DONG energy

PL658/658B

Relinquishment Report

31 July 2015

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Ver. no. 01

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1. Key License history

Licenses PL658 and PL658B are located in the Northern part of the Hammerfest Basin and comprise blocks 7122/2 and part of blocks 7121/2, 3, 5 & 6, and 7122/1 & 4. The prospectivity in the license includes the Lower Cretaceous Knurr Formation (Gram prospect) and the Jurassic Realgrunnen Group (Navaren & Navaren East leads).

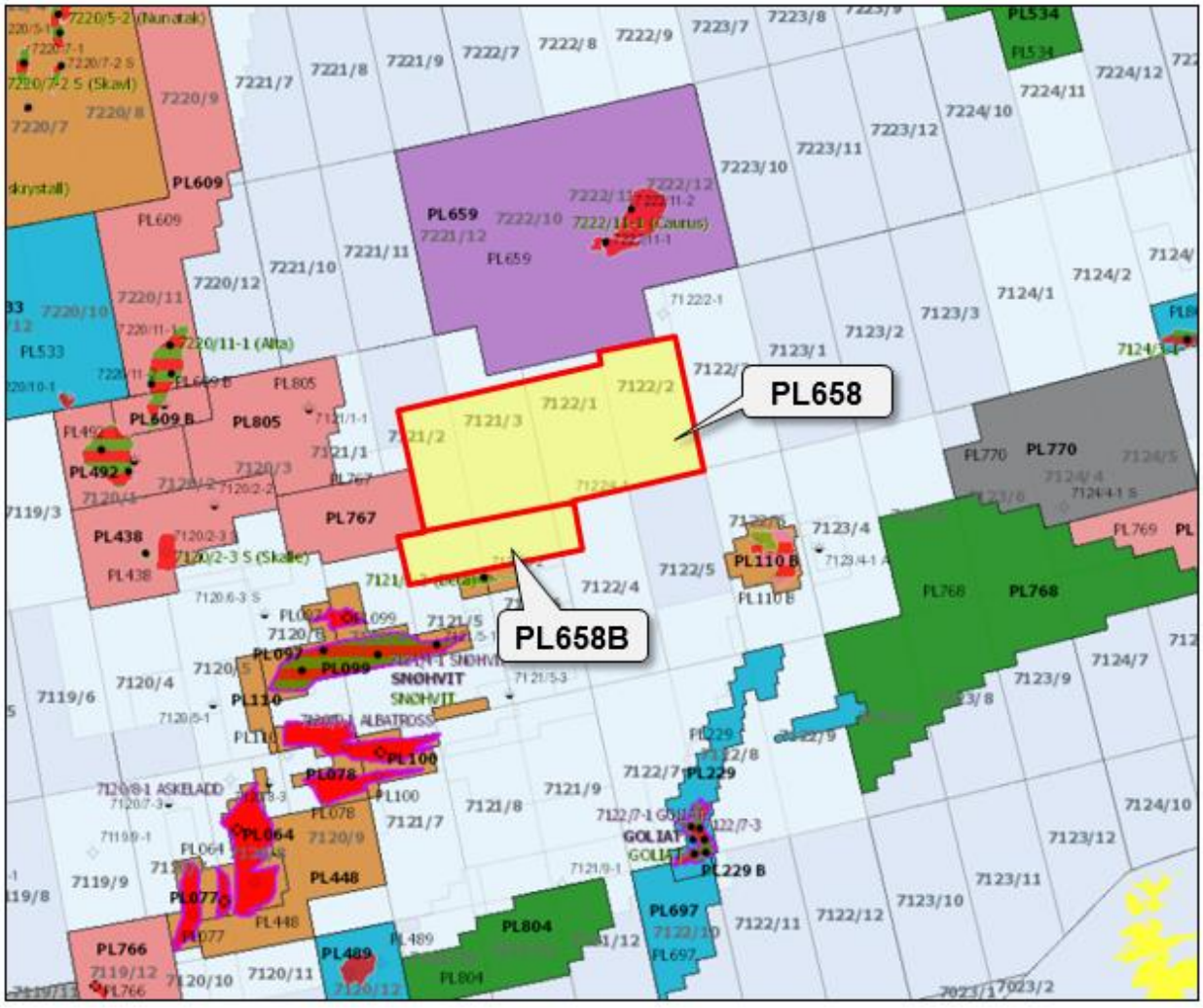


Figure 1. Location map

PL658 (block 7122/2 and parts of blocks 7121/2 & 3 and 7122/1) was awarded 3rd February 2012 as a result of the APA 2011 Round application. DONG E&P Norge was assigned as Operator 50% share, Repsol Exploration Norge 50%.
On 7th February 2014 PL658B (part of blocks 7121/5 & 6 and 7122/4) was awarded as additional acreage with the same ownership. This award was the result of an APA 2013 application.

Work commitments in the license were the following:

- Reprocess existing 3D seismic within 3rd February 2014
- Acquire additional 3D seismic in the NE of the license or relinquish the license within 3rd August 2014
- Evaluate and inform the authorities about the need for additional data/special studies within 3rd August 2014
- Drill or drop decision within 4 years from award
- Decision to concretize (BoK) or drop within 6 years from award
- Decision to continue (BoV) or drop within 8 years from award

An application for dispensation in acquiring additional 3D seismic data was submitted to NPD on 2nd July 2014. This was granted by the authorities on 3rd November 2014, and subsequently the drill or drop decision brought forward to 3rd May 2015.

The assessment of the license prospectivity shows that volumetric potential and/or geological risk are at levels that prevent the partnership committing to exploration drilling in PL658/PL658B. Prospects and leads identified in the license (Fig. 2) have been analysed to the level of irreducible risk. The Operator therefore recommended at the MCM No5 on 24th March 2015 to relinquish the license in full, in accordance with the timeline set forth by the OED, i.e. by the 3rd May 2015.

On the 21st April 2015 the Operator, DONG E&P Norge and the partner, Repsol Exploration Norge, applied to relinquish, in full, licenses PL658 and PL658B. A letter was received on 5th June 2015 in which the authorities state that PL658 and PL658B are considered relinquished from 3rd May 2015.

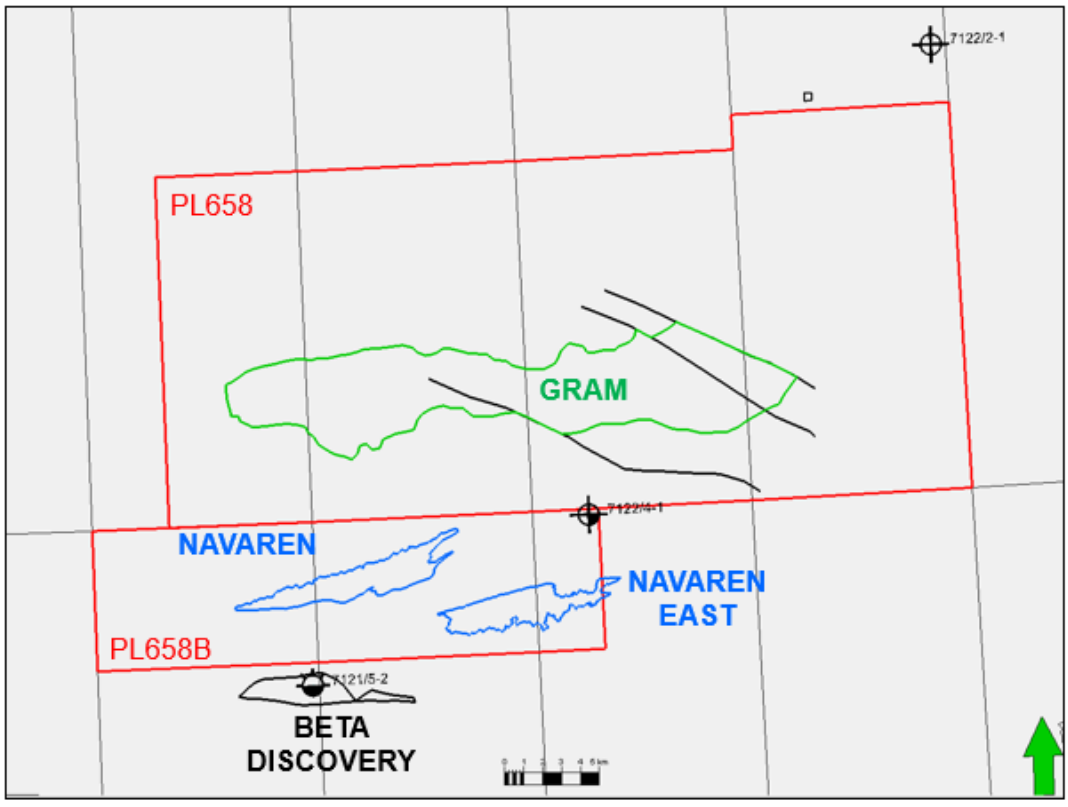


Figure 2. PL658/658B prospect/lead inventory

License meetings

Table 1. License Meetings 2012-2015

Meetings	Date
MCM & ECM No1	27.apr.12
ECM No2	04.sep.12
MCM No2 & ECM No3	22.nov.12
ECM No4	13.mar.13
License fieldtrip Piedmont (Italy)	22-26 apr. 13
MCM No3 & ECM No5	05.nov.13
MCM No4 & ECM No6	20.nov.14
MCM No5 & ECM No7	24.mar.15

2. Database

All public wells and seismic data in the area have been used in the evaluation of the license prospectivity (Table 2.). In addition, and as part of the license work program, DONG E&P Norge undertook the merge and reprocessing of two neighboring surveys (MC3D-SWN2008 & OMV09M01) that resulted in the 1) reducing the multiple response across the target, 2) amplitude preservation and 3) improved resolution. The increased resolution of this dataset, MC3D-SWNR13M, formed the basis for applying for dispensation in acquiring additional 3D seismic.

Table 2. Common database

Well data	2D seismic	3D seismic
7019/1-1	LHSG-89	OMV09M01
7120/1-2	NH9110	MC3D-SWN2008
7120/2-2	NBR07	MC3D-SWNR13M (license commitment)
7120/2-3S	NBR09	
7120/10-2	NBR10	
7120/12-1		
7122/2-1		
7122/4-1		
7020/1-1		
7020/2-1		
7020/8-1		
7120/12-2		
7121/1-1		
7121/4-1		
7121/5-2		
7121/7-2		

7122/6-1		
7122-7,3		
7122/11-1		

The common database includes 9 wells that penetrate the Knurr sequence and 11 wells that can be used for oil source correlation.

Special studies included in the evaluation of the prospectivity in the licence include Sintef 2008 (updated), FIS module 3&4, Ichron (Cretaceous Stratigraphy), Robertson study and the C&C Reservoir data base.

3. Review of geological framework

The Knurr Formation in the Hammerfest Basin is often shaley, but also demonstrates the development of some excellent reservoir properties along the margins. A general lithostratigraphic column of the southwestern Barents Sea is shown in Fig.3. The Knurr Formation sands are widespread across the Southern Norwegian Barents Sea, but are missing in the western and southern Finnmark Platform and in the Loppa High due to deep Tertiary/Quaternary erosion. The main identified prospect in the license, i.e. the Gram prospect, is likely to be formed by deep-marine sediments. Given the early Cretaceous configuration of the Basin, i.e. BCU deep erosion entry points (Fig. 4), the presence of an effective reservoir in the license is not considered to be a major risk factor for prospectivity.

The trapping mechanism however has been identified in the license as the main risk parameter for the Knurr play. As the upflank 7122/2-1 dry well proved a significant thickness of good reservoir sand (Fig. 4), a possible interlobe shale is therefore required in order to separate the different lobate bodies and provide a working side seal. The main focus of the G&G activities was to reduce the risk of lateral seal for the main Gram prospect.
Due to increased seismic resolution, an extended elastic inversion was performed with the reprocessed MC3D-SWNR13M data in an attempt to differentiate between turbiditic lobes and intra-formational shales. The principal results of the inversion (Fig. 5) suggest a continuous sand system along the Basin margin up to the 7122/2-1 well. The presence of a valid trap towards the Northeast is still seen as the main risk for the Knurr prospectivity in the license.
A clearer internal reservoir architecture is also identified from the reprocessed data. This has allowed for a frequency decomposition study to be undertaken, which was used to investigate for sedimentary features that could indicate different depositional environments, i.e. turbiditic fans vs. inter-fan shales.

An update of the basin model was also performed as part of the license work commitment in order to refine the expected hydrocarbon phase for the identified prospect and leads. The principal change, compared to the evaluation described in the APA 2011 application, is a change in the kinetics used in order to match the phases encountered in the surrounding fields and discoveries. Results suggest the presence of a higher portion of gas in the system compared to the original license application. Gram was subsequently modelled as a multi-phase case scenario with a 30% gas partition.

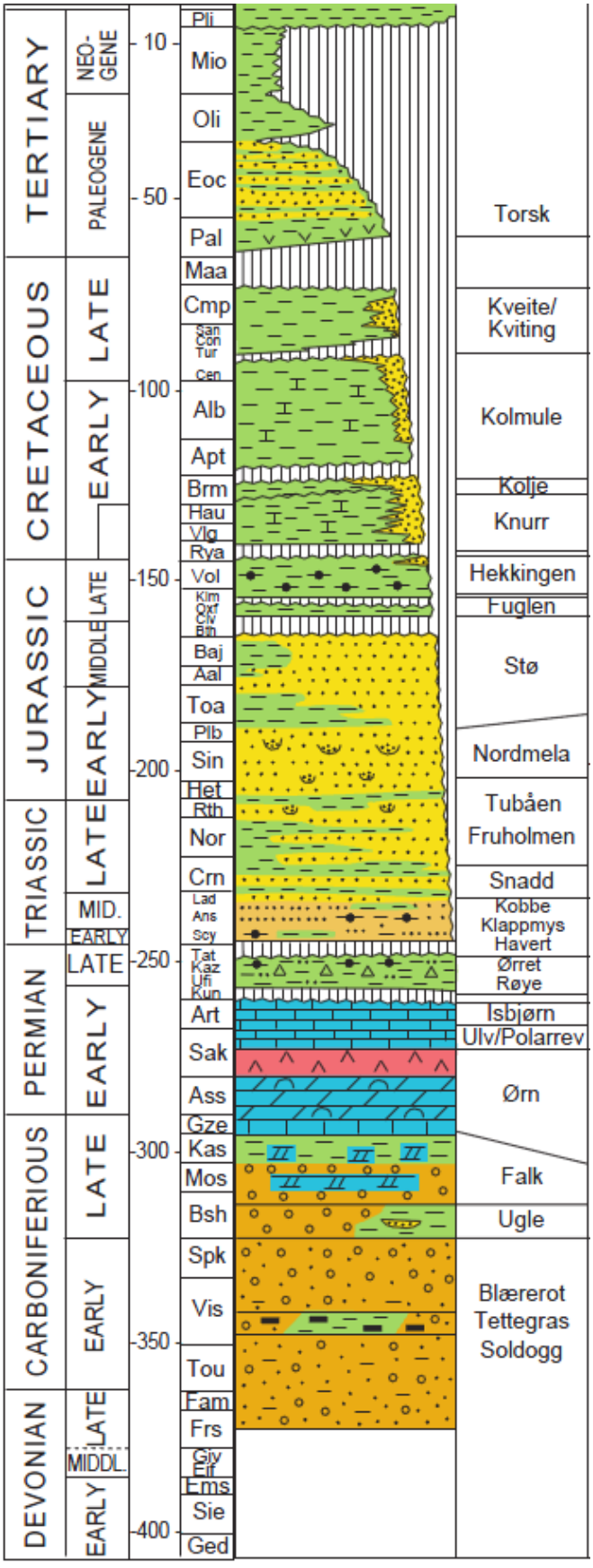


Figure 3. Generalized lithostratigraphic column of the Western Barents Sea

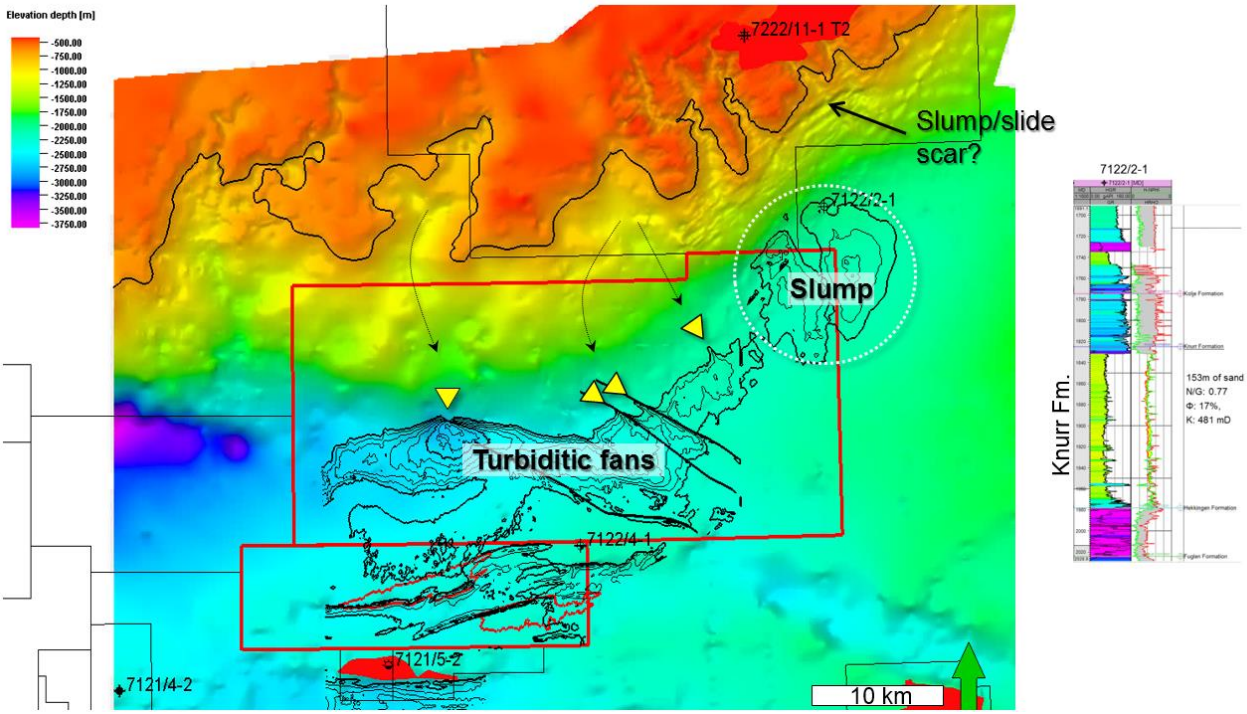


Figure 4. Regional Knurr Formation geological model. BCU depth map (m) draped with Knurr Formation isopach (C.I. 10m, >65m)

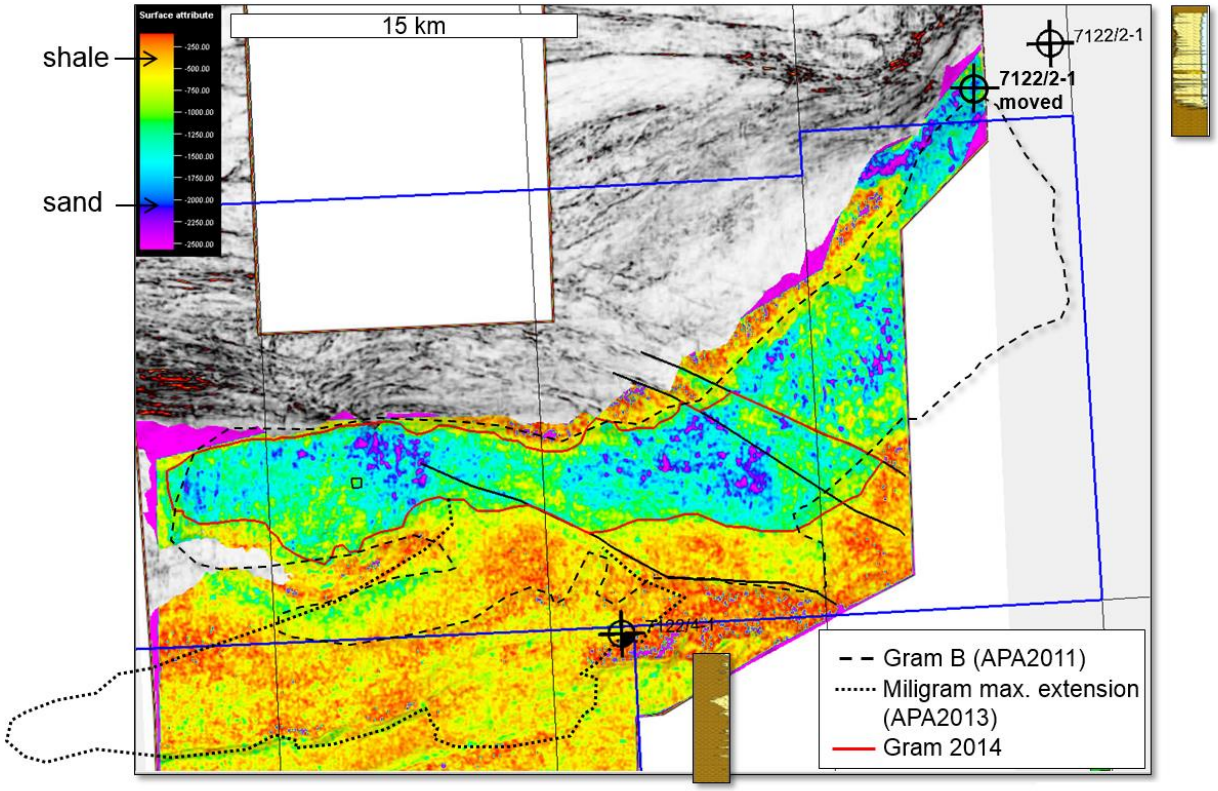


Figure 5. Extended elastic inversion - Sum of negative amplitudes

4. Prospect and leads update

Prospects and leads identified in the license (Fig. 2) include the Gram prospect (Lower Cretaceous Knurr Formation) and the Navaren & Navaren East leads (Jurassic Realgrunnen Group).

Gram prospect update

The Gram prospect is defined as an isopach thickening (Fig. 4) within a graben adjacent to the Loppa High. The seismic inversion undertaken on the reprocessed MC3D-SWNR13M data has allowed for better definition of top and base reservoir. The top of the sand body is at Near Top Knurr, and the base of the body is at Top Hekkingen. Top reservoir depth contours draped on the Knurr Fm. Isopach are shown in Fig. 6. As discussed previously, stratigraphic trapping towards the Northeast is seen as unlikely as there are indications of a continuous sand package without any distinct lateral seal possibility. The trapping style of this scenario is seen as a combination of stratigraphic pinch-out towards the South and a down-faulted trap towards the Northeast (Fig. 6 & 7). A fault seal is therefore required. As there is insignificant throw of the bounding fault close to the apex location (Fig. 7), retention of hydrocarbon is seen as the main risk for the prospect.

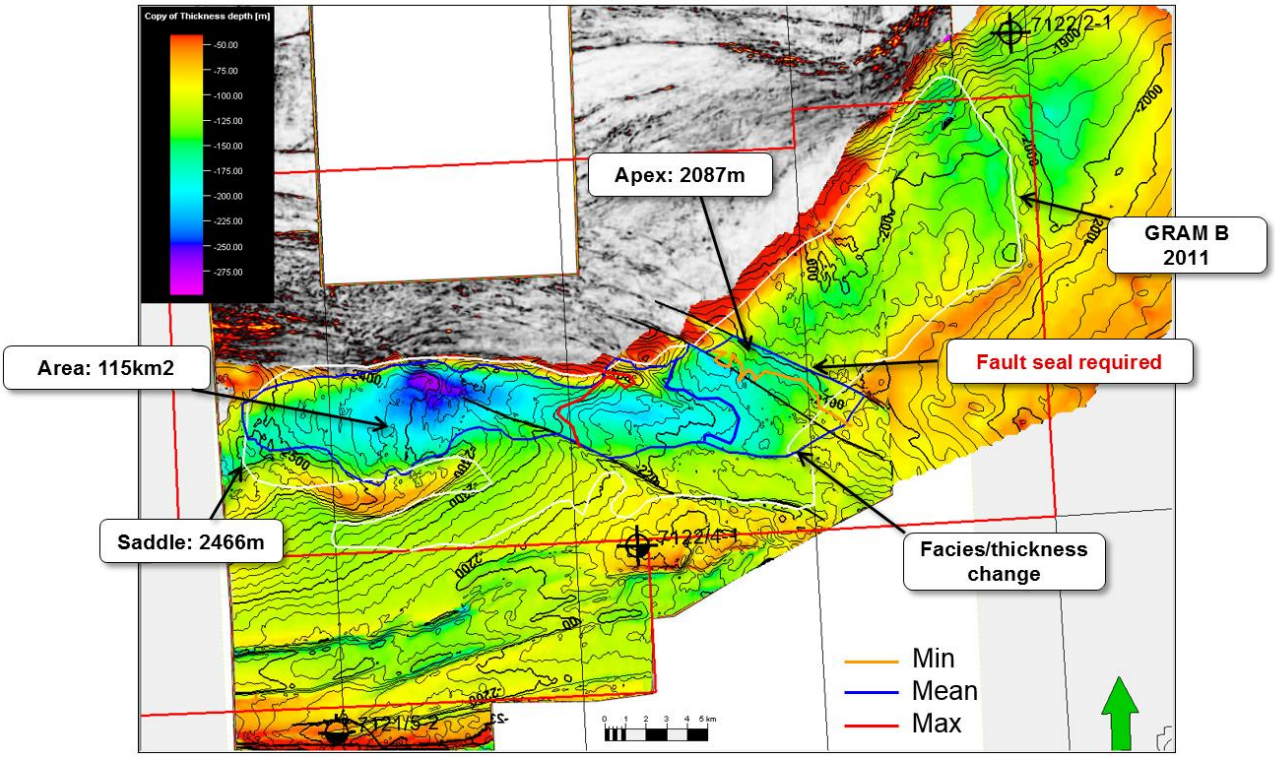
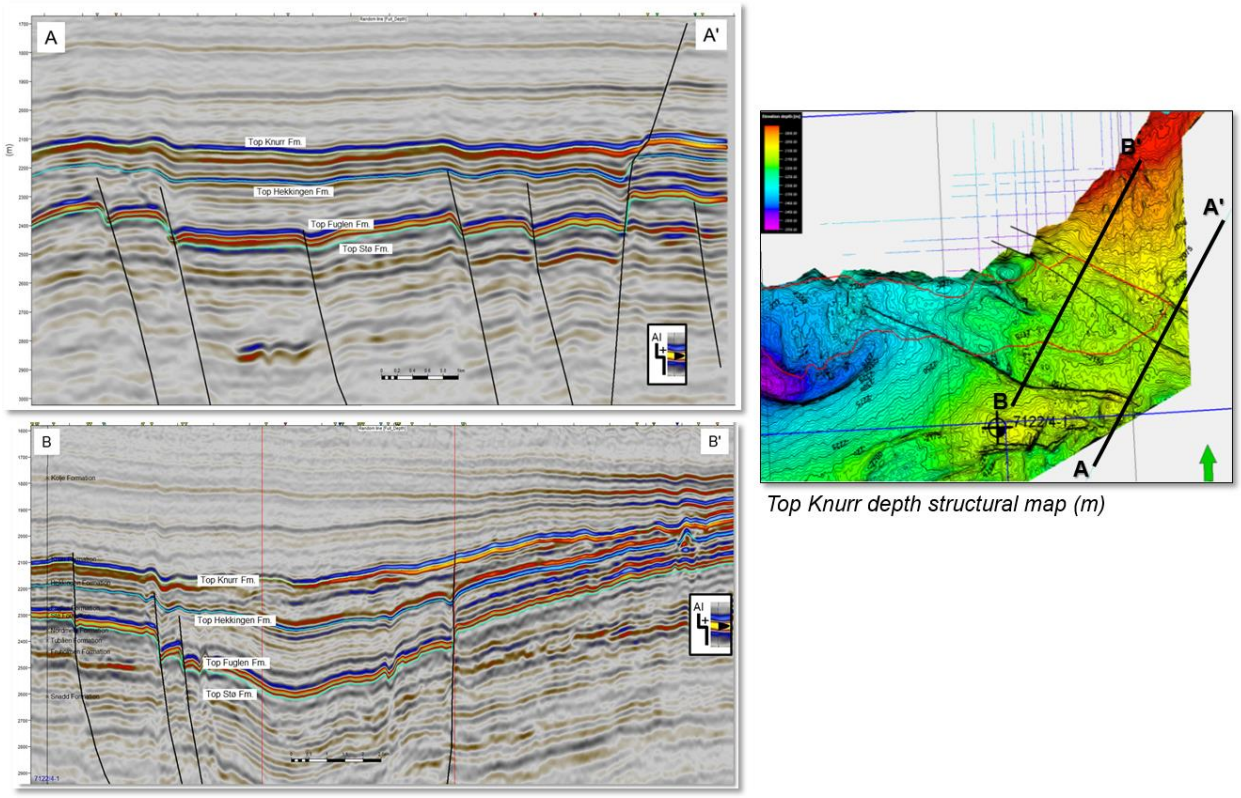


Figure 6. Top Knurr depth contours (20m) draped with Knurr Fm. isopach. Min, mean and max filling contacts.

Fill scenarios (Fig. 6) are mainly steered by the generated volume output from the extensive basin modelling study that was conducted. The expected phase for Gram is a mixture between gas (30%) and oil (70%).

The updated volume and risk numbers for Gram prospect are provided in Table 3.



Top Knurr depth structural map (m)

Figure 7. Seismic sections through the Gram NE bounding fault

Navaren prospect and Navaren East lead

The Navaren and Navaren East structures (Fig. 8 & 9) are defined as rotated fault blocks similar to the Snøhvit Beta discovery (7121/5-2). The basin modelling results suggest a charge limitation to the Navaren East lead, and a difficult migration route from both the North (7122/4-1) and the South (7121/5-2).

The Navaren prospect consists of a 3-way fault bounded closure with a spill point to the East towards the 7122/4-1 well. The Snøhvit Beta discovery (Fig. 9) provides the main analogue for the evaluation of Navaren's volumetrics (reservoir and fluid properties).

The geophysical evaluation of the prospect shows a depth conforming amplitude anomaly corresponding approximately to the structural spill point (Fig. 10). Fluid substitution and AVO modelling have been performed allowing for the inclusion of a DHI uplift to the prospect geological chance of success (Table 4). Based on the geophysical response and the similarities with the Snøhvit Beta discovery, gas is the expected phase.

As in the Snøhvit Beta discovery, the presence of H_2S represents an additional risk.

The volume and risk outputs for the Navaren prospect are provided in Table 4.

Block	7121/2 & 3, 7122/1 &2	Prospect name	Gram	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)	No	Outside play (Y/N)					
Oil, Gas or O&G case:	Oil&Gas	Reported by company	DONG E&P Norge	Reference document				Assessment year	2014
This is case no.:	1 of 1	Structural element	Hammerfest Basin	Type of trap	Combined	Water depth [m MSL] (>0)	312	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)	2,65	12,60	23,40	59,80	0,95	5,50	11,70	30,00
	Gas [10^9 Sm^3] (>0.00)	0,76	2,07	3,22	7,00	0,09	0,28	0,46	0,99
Recoverable resources	Oil [10^6 Sm^3] (>0.00)	0,83	4,95	10,90	29,10	0,21	1,76	4,81	12,80
	Gas [10^9 Sm^3] (>0.00)	0,52	1,45	2,29	5,04	0,05	0,15	0,25	0,55
Reservoir Chrono (from)	Ryanzanian	Reservoir litho (from)	Knurr Fm	Source Rock, chrono primary	Hekkingen Fm	Source Rock, litho primary	Shale	Seal, Chrono	Upper Hauterivian
Reservoir Chrono (to)	Hauterivian	Reservoir litho (to)		Source Rock, chrono secondary		Source Rock, litho secondary		Seal, Litho	Shale
Probability [fraction]									
Total (oil + gas + oil & gas case) (0.00-1.00)	0,10	Oil case (0.00-1.00)		Gas case (0.00-1.00)		Oil & Gas case (0.00-1.00)			
Reservoir (P1) (0.00-1.00)	0,90	Trap (P2) (0.00-1.00)	0,40	Charge (P3) (0.00-1.00)	0,90	Retention (P4) (0.00-1.00)	0,30		

Parametres:	Low (P90)	Base	High (P10)
Depth to top of prospect [m MSL] (> 0)	2087	2087	2087
Area of closure [km^2] (> 0.0)	4,1	17,0	34,1
Reservoir thickness [m] (> 0)	14	22	35
HC column in prospect [m] (> 0)	30	60	150
Gross rock vol. [10^9 m^3] (> 0.000)	0,056	0,466	1,195
Net / Gross [fraction] (0.00-1.00)	0,50	0,70	0,90
Porosity [fraction] (0.00-1.00)	0,12	0,16	0,20
Permeability [mD] (> 0.0)	100,0	200,0	500,0
Water Saturation [fraction] (0.00-1.00)	0,22	0,36	0,50
Bg [Rm3/Sm3] (< 1.0000)			
1/Bo [Sm3/Rm3] (< 1.00)	0,77	0,70	0,62
GOR, free gas [Sm^3/Sm^3] (> 0)			
GOR, oil [Sm^3/Sm^3] (> 0)	50	400	1200
Recov. factor, oil main phase [fraction] (0.00-1.00)	0,20	0,40	0,60
Recov. factor, gas ass. phase [fraction] (0.00-1.00)	0,65	0,70	0,75
Recov. factor, gas main phase [fraction] (0.00-1.00)	0,65	0,70	0,75
Recov. factor, liquid ass. phase [fraction] (0.00-1.00)	0,20	0,40	0,60

Base, Mean
GOR free gas: condensate yield (Sm3/1e6 Sm3): 83-134-200
Bg (m3/1e6 Sm3): 186, 219, 252
HC bearing gross rock volume

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Dato:	NPD will insert value	Registrert Dato:	NPD will insert value	Kart dato	NPD will insert value
				Kart nr	NPD will insert value

Temperature, top res [°C] (>0)	75		
Pressure, top res [bar] (>0)	215		
Cut off criteria for N/G calculation	1.	2.	3.

Table 3. Gram prospect data sheet

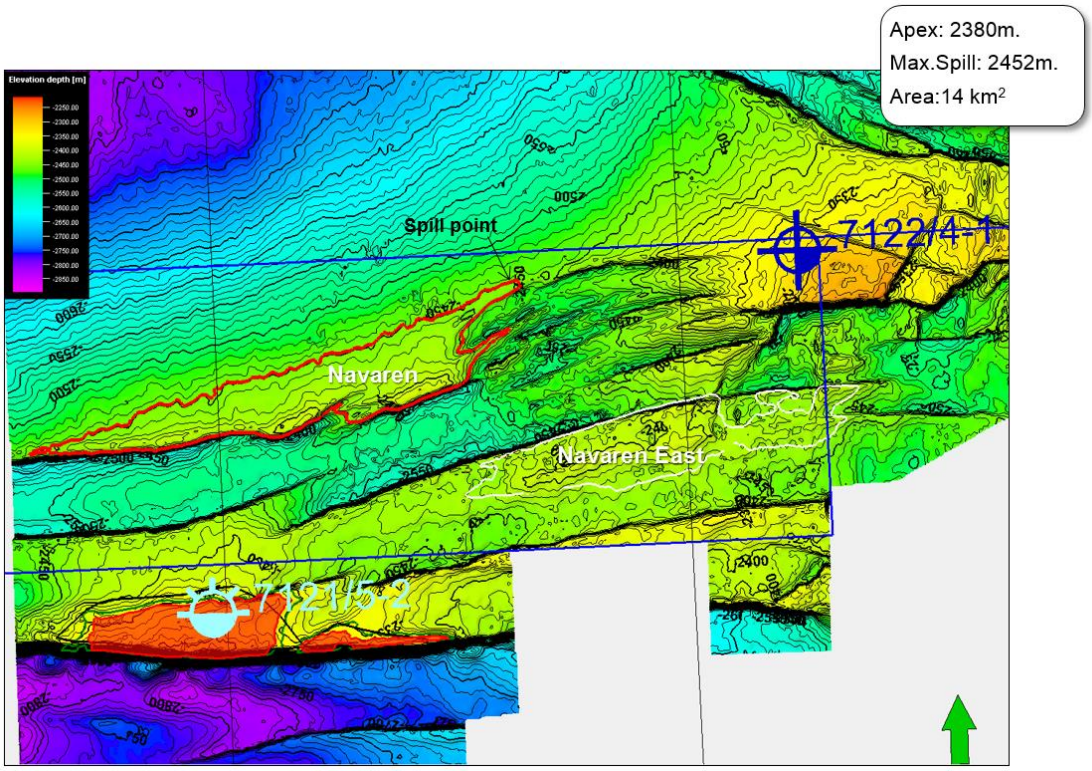

Figure 8. Top Stø depth map (contour 10m, PSDm velocities used)

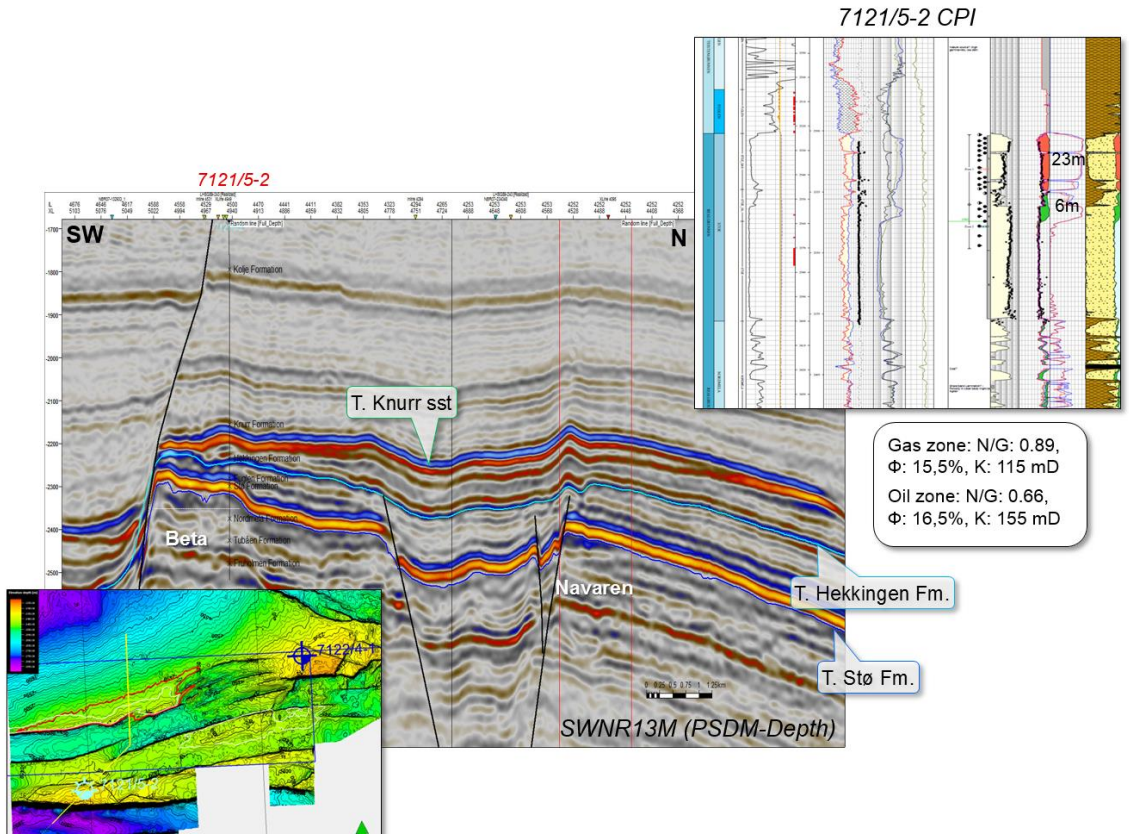

Figure 9. Seismic line through Navaren prospect and Beta discovery

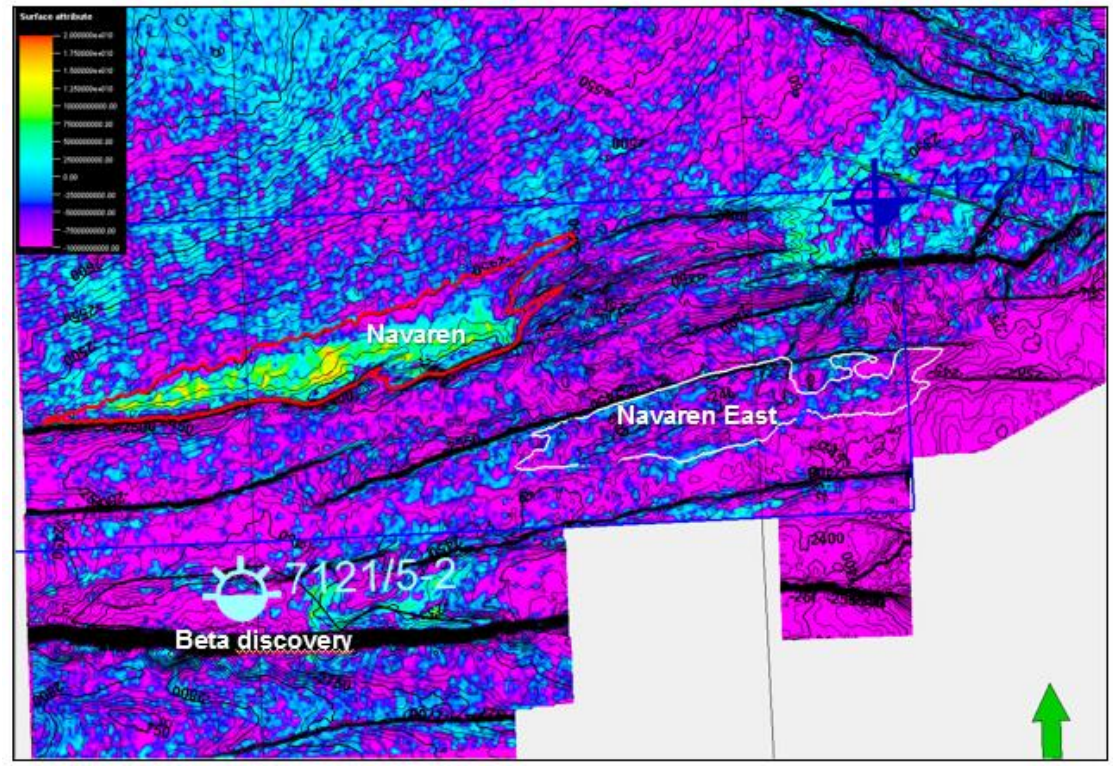

*Figure 10. Mean Amplitude Intercept*Gradient (Top Stø +20ms)*

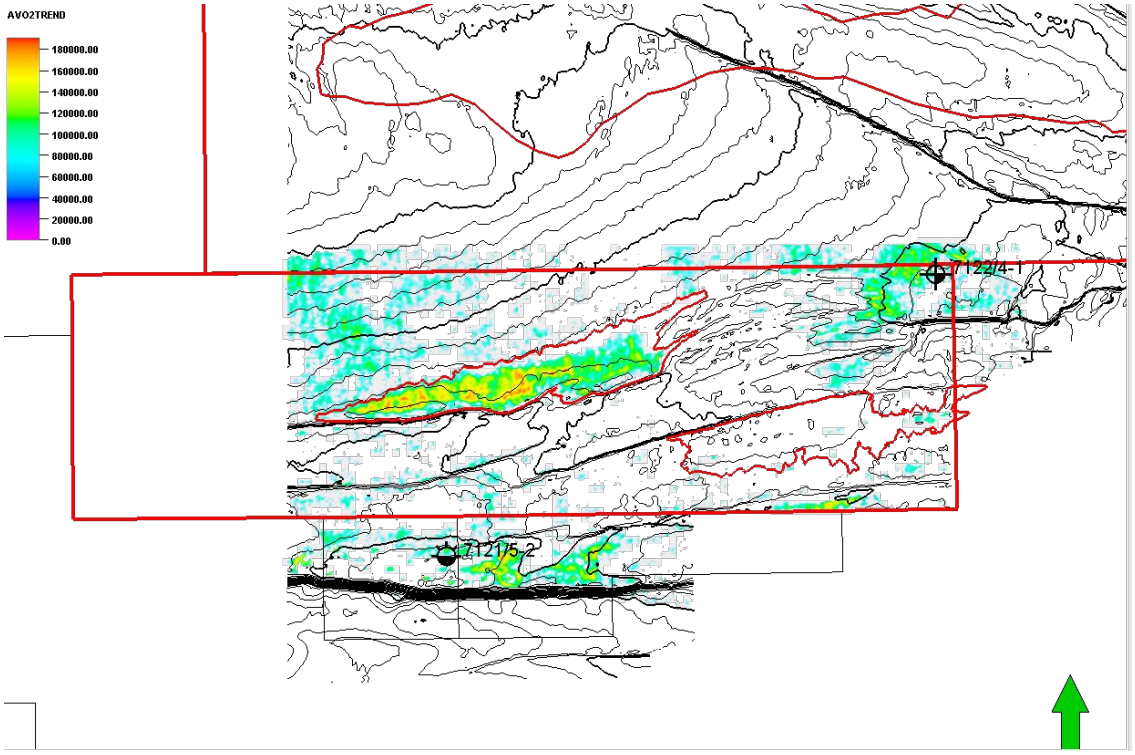

Figure 11. AVO Class II & III (scaled with distance from trend)

Block	7121/5&6	Prospect name	Navaren	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)	No	Outside play (Y/N)					
Oil, Gas or O&G case:	Gas	Reported by company	DONG E&P Norge	Reference document				Assessment year	2014
This is case no.:	1 of 1	Structural element	Hammerfest Basin	Type of trap	Structural	Water depth [m MSL] (>0)	340	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)					0,26	0,60	0,68	1,19
	Gas [10^9 Sm^3] (>0.00)	2,40	4,69	4,78	7,29				
Recoverable resources	Oil [10^6 Sm^3] (>0.00)					0,14	0,33	0,38	0,66
	Gas [10^9 Sm^3] (>0.00)	1,64	3,29	3,37	5,22				
Reservoir Chrono (from)		Reservoir litho (from)	Stø Fm	Source Rock, chrono primary	Hekkingen Fm	Source Rock, litho primary	Shale	Seal, Chrono	Upper Hauterivian
Reservoir Chrono (to)		Reservoir litho (to)		Source Rock, chrono secondary		Source Rock, litho secondary		Seal, Litho	Shale
Probability [fraction]									
Total (oil + gas + oil & gas case) (0.00-1.00)	0,69	Oil case (0.00-1.00)		Gas case (0.00-1.00)	0,69	Oil & Gas case (0.00-1.00)			
Reservoir (P1) (0.00-1.00)	1,00	Trap (P2) (0.00-1.00)	1,00	Charge (P3) (0.00-1.00)	0,80	Retention (P4) (0.00-1.00)	0,60		
Parametres:	Low (P90)	Base	High (P10)	*Base, Mean*					
Depth to top of prospect [m MSL] (> 0)	2380	2380	2380	*Condensate yield: 14,78 - 23,87 - 35,62*					
Area of closure [km^2] (> 0.0)	6,2	10,3	14,4	*1/Bg: 199 - 234 - 269*					
Reservoir thickness [m] (> 0)	58	77	89						
HC column in prospect [m] (> 0)	25	60	72	*Geological POS: 48% (21% DHI uplift)*					
Gross rock vol. [10^9 m^3] (> 0.000)	0,226	0,323	0,419						
Net / Gross [fraction] (0.00-1.00)	0,75	0,85	0,95						
Porosity [fraction] (0.00-1.00)	0,14	0,17	0,21						
Permeability [mD] (> 0.0)	10,0	25,0	80,0						
Water Saturation [fraction] (0.00-1.00)	0,05	0,15	0,30						
Bg [Rm3/Sm3] (< 1.0000)									
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)	0,65	0,70	0,75						
Recov. factor, liquid ass. phase [fraction] (0.00-1.00)	0,50	0,55	0,60	For NPD use:					
Temperature, top res [°C] (>0)	86			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)	245			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

Table 4. Navaren prospect data sheet

5. Technical evaluation and development plan

In the APA 2011 application, a technical evaluation and development plan for the Gram prospect were presented. The development scenario has been updated with the new recoverable hydrocarbon volumes (Table 3) and to include the presence of gas that will be produced and re-injected. The Gram and Navaren prospects are assumed to be developed as a subsea tie back to a future oil & gas processing hub within 30km range from the prospects.

The development concept for both prospects is presented in Table 5 & 6. An economical evaluation has been performed for both prospects.

Table 5. Development concept for Gram prospect

	P90	**P50**	**PMean**	**P10**
Production wells	1	2	4	9
Water injection wells	1	1	1	3
Gas injection wells	1	1	2	3
Number of slots templates	1	1	2	4

Table 6. Development concept for the Navaren prospect

	P90	**P50**	**PMean**	**P10**
Production wells	1	2	2	2
Water injection wells	0	0	0	0
Gas injection wells	0	0	0	0

6. Conclusions

Reprocessing of the available 3D seismic data has led to performing robust rock physics studies, and a better characterization of the internal architecture of the Knurr Fm. package. The results of the seismic inversion suggest a continuous sand system along the Loppa High margin. Therefore, the trapping mechanism is still considered to be a major risk factor for the Gram prospect. It is the license opinion that the Gram prospect has been analysed to a level of irreducible risk, and thoroughly assessed with a multiple-scenario analysis.

The assessment of the license prospectivity shows that volumetric potential and/or geological risk are at levels that prevent the partnership committing to exploration drilling in PL658/PL658B. The license has therefore decided to relinquish PL658/658B in full, in accordance with the timeline set forth by the OED, i.e. by the 3rd May 2015.