PL 604
Relinquishment Report

Blocks;
6706/7, 8, 9 & 6707/7

centrica energi

Statoil

SUNCOR

PL 604 Relinquishment Report

List of figures

1 Key license history

Summary
PL 604 was awarded as part of the 21st licence round on the 13th May 2011 with an initial period of 6 years (3+2+1) of which the first decision, a drill or drop, was due on 13th May 2014, Figure 1.1. The licence PL 604 was relinquished effective 13th May 2014.

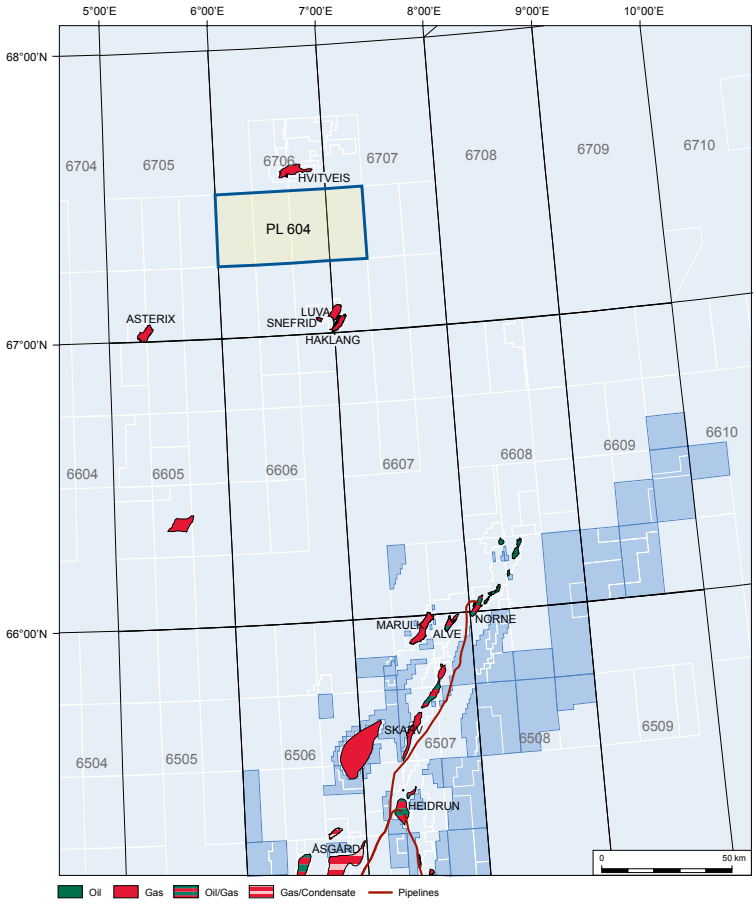

Figure 1.1 PL604 Location: Norwegian Sea, Blocks: 6706/7, 8, 9 & 6707/7

Particpants:
Suncor Energy Norge AS (50%, operator) with partners Statoil (40%) and Centrica (10%). Centrica's stake was acquired from Statoil subsequent to the award.

Work Commitment:
The work commitment was fulfilled by acquiring the 1793 km² SUN12NO01 3D seismic survey.

Meetings held:
MC meetings were held at least once a year in accordance with JOA article 2.1. Below is a list of EC and MC meetings held during the licence term.

1. ECMC meeting on 08/06/2011
2. ECMC meeting on 06/12/2011
3. ECMC meeting on 22/11/2012
4. ECMC meeting on 04/12/2013

Reason for relinquishment:
Prospectivity was identified within the licence area, but individual prospect COS (Chance of Success) were not sufficient to support a drill decision. The drop decision was unanimous amongst partners.

2 Database

The seismic database consisted of all publically available data, a number of purchased long offset 2D MNR lines, as well as the SUN12NO01 3D survey which was acquired by the licence group and fulfilled the licence work program. The latter survey in addition to the adjacent 3D datasets identified in Figure 2.1 were the main datasets used for the licence evaluation. The SUN12NO01 survey was pre-stack merged during processing with a portion of the PC10NO01 survey in order to achieve imaging of the entire licence on one survey.

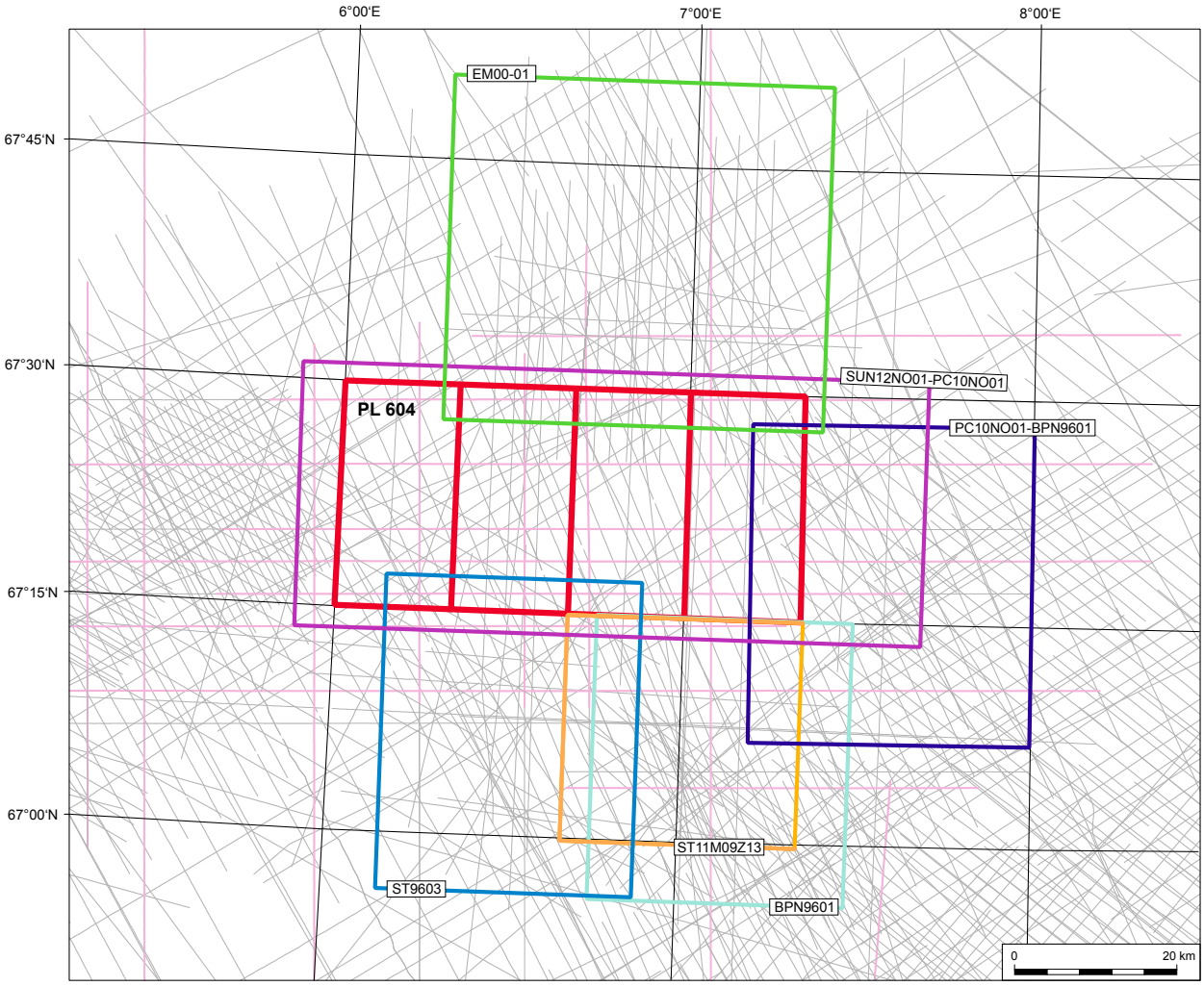

Figure 2.1 PL604 Seismic Database. The licence outline is shown in red. 3D surveys are labelled, purchased 2D lines shown in pink. Thin grey lines show the public 2D.

The newly acquired SUN12NO01 3D survey had greatly improved data quality over the older 3D and 2D surveys, however the licence is situated in an area of poor seismic imaging, due to the presence of volcanic sills and ooze formations that lie above the main target horizons. The Leonard and Salander prospects were significatnly impacted by this issue, which resulted in low confidence of the interpretation. Away from these areas data quality is reasonably good to base Tertiary level.

3 Review of geological framework

The bulk of the technical work was focused on the seismic interpretation of the newly acquired SU12NO01 3D dataset. The Tertiary interval was the main focus as the Cretaceous and older intervals were considered to be too deep for commercial purposes.
The Hel Graben was active during the Tertiary and contains a wedge of Paleocene sediment which thickens towards the center of the graben. The potential target reservoirs were turbidites in the Tang and Tare Formation. The reflector marking the sandy Egga Member of the Tang Formation was mapped in order to progress the pre-exisiting Leonard and Salander prospects (Figure 3.1).

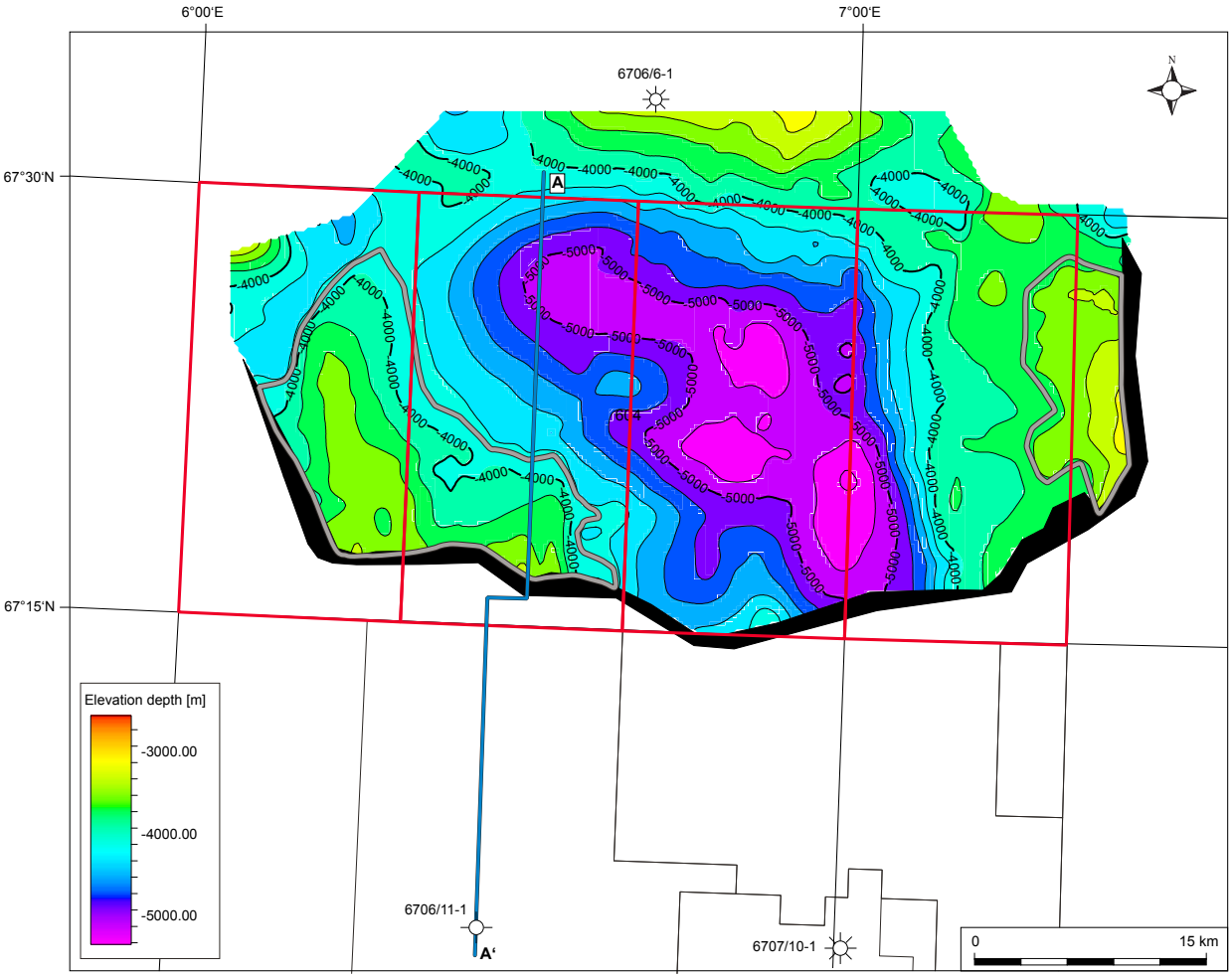

Figure 3.1 Top Egga structure. Depth in meters TVDSS. The updip pinchout of the Egga Member, shown as the thick black line at the southern and eastern edge of the colour filled contours, is the proposed updip trap for this play. The location of seismic line AA' is also shown.

While the final Salander prospect was similar in size to the one based on initial 2D seismic mapping, the Leonard prospect was significantly reduced in size following the 3D interpretation. A seismic line through the Leonard prospect (Figure 3.2) shows the prospect concept as well as the relatively poor data quality which contributed to a low chance of success. The poor data is largely due to the presence of volcanic sills above the target horizon. A class two seismic AVO response,

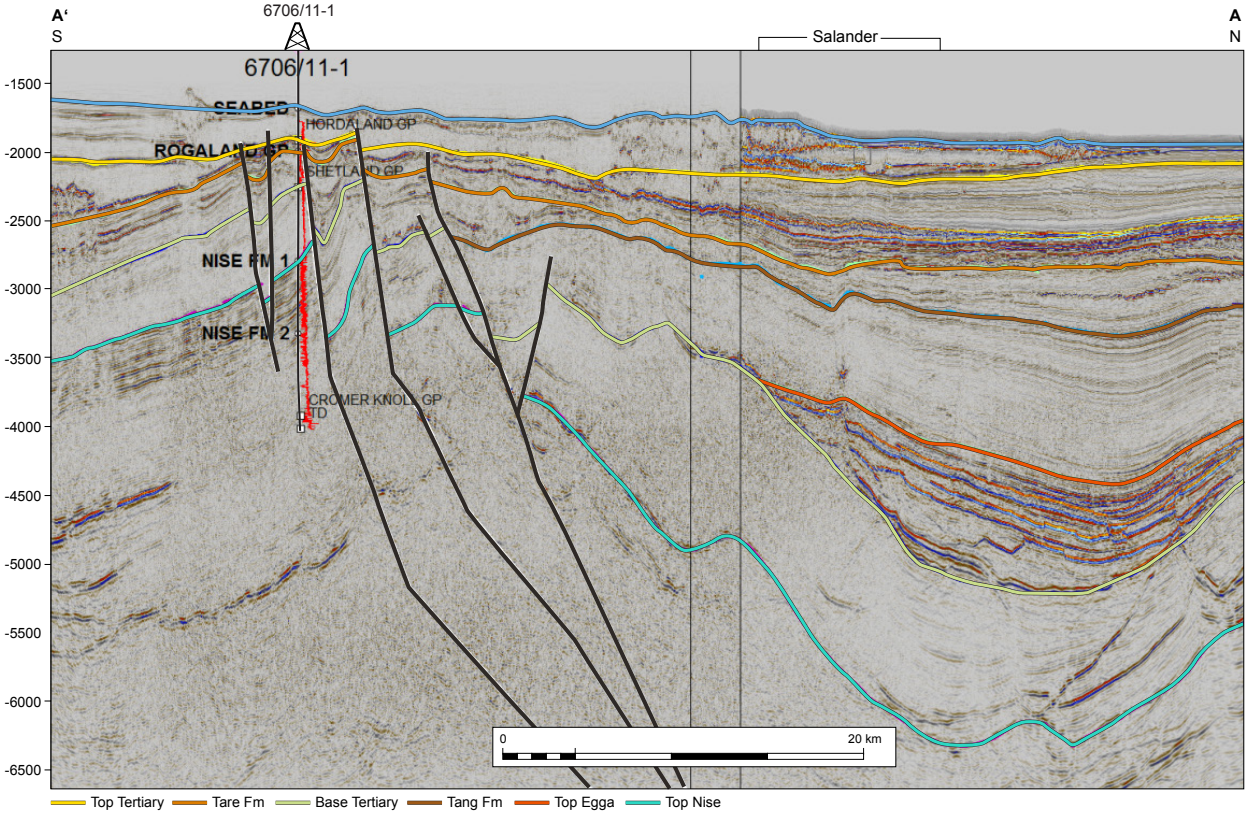

Figure 3.2 Seismic line AA' through the Salander prospect. The updip pinchout of the Egga Member conicides with an area of poor data, leaving significant trap risk for the Salander and Leonard prospects

indicative of reservoir presence at the 6706/6-1 well, is absent at the propsects, adding to reservoir risk.

Additional prospectivity was identified in the late Paleocene Tare Formation. Seismic interpretation of the SUN12NO01 3D revealed a large dome structure (Figure 3.3) which became the Dragon prospect. This structure is thought to have resulted from the late Cenozoic inversion which also gave rise to the Naglefar Dome.

The Dragon structure is associated with amplitude effects and a cross cutting event resembling a DHI. The tilted nature of the crosscutting event Figure 3.4 was the motivation for undertaking the pressure study, which concluded that hydrodynamics could explain the observed three degree tilt. Shallow depth and high risk of amplitude pitfalls reduced the attractiveness of this prospect.

Contractor studies acquired by the licence group:

1. Rock physics study for 7 wells, Cretaceous interval. Rock Solid Images, 2011. On License to share: PL604/Subsurface/Wells
2. Gravity and Magnetic data interpretation of PL604. ARKeX, 2013. On License to share: PL604/Subsurface/Geology and geophysics/Gravity and magnetics
3. Tare Formation pressure study, Ikon Science, 2013. On License to share: PL604/Subsurface/Geology and geophysics/Pressure

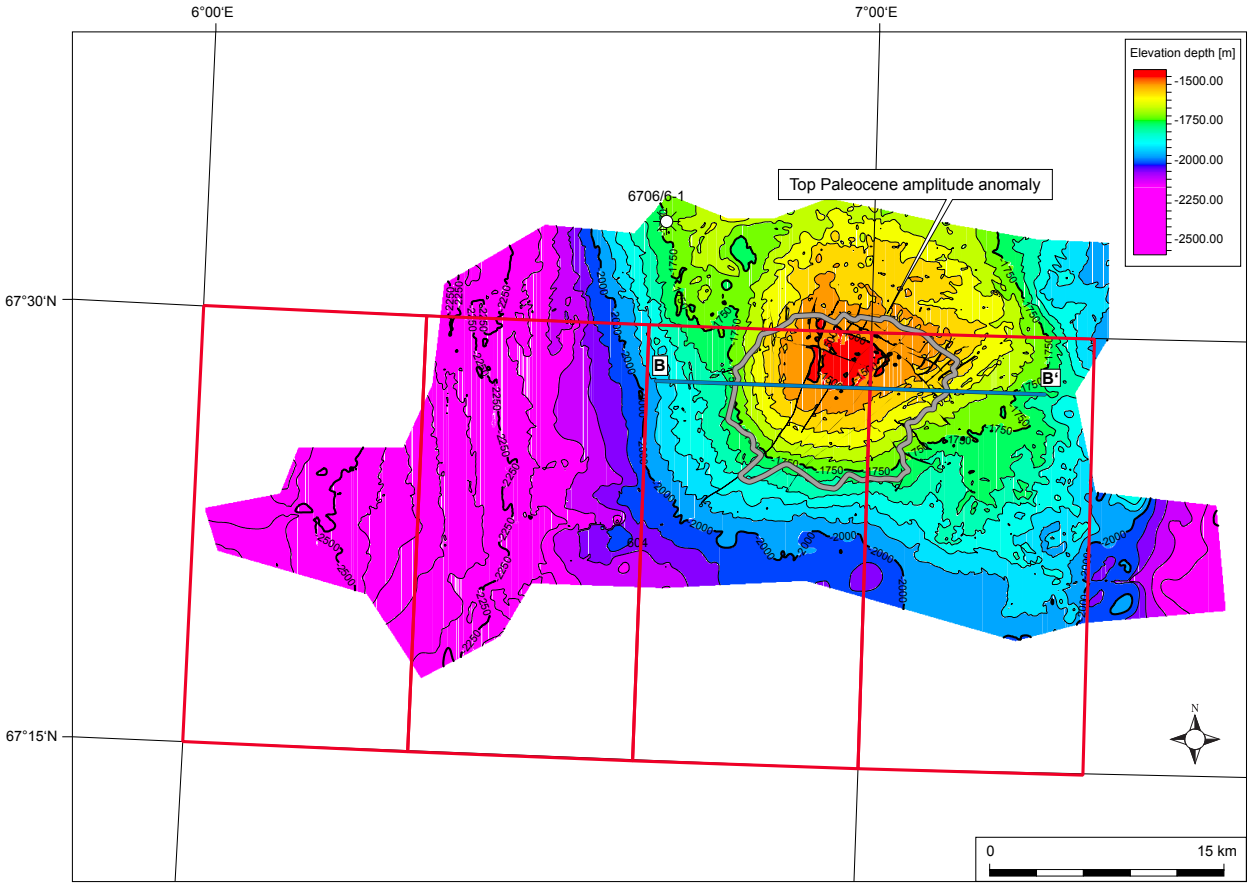

Figure 3.3 Top Paleocene structure. Depth in meters TVDSS. A four-way structural closure at this level forms the basis for the Dragon prospect

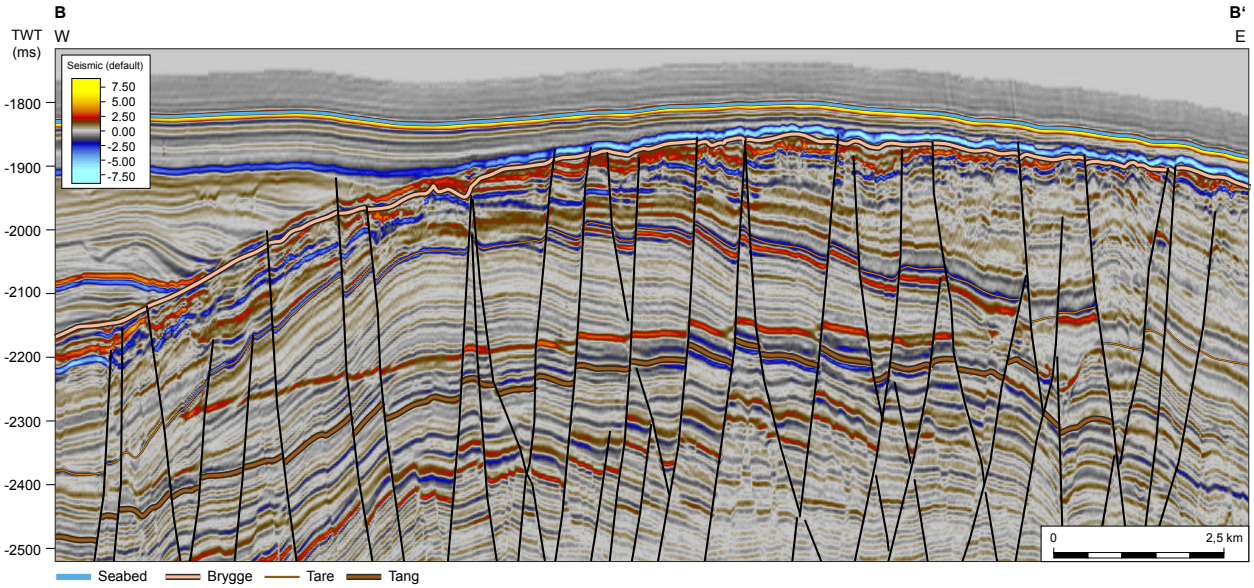

Figure 3.4 Line BB' showing the Dragon prospect. The Tare pick marks the top of the prospect.

4 Prospect update

Prospect Summary

The three prospects identified and assessed are shown in (Figure 4.1).

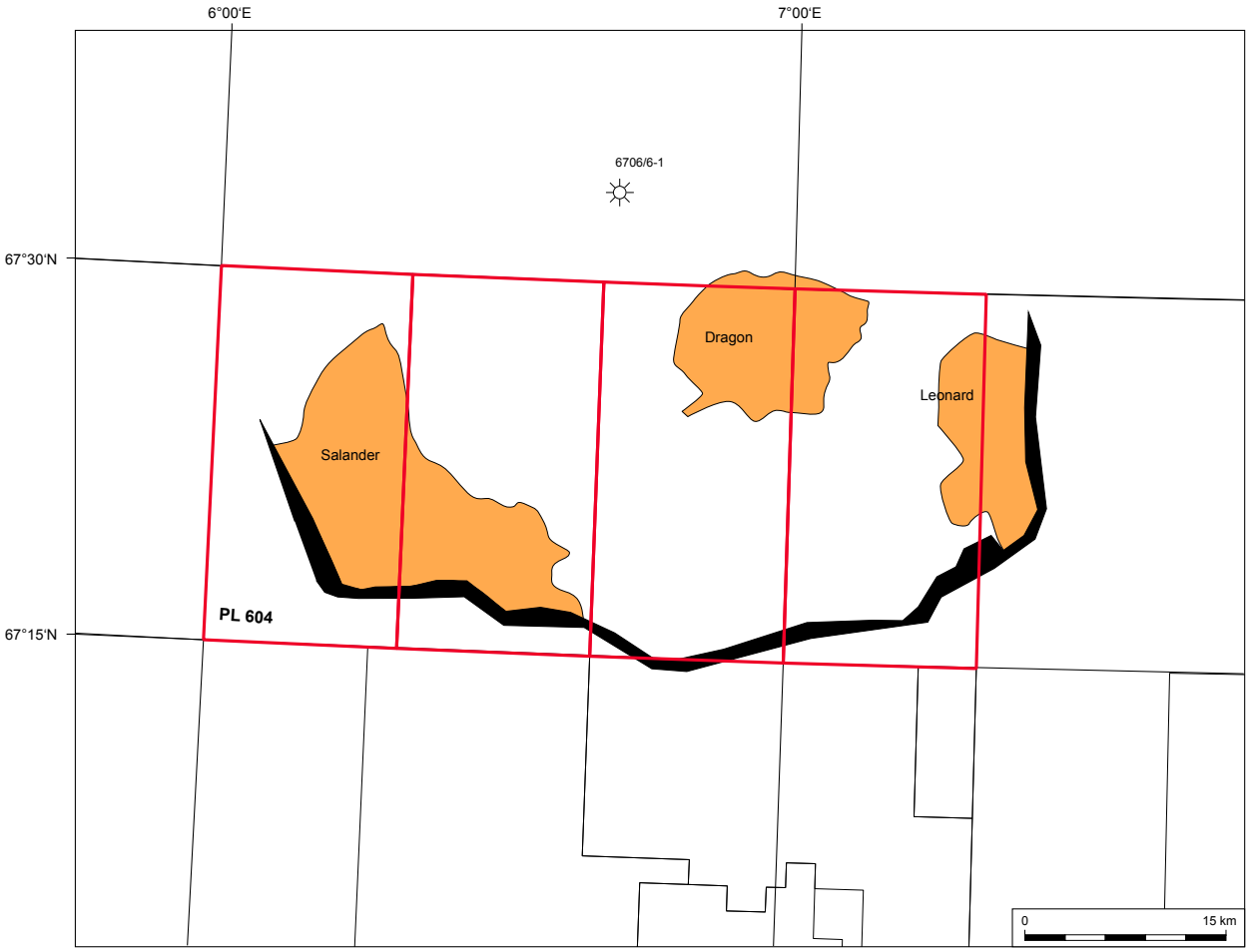

Figure 4.1 PL604 base map. Licence and prospect outlines

Leonard and Salander

- Leonard and Salander are large undrilled combined structural and stratigraphic features.
- Principle reservoir target is the Egga Member of the Tang formation which is gas charged in the nearby Hvitveis discovery.
- The source rock is unknown but proven by several nearby gas discoveries.

Critical Risk

- The key risk for both prospects is trap.
- The traps are poorly defined due to seismic imaging problems caused by intrusive volcanics.

Reserves and geological chance of success (COS)

- Salander Pmean reserves: 147 Bcm gas @ 8% COS (Figure 4.2).
- Leonard Pmean reserves: 42.3 Bcm gas @ 8% COS (Figure 4.3).

Dragon

- Large, four-way structural closure.
- Target reservoir: turbidite sandstone in Paleocene, Tare Formation.
- Potential seismic DHI: Tilted cross-cutting event with coinciding amplitude support at top reservoir.
- Shallow depth below seabed (200-300m at crest) makes gas phase unlikely as overburden could not contain column mapped between top reservoir and cross cutting reflector at base.
- Source rock is unknown but oil phase is inferred from tilted OWC: unreasonably high fluid flow would be required to introduce observed tilts in a GWC.

Critical Risk

- Shallow depth (200-300m below seabed) results in increased risk in seal.
- High charge risk related to potential biodegradation and low temperature.

Reserves and geological chance of success (COS)

- Pmean reserves: 59 x 10^6 Sm^3 @ 11%, with a recovery factor of 10 % (Figure 4.4).

Block	6706/7, 8	Prospect name	Salander	Discovery/Prosp/Lead	Prospect	Prosp ID (or New!)	NPD will insert value	NPD approved (Y/N)	No
Play name	NPD will insert value	New Play (Y/N)	No	Outside play (Y/N)	No				
Oil, Gas or O&G case:	Gas	Reported by company	Suncor Energy	Reference document				Assessment year	2013
This is case no.:	1 of 1	Structural element	Hel Graben	Type of trap	Stratigraphic	Water depth [m MSL] (>0)	1400	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)								
	Gas [10^9 Sm^3] (>0.00)	33,30	180,00	243,00	521,00				
Recoverable resources	Oil [10^6 Sm^3] (>0.00)								
	Gas [10^9 Sm^3] (>0.00)	20,00	108,00	147,00	317,00				
Reservoir Chrono (from)	Paleocene	Reservoir litho (from)	Tang Fm	Source Rock, chrono primary	Unknown	Source Rock, litho primary	Unknown	Seal, Chrono	Paleocene
Reservoir Chrono (to)	Paleocene	Reservoir litho (to)	Tang Fm	Source Rock, chrono secondary	Unknown	Source Rock, litho secondary	Unknown	Seal, Litho	Tang Fm
Probability [fraction]									
Technical (oil + gas + oil & gas case) (0.00-1.00)		Oil case (0.00-1.00)		Gas case (0.00-1.00)	0,08	Oil & Gas case (0.00-1.00)			
Reservoir (P1) (0.00-1.00)	0,60	Trap (P2) (0.00-1.00)	0,30	Charge (P3) (0.00-1.00)	0,70	Retention (P4) (0.00-1.00)	0,60		

Parametres:	Low (P90)	Base	High (P10)
Depth to top of prospect [m MSL] (> 0)	3500	3350	3200
Area of closure [km^2] (> 0.0)	51,0	110,0	210,0
Reservoir thickness [m] (> 0)	85	184	400
HC column in prospect [m] (> 0)	200	440	700
Gross rock vol. [10^9 m^3] (> 0.000)	2,800	13,600	31,200
Net / Gross [fraction] (0.00-1.00)	0,40	0,57	0,80
Porosity [fraction] (0.00-1.00)	0,10	0,17	0,30
Permeability [mD] (> 0.0)	100,0	700,0	1000,0
Water Saturation [fraction] (0.00-1.00)	0,23	0,30	0,40
Bg [Rm3/Sm3] (< 1.0000)	0,0040	0,0037	0,0034
1/Bo [Sm3/Rm3] (< 1.00)			
GOR, free gas [Sm^3/Sm^3] (> 0)			
GOR, oil [Sm^3/Sm^3] (> 0)			
Recov. factor, oil main phase [fraction] (0.00-1.00)			
Recov. factor, gas ass. phase [fraction] (0.00-1.00)			
Recov. factor, gas main phase [fraction] (0.00-1.00)	0,51	0,60	0,70
Recov. factor, liquid ass. phase [fraction] (0.00-1.00)			

Comments: Associated NGL was assumed to be negligible based on dry gas in nearby discoveries.

For NPD use:							
Temperature, top res [°C] (>0)	85	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)	335	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.	2.	3.			Kart nr	NPD will insert value

Figure 4.2 Salander prospects volumes and risk. Red highlights indicate changes from 21st round evaluation.

Block	6707/7	Prospect name	Leonard	Discovery/Prosp/Lead	Discovery	Prosp ID (or New!)	NPD will insert value	NPD approved (Y/N)	No
Play name	NPD will insert value	New Play (Y/N)	No	Outside play (Y/N)	No				
Oil, Gas or O&G case:	Gas	Reported by company	Suncor Energy	Reference document				Assessment year	
This is case no.:	1 of 1	Structural element	Hel Graben	Type of trap	Stratigraphic	Water depth [m MSL] (>0)	1400	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)								
	Gas [10^9 Sm^3] (>0.00)	18,20	53,00	69,90	142,00				
Recoverable resources	Oil [10^6 Sm^3] (>0.00)								
	Gas [10^9 Sm^3] (>0.00)	10,90	31,80	42,30	85,90				
Reservoir Chrono (from)	Paleocene	Reservoir litho (from)	Tang Fm	Source Rock, chrono primary	Unknown	Source Rock, litho primary	Unknown	Seal, Chrono	Paleocene
Reservoir Chrono (to)	Paleocene	Reservoir litho (to)	Tang Fm	Source Rock, chrono secondary	Unknown	Source Rock, litho secondary	Unkown	Seal, Litho	Tang Fm
Probability [fraction]									
Technical (oil + gas + oil & gas case) (0.00-1.00)		Oil case (0.00-1.00)		Gas case (0.00-1.00)	0,08	Oil & Gas case (0.00-1.00)			
Reservoir (P1) (0.00-1.00)	0,60	Trap (P2) (0.00-1.00)	0,30	Charge (P3) (0.00-1.00)	0,70	Retention (P4) (0.00-1.00)	0,60		
Parametres:	Low (P90)	Base	High (P10)	*Comments*					
Depth to top of prospect [m MSL] (> 0)	3200	3350	3500						
Area of closure [km^2] (> 0.0)	5,0	25,0	50,0						
Reservoir thickness [m] (> 0)	85	184	400						
HC column in prospect [m] (> 0)	100	200	300						
Gross rock vol. [10^9 m^3] (> 0.000)	1,600	3,900	8,300						
Net / Gross [fraction] (0.00-1.00)	0,40	0,57	0,80						
Porosity [fraction] (0.00-1.00)	0,10	0,17	0,30						
Permeability [mD] (> 0.0)	100,0	700,0	1000,0						
Water Saturation [fraction] (0.00-1.00)	0,23	0,30	0,40						
Bg [Rm3/Sm3] (< 1.0000)	0,0040	0,0037	0,0034						
1/Bo [Sm3/Rm3] (< 1.00)									
GOR, free gas [Sm^3/Sm^3] (> 0)									
GOR, oil [Sm^3/Sm^3] (> 0)									
Recov. factor, oil main phase [fraction] (0.00-1.00)									
Recov. factor, gas ass. phase [fraction] (0.00-1.00)									
Recov. factor, gas main phase [fraction] (0.00-1.00)	0,51	0,60	0,70						
Recov. factor, liquid ass. phase [fraction] (0.00-1.00)				For NPD use:					
Temperature, top res [°C] (>0)	85			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)	335			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.	2.	3.					Kart nr	NPD will insert value

Figure 4.3 Leonard prospect volumes and risk. Changed values are indicated with red highlighting

Block	6706/9, 6707/7	Prospect name	Dragon	Discovery/Prosp/Lead	Prospect	Prosp ID (or New!)	NPD will insert value	NPD approved (Y/N)	No
Play name	NPD will insert value	New Play (Y/N)	No	Outside play (Y/N)	No				
Oil, Gas or O&G case:	Oil	Reported by company	Suncor Energy	Reference document				Assessment year	2013
This is case no.:	1 of 1	Structural element	Hel Graben	Type of trap	Stratigraphic	Water depth [m MSL] (>0)	1100	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)	298,00	622,00	702,00	1208,00				
	Gas [10^9 Sm^3] (>0.00)					15,50	35,00	41,10	73,10
Recoverable resources	Oil [10^6 Sm^3] (>0.00)	24,90	58,90	71,40	133,00				
	Gas [10^9 Sm^3] (>0.00)					1,30	3,32	4,19	8,05
Reservoir Chrono (from)	Paleocene	Reservoir litho (from)	Tare Fm	Source Rock, chrono primary	Unknown	Source Rock, litho primary	Unknown	Seal, Chrono	Eocene
Reservoir Chrono (to)	Paleocene	Reservoir litho (to)	Tare Fm	Source Rock, chrono secondary	Unknown	Source Rock, litho secondary	Unknown	Seal, Litho	Brygge Fm
Probability [fraction]									
Technical (oil + gas + oil & gas case) (0.00-1.00)		Oil case (0.00-1.00)		Gas case (0.00-1.00)	0,11	Oil & Gas case (0.00-1.00)			
Reservoir (P1) (0.00-1.00)	0,70	Trap (P2) (0.00-1.00)	0,80	Charge (P3) (0.00-1.00)	0,40	Retention (P4) (0.00-1.00)	0,50		

Parametres:	Low (P90)	Base	High (P10)	*Comments*
Depth to top of prospect [m MSL] (> 0)	1500	1550	1600	
Area of closure [km^2] (> 0.0)	100,0	110,0	116,0	
Reservoir thickness [m] (> 0)	75	85	100	
HC column in prospect [m] (> 0)	100	150	200	
Gross rock vol. [10^9 m^3] (> 0.000)	7,500	10,000	12,000	
Net / Gross [fraction] (0.00-1.00)	0,30	0,50	0,80	
Porosity [fraction] (0.00-1.00)	0,15	0,23	0,35	
Permeability [mD] (> 0.0)	500,0	1500,0	3000,0	
Water Saturation [fraction] (0.00-1.00)	0,10	0,20	0,40	
Bg [Rm3/Sm3] (< 1.0000)				
1/Bo [Sm3/Rm3] (< 1.00)	0,94	0,94	0,93	
GOR, free gas [Sm^3/Sm^3] (> 0)				
GOR, oil [Sm^3/Sm^3] (> 0)	40	60	80	
Recov. factor, oil main phase [fraction] (0.00-1.00)	0,06	0,10	0,15	
Recov. factor, gas ass. phase [fraction] (0.00-1.00)	0,06	0,10	0,15	
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)	15			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)	155			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.	2.	3.					Kart nr	NPD will insert value

Figure 4.4 Dragon prospect volumes and risk.

5 Technical evaluations

All prospects were deemed too high risk to support a drill decision and therefore a full technical and economic evaluation was not conducted.

6 Conclusions

The evaluation of the newly acquired SUN12NO01 3D dataset showed the original play concepts to be valid however the prospects could not be sufficiently de-risked to meet the Licence group's drill criteria. A third prospect, Dragon, was indentified; however it also had a low COS due to its shallow depth and ambiguous seismic amplitude response. Given that no valid drilling candidates were identified, the partnership unanimously decided to relinquish the licence.