# Relinquishment Report

# PL458

22.04.2010


MC chairman Svend Erik Pettersson

EC chairman Anne-Lise Lysholm

**Relinquishment Report – PL 458**

## PL 458 Recommendation

The evaluation of PL458 showed that the licence area contains several small prospects. The GCF's (Geological Chance Factor) varies between 4-40% (individual reservoirs). The key risk factors are varying but are mainly the trap definition for the stratigraphic and largest trap (Horngjel). The P50 recoverable resources varying from <0,1 – 5,1 Mm3 oe. A technical/economical evaluation has been performed on the Horngjel Prospect giving a negative EMV.

**With this resource basis the partnership recommended to drop the PL458 by end February 2010.**

The evaluation of PL458 was presented in an internal ERN (E.ON Ruhrgas Norge AS) Peer-Review on 12.1.2010, where the peers supported the recommendation given by the team.

## Licence overview and work-commitment

PL 458 comprising part of block 25/10 (33,8 km$^2$) was awarded in the APA 2007, on 29.2.2008 and is valid until 1.3.2013. The licence was awarded to ERN (40%) as operator with NORECO (30%) and Det norske oljeselskap (30%) as partners. The licence commitment comprised reprocessing of existing 3D seismic covering the whole awarded acreage within the first 2-years period. A drill or drop decision was due end February 2010. Reprocessing, seismic interpretation, petrophysics, sequence stratigraphy, volume-calculations, risking and technical/economical evaluation have been performed during the licence period.

**Production licence: 458**

**General information**

| | |
|---|---|
| NPDID production licence: | 4910277 |
| Licence status: | ACTIVE |
| Licensing activity: | TFO2007 |
| Date granted: | 29.02.2008 |
| Date valid to: | 01.03.2013 |
| Original area: | 33.757 km$^2$ |
| Current area: | 33.757 km$^2$ |

History

**Current licensee(s)**

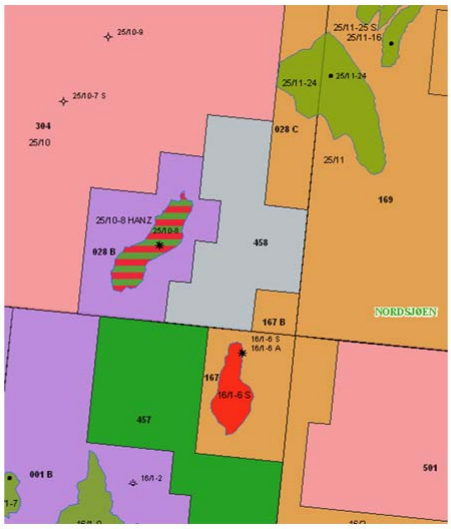
| Period | Company | Interest [%] |
|---|---|---|
| 29.02.2008 - | Norwegian Energy Company ASA | 30.000000 |
| - | Det norske oljeselskap ASA | 30.000000 |
| - | E.ON Ruhrgas Norge AS | 40.000000 |

**Current operator(s)**

| Period | Company |
|---|---|
| 29.02.2008 - | E.ON Ruhrgas Norge AS |

**Current area(s)**

| Period | Nation | Block | Polygon | Area [km$^2$] |
|---|---|---|---|---|
| 29.02.2008 - | NO | 25/10 | 1 | 33.757 |




Key facts:

- All licence commitments for initial period met.
- Drill-or-drop due 28. Feb. 2010.
- ERN reprocessed and merged 3 seismic surveys from mid-October 2008 to end March 2009
- Work program and studies performed
  - -Reprocessing
  - -Seismic interpretation
  - -Petrophysics
  - -Sequence stratigraphy
  - -Volumetrics-Risking
  - -Tech/econ for Horngjel Prospect

## Location, structural setting and reservoirs

PL 458 is located on the western margin of the Utsira High straddling the Gudrun Terrace which comprises the eastern terrace of Viking Graben. The block is located in close vicinity to several discoveries and fields in production (Hanz, 16/1-6S, Luno, Ragnarrock, 24/11-24 and Grane).

Reservoirs anticipated and prospects defined in the licence are of Callovian/Oxfordian, Kimmeridgian, Palaeocene and Oligocene age. The Permian Rotliegendes Gp. might also have a potential in the licence but has not been evaluated.

## Prospects description, volumes and risking

The **Horngjel** is a stratigraphic trap with potential reservoir at Kimmeridgian level. It is located in the eastern part of the licence in a sub-basin/embayment which formed during the late Jurassic extension. Horngjel forms a wedge shaped stratigraphic trap trending in N –S direction. It is limited to the west by a prominent and curved salt-/ridge trending N-S. and by truncation by the BCU to the east. Top of the reservoir is defined by the BCU and the base by the Kimmeridgian Unconformity (Kim_Unc, Ki4sb). The reservoir is expected to be intra Draupne Fm. sands as found in well 25/10-8 and 8A. The volume-calculations are based on direct input of GRV from the thickness map between BCU and the Kim_Unc. The areal extend of the trap is 19,6km$^2$ and the gross reservoir thickness varies from 0-120m inside the wedge. The shallowest point of the trap is at 2150m and the deepest contour is at 2250m. The main risks are attached to charge and seal (top and lateral seal to the east). The overall GCF is calculated to be 4% with a P50 potential recoverable resource of 4,2 MSm$^3$ oil and 0,2 BSm$^3$ gas.

***Jurassic:***

**Horngjel** (stratigraphic trap-lead with potential reservoir at Kimmeridgian level)

- Top reservoir 2150m
- GCF 4%
- P50 recoverable resources – 28 mmboe

***Jurassic-Palaeocene-Oligocene:***

**Ålekvabbe** (small structural 4-way dip closure, stacked reservoirs at Upper Jurassic, Palaeocene and Oligocene levels)

- Top reservoir 1400m-1985m
- GCF 20-36% (comb. 75%)
- P50 recoverable resources (comb.) – 11,4 mmboe

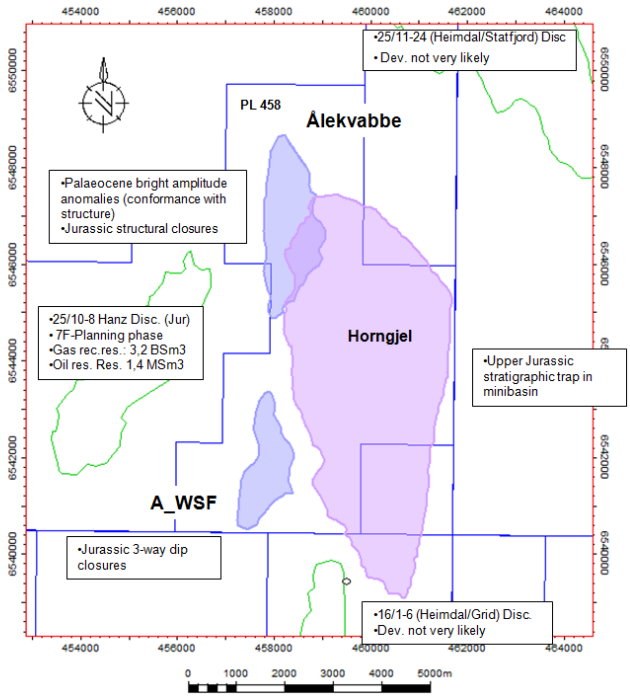
***Jurassic:***

**A_WSF** (small structural 3-way dip closure, stacked reservoirs at 2 levels in Upper Jurassic)

- Top reservoir 2120m
- GCF 31-36% (comb. 53%)
- P50 recoverable resources (comb) – 3,8 mmboe

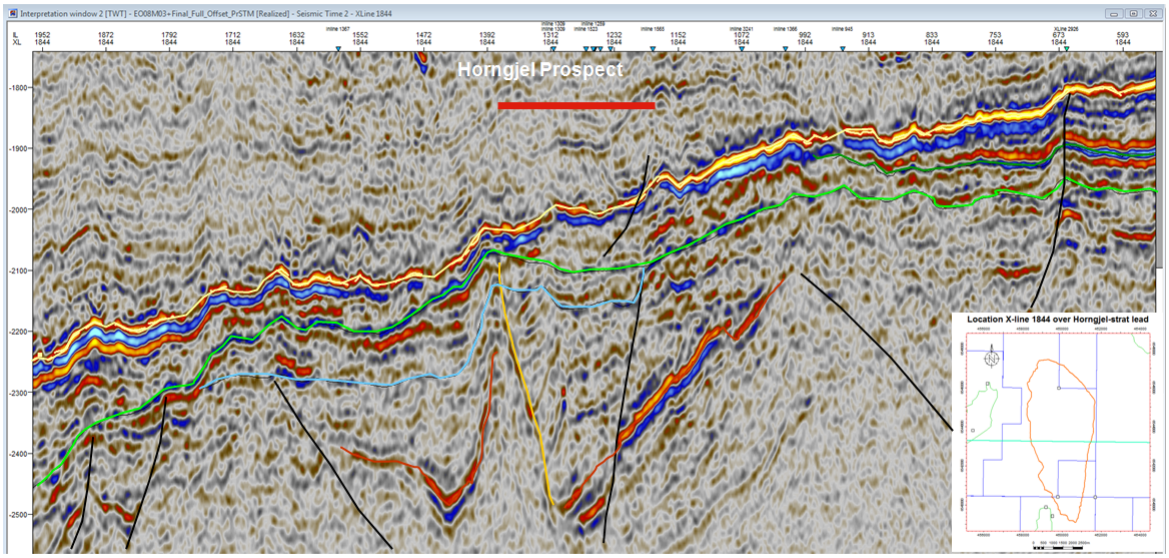
The other partners have an **alternative model** for the structural/geological development of the area consequently leading to another prospectivity of the block. It is understood by ERN that partners only sees prospectivity attached to the western part of the licence. They indicate a stratigraphic trap in the Upper Jurassic located updip to the dry well 25/10-8A.

ERN have only done a rough evaluation of the potential of the alternative model



## Cross-line 1844 over the Horngjel Prospect

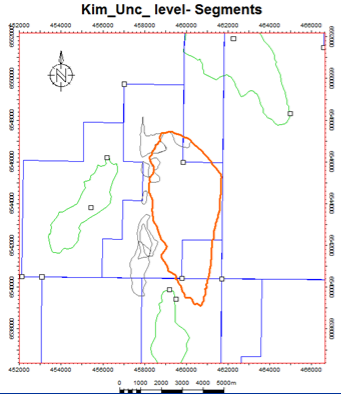
W E



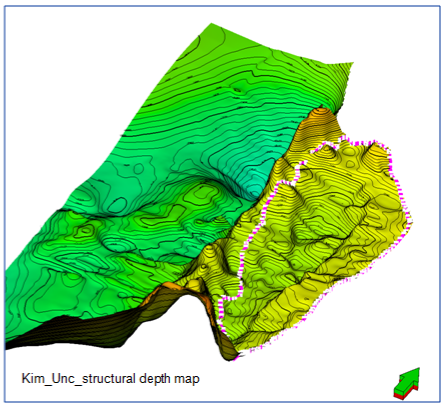

Top Shetland Gp.
Cromer Knoll Gp.
BCU
Kim_Unc
Top Zechstein/Top Rotliegendes
Eastern salt wall



Kim_Unc_ level- Segments



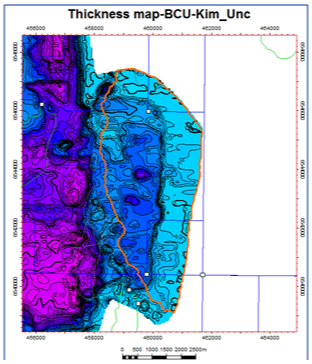
- Horngjel Prospect is located in a **sub-basin/embayment** which formed during the late Jurassic extension.
- Most likely related to extensional fault arrays which generated footwall/hanging wall systems with interconnected relay ramps.
- Forms a wedge shaped **stratigraphic** trap trending in a North –South direction
- Limited to the west by a prominent and curved salt-wall/ridge trending N-S



Kim_Unc_structural depth map

- Reservoir: Kimmeridgian intra Draupne Fm. Sandstones
- Top reservoir defined by: BCU structural depth map
- Areal extend:19,5 km2
- Top structure: 2150m
- Deepest contour: 2250m
- Volume calculations: Direct input of GRV based on thickness map between BCU and the Kim_Unc.
- Recoverable resources: **4,48 Mm3 OE**

Thickness map-BCU-Kim_Unc



- Thickness varies between 0 and 120m inside wedge

GCF=4%

The **Ålekvabbe Prospect** is a small structural trap comprising 4 potential reservoir levels. The closure is located in the northern part of the licence over and along the northern tip of the salt wall. It is believed to be formed gradually during movement of the Zechstein salt at least into the Upper Cretaceous and possible even post-dating the deposition of the Heimdal Fm. The reservoirs are expected to be stacked Hugin Fm., intra Draupne ss, Heimdal and Grid Fms. The markers defining the top reservoirs are following: Kim_Unc (Ki4sb), BCU, top Heimdal (Th4mfs) and near top Grid (near Ru2mfs). Structural 4-way closures are defined on all levels expect at the Hugin Fm. level which comprise a 3 way-dip closure limited in the north by truncation by the BCU.

The volume-calculations are based on area-depth curves for each closure. The areal extend of the traps is limited and not more than $3km^2$ for the largest. Due to the small size a simplified filling model (fill to spill) has been applied. Top of the shallowest reservoir (Grid Fm.) is at 1400m and top of the deepest (Hugin Fm.) is at 1985m. The main risks are attached to different factor for each level but due to the structural nature and optimal position in relation to charge all of the reservoirs have a high GCF (from 20-36%). Combined recoverable resources (P50) for 4 levels have been calculated to 1,7 $MSm^3$ oil with a combined GCF of 75% (max shared probability on charge).

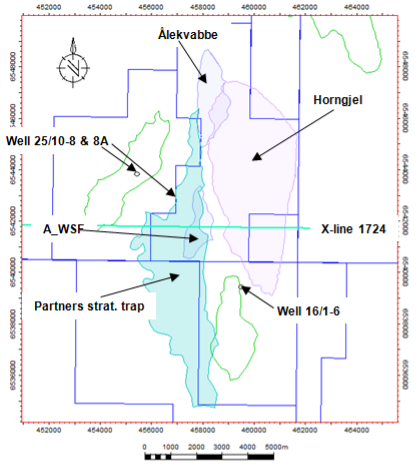
The **A_WSF Prospect** is a small structural trap comprising 2 potential reservoir levels. The closure is located in the southern part of the licence over and along southern tip of the salt wall. A_WSF is located north of the northern tip of the 16/1-6S Basement High. It comprises a down-faulted nose plunging to the north, partly limited by the salt wall to the east and. The reservoirs are expected to be stacked Hugin Fm. and intra Draupne ss, defined by the Kim_Unc (Ki4sb) and BCU. Structural 3-way closures are defined on both levels.

The volume-calculations are based on area-depth curves for each closure. The areal extend of the traps is limited and less than $2km^2$ for the largest. Due to the small size a simplified filling model (fill to spill) has been applied. Top of the shallowest reservoir (intra Draupne ss.) is at 2117m and top of the deepest (Hugin Fm.) is at 2171m. The main risk is attached to the geometry factor but due to the structural nature and optimal position in relation to charge all of the reservoirs have a high GCF (from 31-36%). Combined recoverable resources (P50) for 2 levels have been calculated to 0,6 $MSm^3$ oil with a combined GCF of 53% (max shared probability on charge).

The other partners in the licence have an **alternative model** for the structural/geological development of the area consequently leading to another prospectivity of the block. Consequence

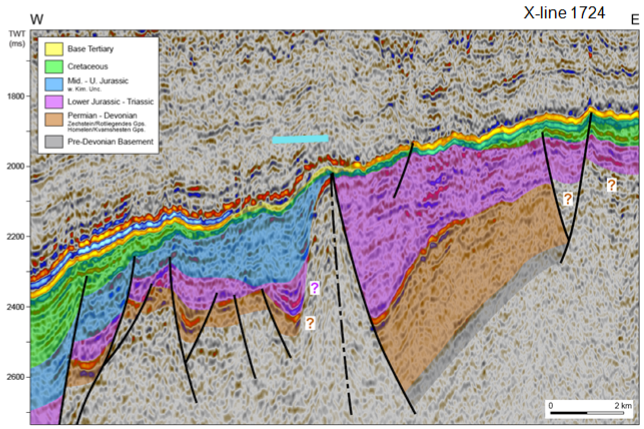
is that partners only see prospectivity in to the western part of the licence. They indicate a stratigraphic trap in the Upper Jurassic located updip to the dry well 25/10-8A.

ERN does not believe in this model and have only done a rough evaluation of the potential of the alternative model giving a potential of 6MSm$^3$ OE. This model has not been risked.




- Stratigraphic trap at BCU level seen as main possibility by partners in licence.
- Not considered as prospective by ERN except shallowest structural part corresponding to the Jurassic A_WSF prospect
- Does not close to the north or to the south inside reprocessed area
- Located up-dip dry well 25/10-8A and west of the salt wall in ERN interpretation/west of major wrench fault in partners interpretation.

- ERN has performed a rough volume estimate to establish potential and compare size with the structural closures defined in PL 458. Not risked as considered only a lead
- Max case at 2300m contour defined by deepest contour above 25/10-8A (BCU entry on map) and an embayment to the south close to south boundary of survey.
- Limited to the east by western flank of salt wall (for this calculation handled as a fault in Petrel) and the western limit of the basement high (16/1-6A).



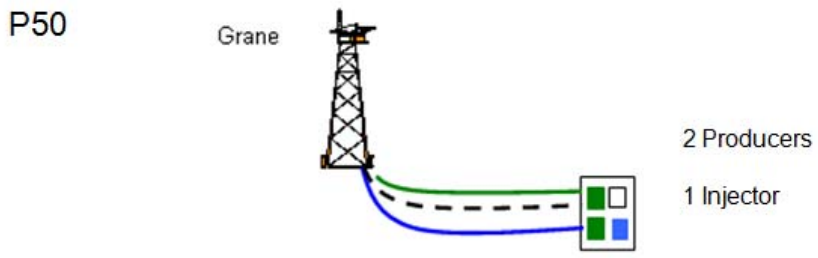

- The top of the trap is defined by the BCU.
- GRV based on area-depth relation
- Reservoir assumed to be late Kimmeridgian intra Draupne sandstones (Ki5-Ki6-Ki7) or older
- Reservoir parameters based on mainly well 25/10-8A. Assuming increased thickness towards the east against the salt-wall/limiting fault
- Top structure is at 1920 m.
- Deepest contour is at 2300m.
- Structural relief of 380m.
- Max case OWC: 2300m (updip 25/10-8A/embayment)
- Min case OWC: 2190m (A_WSF max closure)

- **Recoverable resources P50 case: 6 MSm3 OE**

**NB! Volume potential – total area inside reproc. seismic**

## Technical/economical evaluation of the Horngjel Prospect

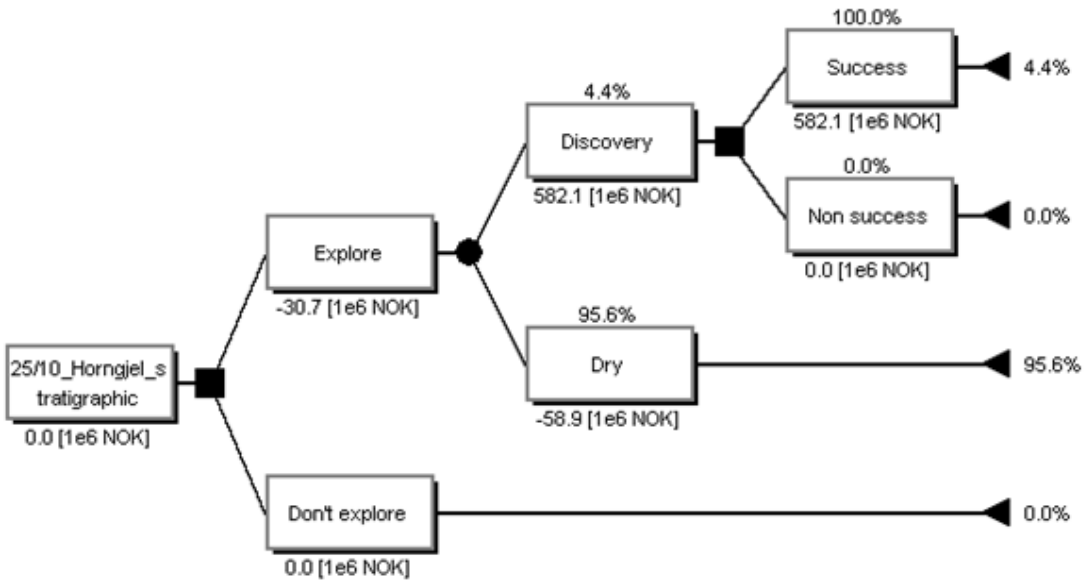
Field development and economics have run for the Horngjel Prospect as the largest prospect. The development is assumed to be a simple template (water-depth 130m) with water-injection, production and umbilical tied back to the Grane Field located 18km to the NE. The necessary water injection will be supplied from the Grane facilities. There are uncertainties related to available space and capacities on the Grane Platform which may mean additional topsides modification cost not taken into account in the evaluation. Also several discoveries in the area may lead to a new standalone development for Luno, Ragnarock, Hanz and Draupne.



For the P50 volume case economic it is assumed that an exploration is drilled in 2012 followed shortly by an appraisal. Two oil producers are anticipated with the first pre-drilled in 2017 with production start in 2018.

The IRR is set to 10%. Tariff for oil is 63NOK/$Sm^3$ and for gas 30 øre/$m^3$.

The evaluation of the P50 case gives a negative EMV (-31MNOK) with a IRR of 10%.




**Conclusion and recommendation**

The evaluation of PL458 shows that licence has several small prospects.

- GCF varies between 4-40%
  - Key risk factors are varying but mainly trap definition for the stratigraphic and largest trap (Horngjel)
- P50 recoverable resources varying from <0,1 – 4,5 Mm3 oe.
- Due to the low potential/high risk of the prospects a tech/econ evaluation has only been performed for the largest prospect (Horngjel Prospect)
- Horngjel:
  - Negative economics – EMV (-31MNOK) with at IRR of 10%
  - P50 volumes – 4,2 MSm3 oil
  - GCF = 4%

**With this resource basis the partnership recommended to drop the PL458 by end February 2010.**