore, due to the possibility for onlapping thin intra-Lange Formation sandstone intervals within the immediate overburden that may act as thief zones. Additional risk was placed on the reservoir due the possibility for reservoir quality deterioration via cementation associated with the deep burial depths (4000 – 4700 m) and high expected reservoir temperatures. Pre-drill uncertainty was placed on hydrocarbon phase based on variability in fluid type and GOR in nearby discoveries. Single-phase gas and oil cases where prognosed with equal likelihood. Separate hydrocarbon columns and contacts were prognosed for the Garn and Ile-Tofte reservoirs based on known pressure barriers between the formations in Tott East provided by shales of the Not Formation.

The well was placed in an area to the northwest of the structure of notably strong seismic amplitude response at Ile and Tofte levels. This localised and untested amplitude character, different from Tott East, resulted in pre-drill prognosis uncertainty. The pre-drill expectation from the amplitude character was for an Ile-Tofte reservoir “sweet-spot” with enhanced reservoir quality based on indications from quantitative seismic analyses. Testing this amplitude response formed an additional objective and driver for reservoir target location.

Deviations from the pre-well geological prognosis were largely within the expected uncertainty. Larger deviations seen for the Upper Cretaceous formation tops (e.g., Top Kvitnos, Lysing and Lange formations) are primarily attributed to picking errors due to poor seismic reflectivity and lack of strong seismic reflectors within the section making for challenging interpretation. The Top Garn reservoir came in 1 m shallow; however, the overlying BCU pick came in 23 m MD deep. The Spekk Formation was absent, and Melke Formation sat directly beneath the BCU as confirmed by biostratigraphic analysis. This deviation in prognosis is the result of increased erosion at the BCU than interpreted pre-well.

The well proved a gas/condensate column of 24 meters in the Garn Formation, with a gas water contact at 4170 m TVDSS. One 36 m core was acquired within the Garn Formation. The underlying Ile and Tofte formations were water-filled. Poor to moderate reservoir quality was encountered in the Garn Formation. Whilst good to very good reservoir quality was proven in the Ile and Tofte formations. Analysis of the acquired data and volume update of the Garn Fm. discovery concludes only a technical success, with proven resources below the minimum risked pre-well estimate. Trap failure via leakage is considered the most significant contributor to underfilling in the Garn Fm.

The Tott West Garn discovery outline is based on the intersection between the observed HCWC in 6406/5-2 ST2 and the interpreted top Garn Fm. reservoir structure map giving a 4-way dip-closed trap bound by faults to the northeast and west. Significant footwall erosion is observed along the bounding fault to the west, such that

the discovery outline reflects a combination of faulting and erosion. The discovery covers an area of 2.7 km^2, with a mapped apex at 4120 m MSL approximately 1.5 km NNE of the well location. Uncertainty in the top reservoir outline is small and is associated with structural and depth uncertainty away from the well location. No faulting within the discovery area that would serve to compartmentalize the reservoir is observed. The top seal is provided by Upper Jurassic shales of the Melke Fm. overlain by Cretaceous mudstones.

Indications of residual hydrocarbons throughout the reservoir sections point to a possible ancient deep filling history to the Tott West structure that has subsequently leaked rather than underfilling due insufficient hydrocarbon charge. Top seal failure and/or leakage through thin onlapping Intra-Lange Sandstone thief sands are postulated as the possible mechanism for post-filling leakage.

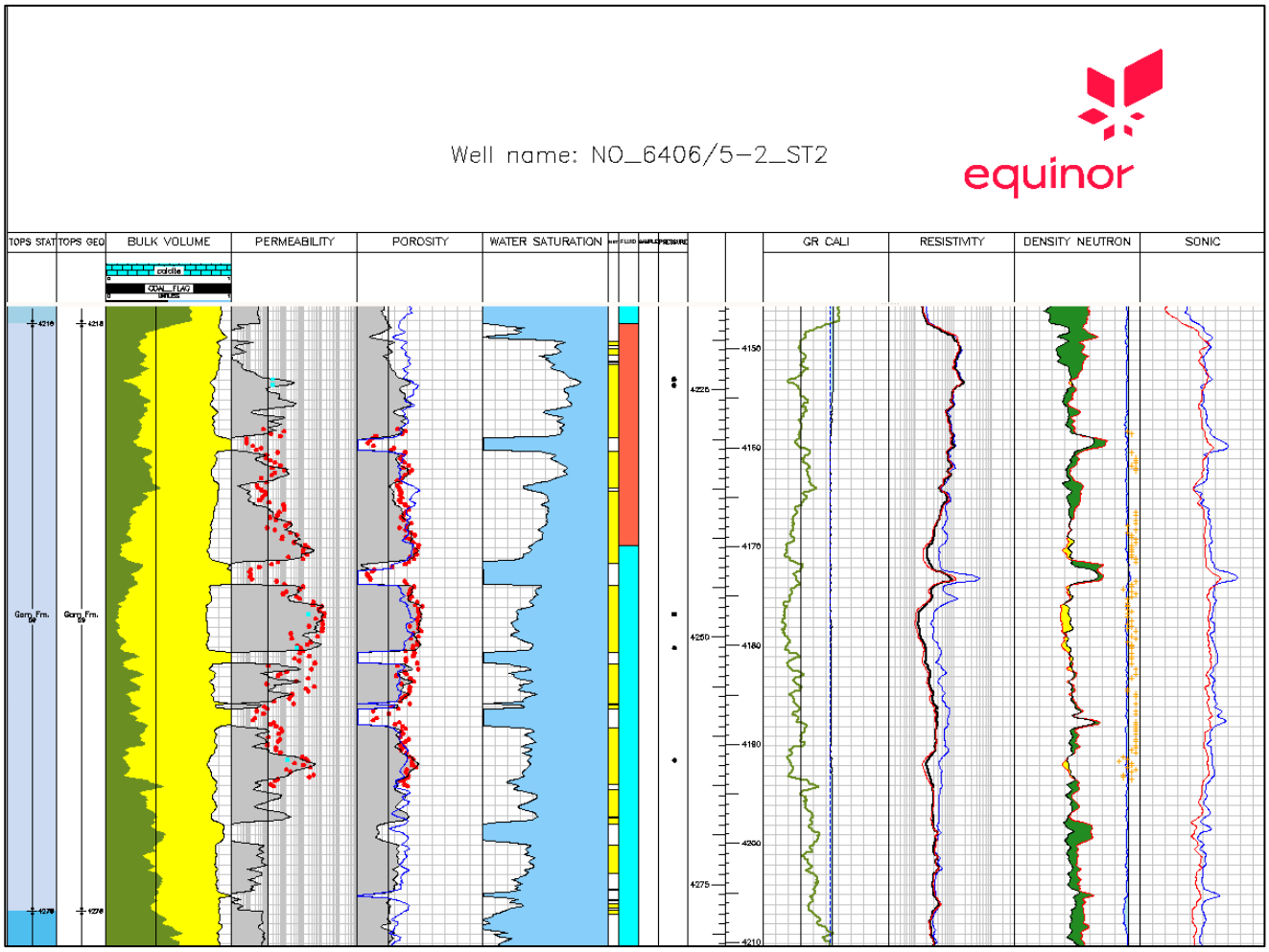

Figure 4-1 CPI plot Garn Fm.

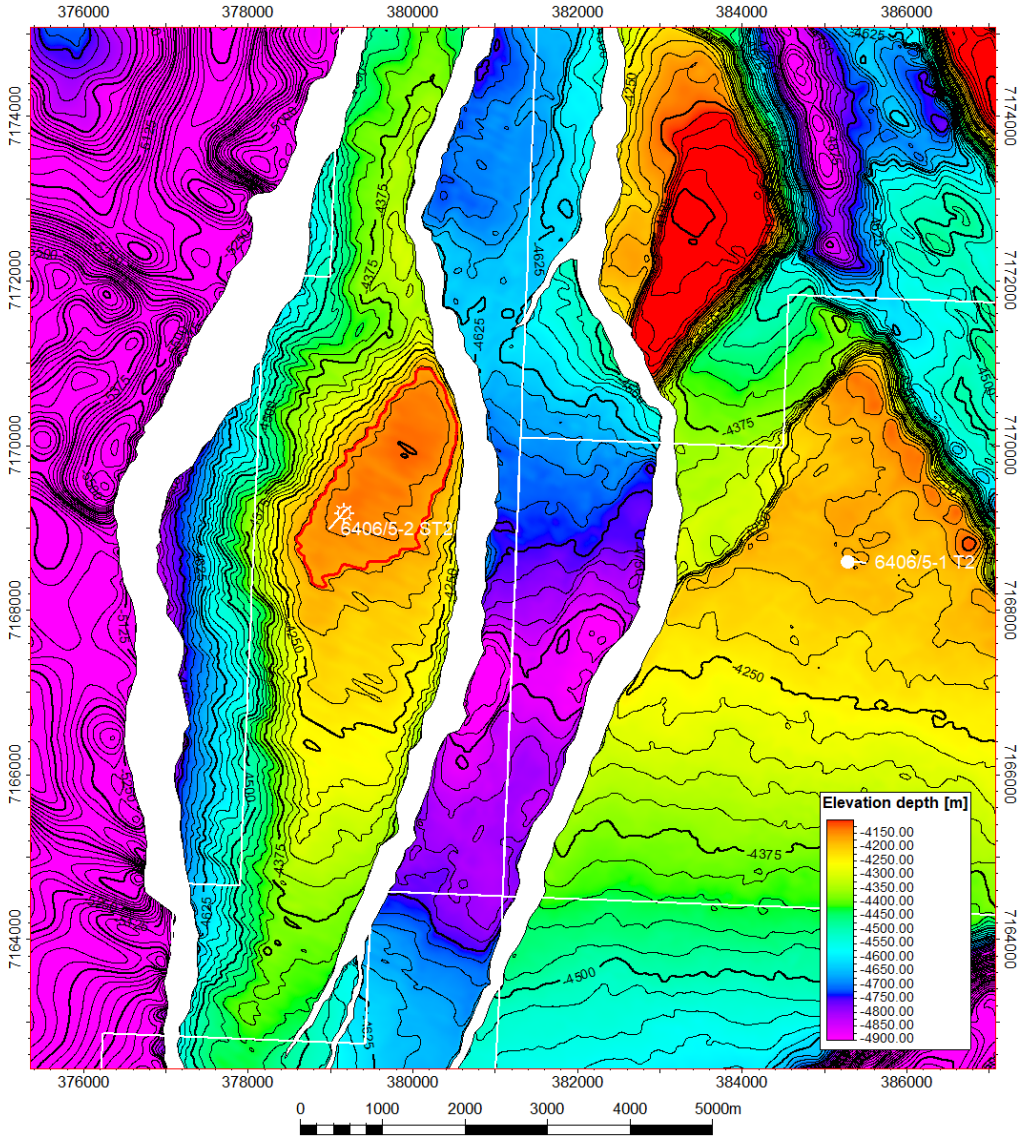

Figure 4-2 Top Garn Formation, post-well updated, structural depth map with fault polygons. Red polygon: TottWest discovery mean outline at GWC 4170 m TVDSS. Contour interval 25 m.

Table 4-1 Post-drill Garn Fm. discovery reservoir properties applied in volume calculations.

Reservoir Segment	Parameter	Minimum P(100)	Mean	Maximum P(0)
Garn Fm. Discovery	Area (km^2) at 4170 m TVDSS		2.69	
	Calculated gross thickness within discovery area (m)	-	56	-

	Gross Rock volume at 4170 m MSL (10^6 m^3)	37.5	55.8	76.5
	Net/Gross	0.67	0.75	0.82
	Porosity	0.13	0.15	0.17
	1/Bg [Sm^3/m^3]	321	360	399
	Cond. Yield [$Sm^3/10^6m^3$]	350	959	1600
	Gas Saturation	0.5	0.6	0.7

Calculated in-place volumes for the Tott West Garn discovery are shown in Table 4-2. The volumes are calculated from Monte Carlo simulations in GeoX using probability distributions functions defined for the input variables with associated uncertainty span listed in Table 4-1.

Table 4-2 Post-drill in-place resources in the Tott West Garn discovery.

Resource Phase	P100	P90	Mean	P10	P0
Main: Non-Associated Gas (10^9 Sm^3)	0.81	1.04	1.35	1.69	2.09
Associated: Condensate (10^6 Sm^3)	0.47	0.78	1.30	1.85	2.56
Total Resources (10^6 Sm^3 OE)	1.41	1.92	2.65	3.43	4.46

The recoverable volumes are shown in Table 4-3. The recovery factors are set with reference to analogues in nearby producing fields and provisional assumptions for potential development solutions.

Table 4-3 Post-drill recoverable resources in the Tott west Garn discovery.

Resource Phase	P100	P90	Mean	P10	P0
Main: Non-Associated Gas (10^9 SM^3)	0.20	0.28	0.40	0.53	0.68
Associated: Condensate (10^6 Sm^3)	0.12	0.21	0.37	0.54	0.78
Total Resources (10^6 Sm^3 OE)	0.38	0.54	0.77	1.02	1.36

5 Technical Evaluation

Discovered gas/condensate volumes within Tott West Garn are small and not commercially viable for field development.

6 Conclusion

Well 6406/5-2 ST2 tested the only defined prospect within the PL255B license. The post-well analysis has shown that the discovery is a failure given the small in-place volumes.

7 Appendix

Table 7-1: Tott West Discovery Data

Block	6406/5	Prospect name	Tott West	Discovery/Prosp/Lead	Discovery	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:	Gas	Reported by company	Equinor Energy AS	Reference document	PL255B/C Licence Status Report			Assessment year	2023
This is case no.:	1 of 1	Structural element	Halten Terrace	Type of trap	Structural	Water depth [m MSL] (>0)	304	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)					0.78	1.20	1.30	1.85
	Gas [10^9 Sm^3] (>0.00)	1.04	1.30	1.35	1.69				
Recoverable resources	Oil [10^6 Sm^3] (>0.00)					0.21	0.34	0.37	0.54
	Gas [10^9 Sm^3] (>0.00)	0.28	0.38	0.40	0.53				
Reservoir Chrono (from)	Jurassic, Bathonian	Reservoir litho (from)	Garn Fm.	Source Rock, chrono primary	Jurassic, Kimmeri	Source Rock, litho primary	Spekk Fm.	Seal, Chrono	Jurassic, Oxfordian
Reservoir Chrono (to)	Jurassic, Bajocian	Reservoir litho (to)	Garn Fm.	Source Rock, chrono secondary	Jurassic, Oxfordi	Source Rock, litho secondary	Melke Fm.	Seal, Litho	Melke Fm.
Probability [fraction]									
Total (oil + gas + oil & gas case) (0.00-1.00)	1.00	Oil case (0.00-1.00)	0.00	Gas case (0.00-1.00)	1.00	Oil & Gas case (0.00-1.00)	0.00		
Reservoir (P1) (0.00-1.00)	1.00	Trap (P2) (0.00-1.00)	1.00	Charge (P3) (0.00-1.00)	1.00	Retention (P4) (0.00-1.00)	1.00		
Parametres:	Low (P90)	Base	High (P10)	*Comments*					
Depth to top of prospect [m MSL] (> 0)	4120	4120	4120						
Area of closure [km^2] (> 0.0)		2.7							
Reservoir thickness [m] (> 0)		56							
HC column in prospect [m] (> 0)		50							
Gross rock vol. [10^9 m^3] (> 0.000)	0.038	0.056	0.077						
Net / Gross [fraction] (0.00-1.00)	0.67	0.75	0.82						
Porosity [fraction] (0.00-1.00)	0.13	0.15	0.17						
Permeability [mD] (> 0.0)	2.6	7.0	11.3						
Water Saturation [fraction] (0.00-1.00)	0.30	0.40	0.50						
Bg [Rm3/Sm3] (< 1.0000)	0.0025	0.0028	0.0031						
1/Bo [Sm3/Rm3] (< 1.00)									
GOR, free gas [Sm^3/Sm^3] (> 0)	625	1042	2857						
GOR, oil [Sm^3/Sm^3] (> 0)									
Recov. factor, oil main phase [fraction] (0.00-1.00)	0.08	0.12	0.16						
Recov. factor, gas ass. phase [fraction] (0.00-1.00)	0.08	0.12	0.16						
Recov. factor, gas main phase [fraction] (0.00-1.00)	0.24	0.29	0.35						
Recov. factor, liquid ass. phase [fraction] (0.00-1.00)	0.23	0.28	0.34	For NPD use:					
Temperature, top res [°C] (>0)	135			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)	766			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. PHIT > 0.1	3.					Kart nr	NPD will insert value