

PL759 Relinquishment Report





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1. License Overview

1.1. Executive summary

PL 759 was awarded as result of APA2013, on 7th February 2014 with Edison Norge AS (former Edison International Norway Branch) as an operator with a 40% interest and with Skagen 44 and Concedo partners with 30% interest each. The license covers a 22.336 km2 area in block 6608/10, between Dompap and Fossekall discoveries, in the Norwegian Sea.

The work obligation for the first 2 years sub-period was to reprocess or acquires 3D seismic data before the drill or drop decision gate, 7th February 2016. Decision on Continuation within 5 years and PDO submission after 6 years are the main decision gates.

PL759 is located in the Norwegian Sea (fig 1.1) within the Revfallet Fault complex on the northeastern part of the Dønna Terrace and east of the Ytreholmen Fault Zone. The Nordland ridge and the Rås and Træna basins are stretched in the neighboring eastern and western areas respectively.



Figure 1.1 Location map of PL759, neighboring licenses, discoveries and Fuglekongen prospect and lead

There are two main play models in the area, Lower to Middle Jurassic and Upper Jurassic;

1) In the northern Dønna Terrace Lower to Middle Jurassic play, the main reservoirs are sandstones of the Åre and Tofte Fms deposited in coastal, deltaic depositional



environments. In this model, trapping mechanism is generated by rotated and uplifted fault blocks with 3-way closures against large offset sealing faults. Source is supplied by a combination of the Spekk Formation marine shales, and the Åre Formation lacustrine coals and mudstones.

2) The secondary play model is Upper Jurassic with main reservoirs comprising sandstones developed within the Melke Fm representing lower shoreface environment. These sandstones show poorer reservoir quality and are mainly considered as carrier beds in the area. Trapping mechanism, similar to the main play is controlled by fault block rotation and uplift. Marine shales of the Spekk and Åre FMs. are the main source rock.

Both Jurassic plays are well-known in the area, with HC occurring in the Melke, Garn, Ile, Tofte and Åre Fms.

The main prospect in PL759 is named Fuglekongen (fig 1.1) defined as a rotated fault block with the Middle Jurassic reservoirs as the main targets.

Trap and source effectiveness for Tofte and Åre Fms, primary targets were the key risk factors.

The work program for PL 759 was fulfilled with the purchase of part of the PGS MC3D-HVG2012M. Furthermore a wide range of geological and geophysical studies have been conducted to de-risk the Fuglekongen prospect in order to mature a recommendation for the Drill or Drop gate. The integration of good quality seismic data along with the acquisition and conditioning of pre-stack gathers for specific AVO studies were the key elements for the evaluation of PL759].

The results of the studies led to the new recoverable resources evaluation and risk assessment for Fuglekongen prospect:

Target/Reservoir	P50 recoverable resources MilSm3	COS %
Intra Melke Sst	0,2	38
Tofte Fm	0,8	49
Åre Fm	0,01	35

The potential of the deep marine Lower Cretaceous has also been evaluated. An oil column of 4 meters in the Lysing Fm. is present in the Dompap structure, but it has not been possible to delineate and mature any prospects at this level within the PL759 area.

The Fuglekongen Lead (APA 2013 application) is a horst block with Triassic reservoirs extending into the eastern open acreage and PL 128, but the structure has no valid closure and is open towards the northeast.



Edison Norge AS and its JV partners believe that the estimated volumes of the main prospect (Fuglekongen) do not constitute an economically viable accumulation and the upside potential cannot be matured into prospects. Upon the above mentioned considerations the recommendation to the license MC committee was to drop the production license, proceeding with the submission of the relinquishment notification within 7th February 2016.

1.2 Work Program and Duration

PL759 was awarded on 7th February 2014 with the following JV configuration:

- Edison Norge AS, Operator 40%
- Skagen 44 AS, partner 30%
- Concedo ASA, partner 30%

The license history, applications and work program can be summarized as follows:

- License History:
 - o Acquired directly in APA 2013
 - Relinquishment was recommended in an ECMC meeting to the JV partners for a full relinquishment on the November 4th, 2015
- Initial commitments and restrictions:
 - o Acquire 3D seismic data and conduct G &G studies
- Initial period of 6 years
 - DoD decision by February 2016
- License Meetings
 - Four EC/MC meetings (two meetings per year from the award)
 - One work meeting during the first stage of the project

2.Database

2.1 Seismic Database

The original interpretation was based on the ST9301R00 3D data as part of CS01V06 Merge 3D seismic. ST04M17 (2004) and Spectrum mega merge (2014) were included in the common database (fig 2.1.1 & table 2.1.1).

The PGS MC3D-HVG2012 was acquired with a coverage of 68,3352 sqkm. as the main 3D seismic data to enhance the quality of the prospect mapping and in a second stage the prestack gathers were purchased and processed/conditioned (Sharp Reflection) for AVO analysis as part of the license G&G study.





Figure 2.1 1 Map showing the Seismic database

Survey Name	Year	Company Processed	Туре	Size(km2)	Color	Quality
MC3D-HVG2012M Full Offset Mig.Fin	2012	PGS Exploration	3D	68,3352		Very.Good
Spectrum Merge	2014	Spectrum AS	3D	1005,990		Fair
ST04M17 Full Offset Mig.Fin	2004	Den Norske Stats Oleselskap	3D	2225,790		Good

Table2.1 1 Seismic database used for the PL759 evaluation

2.2 Well database

The key wells used for seismic to well tie, depth conversion, stratigraphic and petrophysical analysis are listed in Table 2.2.1 and their location is shown in Fig. 2.2.1.

Well	Discovery	Drilled	Total Depth	TD Formations	Well status	Operator	CPI
6608/10-5		1995	3200	E. Jurassic	Dry	Statoil	X
6608/10-12	Skuld	2008	3180	E. Jurassic	Oil	Statoil	X
6608/10-12 A	Skuld	2008-09	3075	E. Jurassic	Oil	Statoil	X
6608/10-14 S	Skuld	2010	2880	E. Jurassic	Oil/Gas	Statoil	X
6608/11-4	Linerle	2004	2317	L.Triassic	Oil	Statoil	X
6608/11-6		2008	1850	L.Triassic	Dry	Statoil	
6608/11-2	Falk	2000	2215	L.Triassic	Oil	Statoil	
6608/10-1		1989	3437	E. Jurassic	Dry	Statoil	X
6608/8-1		1997	3013	L.Permian	Oil Shows	Statoil	
6608/8-2		2007	2831	L.Triassic	Dry	Statoilhydro ASA	
6608/10-16		2014	4025	L-M Jurraic	Shows	Noreco Norway AS	
6608/11-5		2006	2270	L.Triassic	Shows	Statoil	

Table 2.2.1 Well database-key wells are highlighted in pink color

Edison Norge AS





3. Overview of the geological framework / Prospectivity

3.1 Studies

A wide range of comprehensive studies have been carried out since the award of the license in order to expand the information content and gain confidence on the geological framework and prospectivity of the area. The studies are listed below:

- Seismic interpretation/well tie (10 seismic horizons)
- Petrophysics (6 wells)
- AVO analysis/ Rock physics (Seismic data conditioning by Sharp reflection)
- Geochemistry and basin modelling (IGI)
- Structural geology/ Fault seal analysis (Internal study)
- Seismic attribute analysis

3.2 Results of the Block evaluation

The pre-award evaluation of the license area suggested a probability of discovery for Intra-Melke Sst (fig 3.2.1), Tofte (fig 3.2.2) and Åre Fms being 21%, 44% and 31% respectively with the main risk being reservoir quality (Intra Melke Sst) and trap (Åre and Tofte Fms.).



Figure 3.2 1 Depth map of the Melke Fm. (BCU) with the polygons of the Melke Fuglekongen prospect pre-award (old) and mapped on the license commitment new seismic (new).



Figure 3.2 2 Depth map of the Tofte Fm. with the polygons of the Tofte Fuglekongen prospect pre-award (old) and mapped on the license commitment new seismic (new).

Åre and Tofte Fms. constitute one container with the same top reservoir surface (fig. 3.2.2); only a very insignificant part of the Åre Fm. is present above the structural spill point.



The G&G studies have successfully de-risked the prospect. Mapping of the new high quality seismic data confirmed the structural closure. Presence of HC is strongly supported by the rock physics and AVO results including a clear anomaly conforming to the mapped structure and associated with clear flat events.

The AVO anomalies show an excellent tie to the wells and explain the discovery and dry wells in the license and nearby area. The good well tie proves AVO as a reliable HC indicator in this area.

Structural validation and fault seal analysis of the prospect bounding faults suggest a high sealing potential. However, prospect mapping of the new data resulted in a much smaller closure than presented in the application document. The main reasons for this reduction in size are as follow:

- The structural spill point of the Tofte Fm is much shallower than was previously thought (fig 3.2.3 & 3.2.4).
- The Tofte spill point towards the structure tested dry by the 6608/10-5 well is not controlled by the thick down-faulted Not-Melke section towards the east of the closure. Instead, erosion plays a major role as trapping mechanism, however, reducing the HC column and defines the maximum closure of Fuglekongen prospect much smaller (fig 3.2.3).
- The throw of the fault to the SE that originally believed to form a lateral seal is now much smaller. (shown in fig.3.2.3)





Figure 3.2 3 NW-SE seismic section through Fuglekongen prospect. Note the deep erosion east of the prospect.



Figure 3.2 4 NE-SW seismic section through Fuglekongen prospect.

Geochemistry study confirmed that the source rocks are, as expected, Spekk and Åre Fms. However, a comparison to the southern Norwegian Sea/ Haltenbanken area suggests that the following key factors can play roles in source rock characteristic in the PL759 area:

• The Spekk Fm. is a relatively lean source rock



- The Åre 2 may be a significant oil-prone source rock
- In areas with locally immature Spekk, it is still possible to find oil sourced from Åre 2 (if thick Fangst and Båt Gp would be present)

In general migration and charge are considered to have lower risk in the license area and an overview of the related basin modeling study can be summarized as follows:

- Fuglekongen Prospect does not seem to be in a migration shadow;
- The main HC phase is oil;
- Fault and lateral seal is critical to trap significant volumes;
- Late gas is a potential risk.

The Fuglekongen lead (fig 1.1) in the east of the prospect, however, can be in migration shadow.

4. Prospect update

Pre-award evaluation of the Fuglekongen prospect estimated the total Pmean recoverable resources of Intra-Melke, Tofte and Åre Fms being 7.76 mill Sm³ oil and 1 mill Sm³ gas (Table 4.1).

Discovery/ Prospect/ Lead name ¹	D/ P/ L ²	C				Case		Unrisk	ed recove	erable re	sources *	i.		Resources in	Reserve	nic	Nearest r infrastru	elevant cture 8
		(Oil/ Gas/ Oil&Gas) 3	(Oil/ Gas/ Oil&Gas)	O	nil [10 ⁶ Sm (>0.00)	č)	0	Gas [10 ⁹ S (>0.00)	m²]	Probability of discovery ⁸ (0.00 - 1.00)	acreage applied for [%] ⁶	Litho-/ Chrono- stratigraphic level	Reservoir depth	Name	Km			
			Low (P90)	Base (Mean)	High (P10)	Low (P90)	Base (Mean)	High (P10)		(0.0 - 100.0)	- ;	[m MSL] (>0)		(>0)				
Fuglekongen Prospect	Р	Oil	5.51	7.76	10.10	0.72	1.00	1.31	0.44	100.0	Tofte, Åre Fms / Lower Jurassic	2820	Norne	22				
Fuglekongen Lead	L									90.0	Åre, Grey Beds Fms/Lower Jurassic, Triassic	2280						

Table 4. 1 Pre-award calculated resources (2013)

The total recoverable resource after de-risking the prospect, reduced to 1.02 mill Sm³ for all reservoir levels, although the chance of success increased from 44% to 49% (table 4.2).

Discovery/ D/ Prospect/Lead P/ name ¹ L ²		Case		Unrisk	ed recove	erable re	sources	4		Resources in	Reservoir		Nearest relevant infrastructure ⁸		
	D/ P/ L ²	(Oil/ Gas/ Oil&Gas)	/ i/ Oil [10 ⁶ Sm ³] ias) (>0.00)			Gas [10 ⁹ Sm ³] (>0.00)			Probability of discovery ⁵ (0.00 - 1.00)	acreage applied for [%] ⁶	Litho-/ Chrono-	Reservoir depth	Name	Km	
		3	Low (P90)	Base (Mean)	High (P10)	Low (P90)	Base (Mean)	High (P10)		(0.0 - 100.0)	7	[m MSL] (>0)		(>0)	
Fuglekongen	Ρ	Oil	0,16	0,20	0,25	0,00	0,00	0,01	0,38	100,0	Melke Fm/U-Mid Jurassic	2805	Norne	22	
Fuglekongen	Р	Oil	0,70	0,81	0,93	0,02	0,02	0,02	0,49	100,0	Tofte Fm/L.Jurassic	2890	Norne	22	
Fuglekongen	Р	Oil	0,01	0,01	0,02	0,00	0,00	0,00	0,35	100,0	Åre Fm/L.Jurassic	2930	Norne	22	
				sum	=1.02										

Table 4. 2 Updated recoverable resources after de-risking of Fuglekongen prospect

The integration of good quality seismic data along with the acquisition of pre-stack gathers for specific AVO studies was extremely valuable for the PL759 evaluation. The Fuglekongen



structure is confirmed and well constrained but the new mapping reduced the size of the prospect. The AVO study produced a positive AVO anomaly but only at the apex of the Fuglekongen structure.

The volumetric calculations carried out on the basis of new mapping and better understanding of the petroleum geology resulted in highlighting a very small prospect. Based on the new interpretation, a saddle separates Fuglekongen prospect from the 6608/10-5 structure (fig 3.2.4). This feature defines the maximum closure of the prospect and turns it into a very small container.

Fuglekongen lead, previously thought as an upside potential is not a viable exploration target with any associated structural closure. Therefore volumetric calculation and risk evaluation have not been considered.

The work program also covered the Cretaceous interval. Seismic attribute mapping indicate that Cretaceous can be highly prospective in terms of reservoir development with some interesting seismic flat events. However the cretaceous prospectivity is mainly developed outside the license area. Therefore no further prospectivity can be expected within the license area.

5. Technological assumptions and development

Water depth in PL759 is 345 m. and the reservoir pressure and temperature are assumed to have normal gradients based on nearby wells. In the case of a discovery the field will be developed as a satellite to Norne FPSO with two 4 slot templates. The Norne FPSO is used as the host processing facility for a number of surrounding fields which are expected to prolong the life of the facilities. The wells will be tied in to the Norne facilities by a new 25 km long 12" pipeline and a 6" water injection pipeline. MEG (Monoethylene Glycol) and corrosion inhibitor/pH stabilizer, supplied from the host platform, will be injected continuously into the well stream pipeline to prevent hydrate formation and for corrosion protection. Control of the wells will be by utilizing a standard umbilical/service line.

The oil will be offshore loaded and exported via shuttle tankers, and the gas exported through the Åsgard transportation System (ÅTS).

As an alternative to direct tie-back to Norne, the Fuglekongen Prospect may be tied back to the Skuld Field for further transportation to the Norne FPSO.

7. Conclusion

PL 759 is located between the two oil discoveries Dompap in the north and Fossekall in the south. The main prospect called Fuglekongen is a small structural closure with potential lower, middle and upper Jurassic reservoirs. Trapping mechanism includes faulting, rotation



and uplift of the fault block resulting in 3-way closure against offset sealing faults; in addition erosional topography may contribute to the formation of a trap.

The extensive G &G technical evaluations including qualitative/quantitative seismic data analysis, structural study, petrophysics and basin modeling carried out by the operator have indicated the following results:

- Detailed seismic interpretation of the new data concluded that the Fuglekongen structural closure is much smaller than the initial pre-award measurements.
- AVO analysis was found reliable and elevated the COS because the results showed a very good tie with the nearby discovery and dry wells. However, AVO anomalies indicated a very small accumulation of HC within the crest of the Fuglekongen prospect.
- Remarkable decrease in the total recoverable resources from 7.2 to 1.2 mill Sm3 (P50) turned the Fuglekongen prospect into a marginal accumulation that cannot justify drilling.
- Cretaceous prospectivity was also investigated with promising results but any potential drillable prospect extends mainly outside PL759.

Based on the mentioned results and JV partner's alignment, there are no viable exploration targets within the license and the operator and partners recommend relinquishing the license.