wintershall dea

# RELINQUISHMENT REPORT
## PL989

concedo

AkerBP

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# Summary

## Introduction

Following the APA 2018 application round, PL989 was awarded 01.03.2019. Dea Norge AS (Wintershall Dea Norge AS) (40%) has been the operator for the licence along with partners Lundin Norway AS (Aker BP ASA) (30%), and Concedo AS (30%). The initial drill-or-drop decision was 01.03.2021. An extension of this decision date was applied for three times with the last approval for a new drill-or-drop decision set to 01.09.23. In the start the main prospect was Upper Jurassic Sognefjord & Brent "Usken" prospect, in the second phase the main prospect was the appraisal of the "Ulven South 36/7-2" (1997) stranded heavy oil discovery.

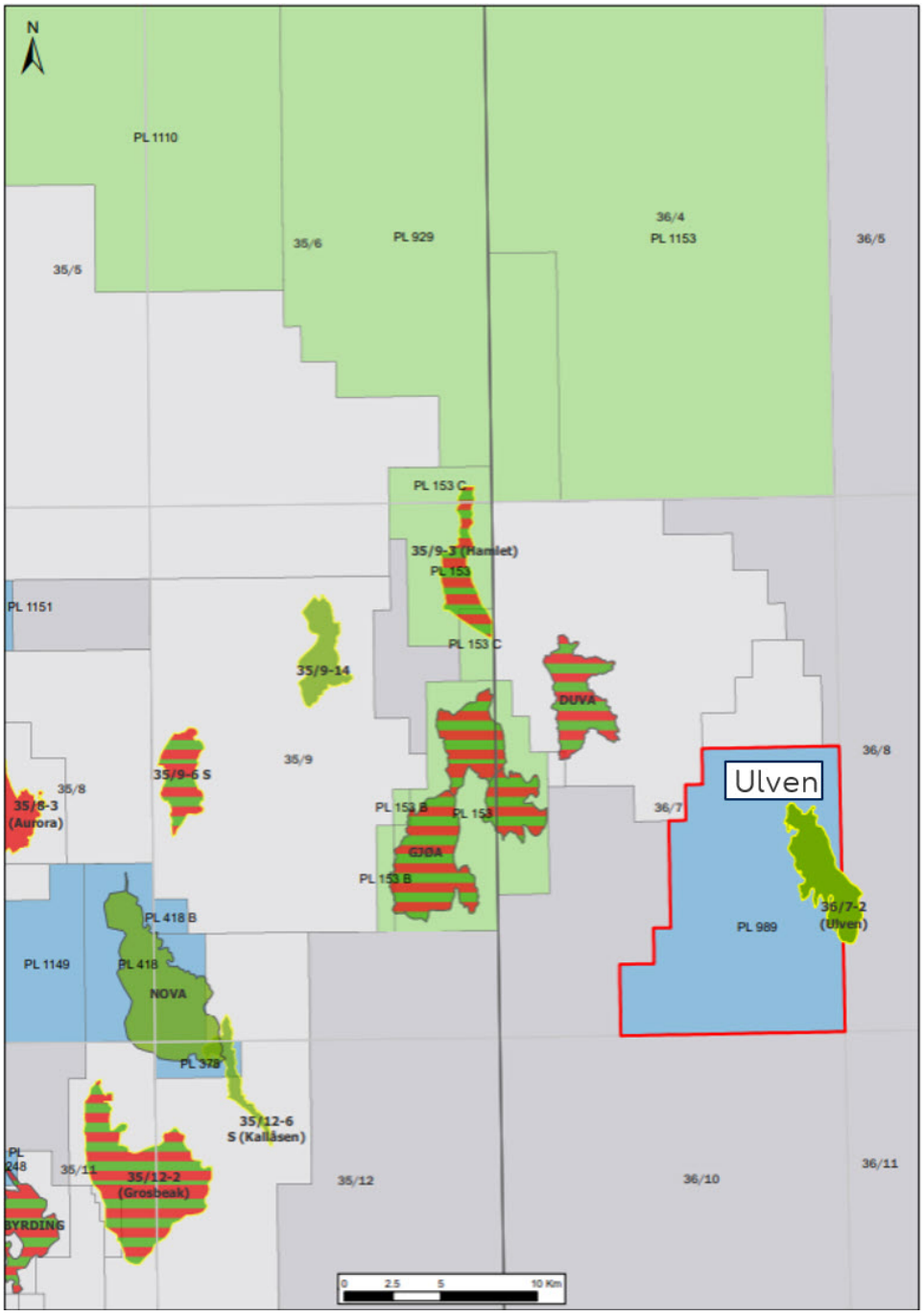


**Fig. 1 PL989 Licence Overview**

*The Ulven (North and South) prospect (yellow polygon) is located within PL989. The Gjøa field is located 15km west of the prospect.*

The initial work program for PL 989 was the acquisition of 3d seismic broad band data, fault seal analysis of the "Usken" prospect, hydrocarbon migration modelling, reservoir characterisation, in-house SCAL and micro-CT study. In a second phase an updated biostratigraphy and palynofacies analysis of the key 36/7-2 well was done using fresh core samples, integration of the newly analysed oil sample of 36/7-2 into the regional geochemical study and preparing for the drilling of an exploration well.

Main prospects for the licence have been the Upper Jurassic Sognefjord & Fensfjord "Usken", a complex structural trap in a hanging-wall setting. Source rock was in the prolific Upper Jurassic Draupne Fm and the most likely hydrocarbon phase was oil. However, irreducible risk elements were too high and volumes too small for a drill recommendation with the largest risk being trap validity / retention of charge. The underlying lead "Usken Brent" was rejected because of high risk of migration pathway.

Minor prospectivity was seen also in Coniacian Kyrre leads. However, the size of the potential gas volume was evaluated to be too small to be prospective.

The second main prospectivity was seen in the appraisal of the Upper Jurassic Sognefjord & Fensfjord Ulven South 36/7-2 stranded biodegradaded oil discovery with a OWC at 945m. "Ulven North" prospect is a robust 4-way dip closure with spill to "Ulven South" forming an eight-shape closure. Both structures share a pronounced depth conform amplitude, which is seen to be the common GOC.  Key risk of "Ulven North" and "Ulven South" is related to API and mobility of the discovered oil. However, migration modelling showed that several migration pulses arrived in the "Ulven" prospect / discovery from the Gjøa kitchen from North and that there were chances to find better oil qualities in "Ulven North" structure.

# 1 History of the production license

**Table 1.1 PL989 Milestone overview**

| Licence | PL 989 |
|---|---|
| Awarded | 01.03.2019 (APA 2018) |
| Licence blocks | 36/7 |
| Licence drill-or-drop extensions | 01.03.2021 (initial) to 01.03.22 (new)<br>01.03.22 (initial) to 01.03.23 (new)<br>01.03.23 (initial) to 01.09.23 (attempt to find new partners) |
| Licence period | Expire 01.09.2023 (DOD 01.09.2023) |
| Licence group | Wintershall Dea Norge AS 40% (Operator)<br>Aker BP ASA 30%<br>Concedo AS 30% |
| Licence area | 139 km2 |
| Work program | Acquisition of 3d broad band seismic |
| Meetings held | 08-04-2019 MC startup meeting #1<br>12-09-2019 EC workshop<br>13-11-2019 EC/MC meeting #2<br>25/26-03-2020 EC workshop<br>09-06-2020 EC Geochemistry workshop<br>28-10-2020 EC/MC meeting #3<br>17-11-2021 EC7MC meeting #4 (Covid)<br>06-04-2022 EC/MC #5 Ulven prospect<br>23-11-2022 EC/MC #6 Drill decision |
| Work performed | • Seismic imaging improvement.<br>• Interpretation of the 3D seismic data, CGG 17M01, and relevant offset wells.<br>• Fault seal evaluation.<br>• Petrophysics evaluation.<br>• 3D HC Migration modelling.<br>• 3D seismic QI analysis; AVO, inversion and fluid substitution.<br>• In-house SCAL / micro-CT study.<br>• Geochemistry study and re-evaluation of 36/7-2 oil sample<br>• Biostratigraphy and Palynologic facies analysis<br>• Volume and risks evaluation of all identified prospect opportunities in the licence. |
| Reasons for drop | Prospect "Ulven North" & "Ulven South" 36/7-2 was dropped because of partner withdrawal |

# 2 Database overviews

## 2.1 Seismic database

The seismic database for PL989 is listed in Table 2.1 and shown in Fig. 2.1.

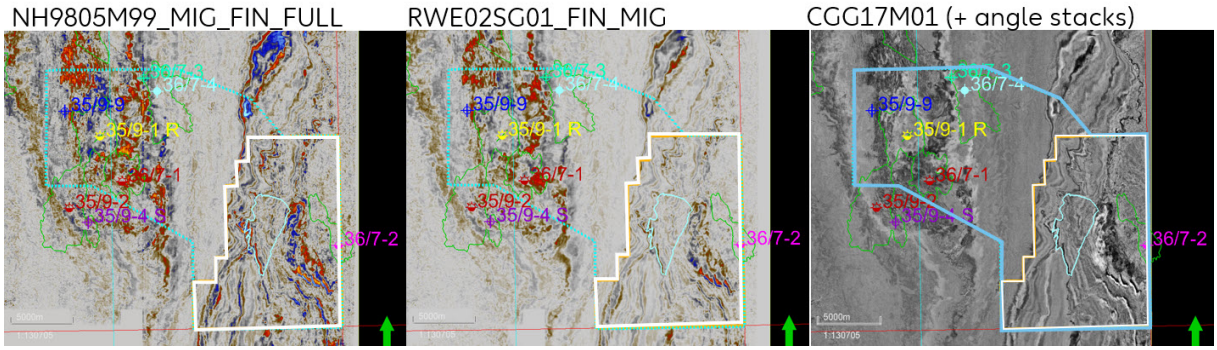


**Fig. 2.1 Seismic Database**

*The Seismic database for PL989 is within the turquois polygone.*

**Table 2.1 Seismic Database**

| Survey | NPDID | Volumes | Domain | Year | Quality |
|---|---|---|---|---|---|
| CGG17M01-NVG-Horda-Tampen | 8128 | Near-Mid-Far-Full Stack | 3D Time | 2017 | Very good quality, new, broadband seismic dataset. |
| RWE02SG01 | | Full Stack | 3D Time | 2002 | Moderate quality.Post-stack merge. |
| NH9805M99 | 3932 | Full Stack | 3D Time | 1998 | Fair |

## 2.2 Well database

The well database for PL989 is listed in Table 2.2 and shown in Fig. 2.2.

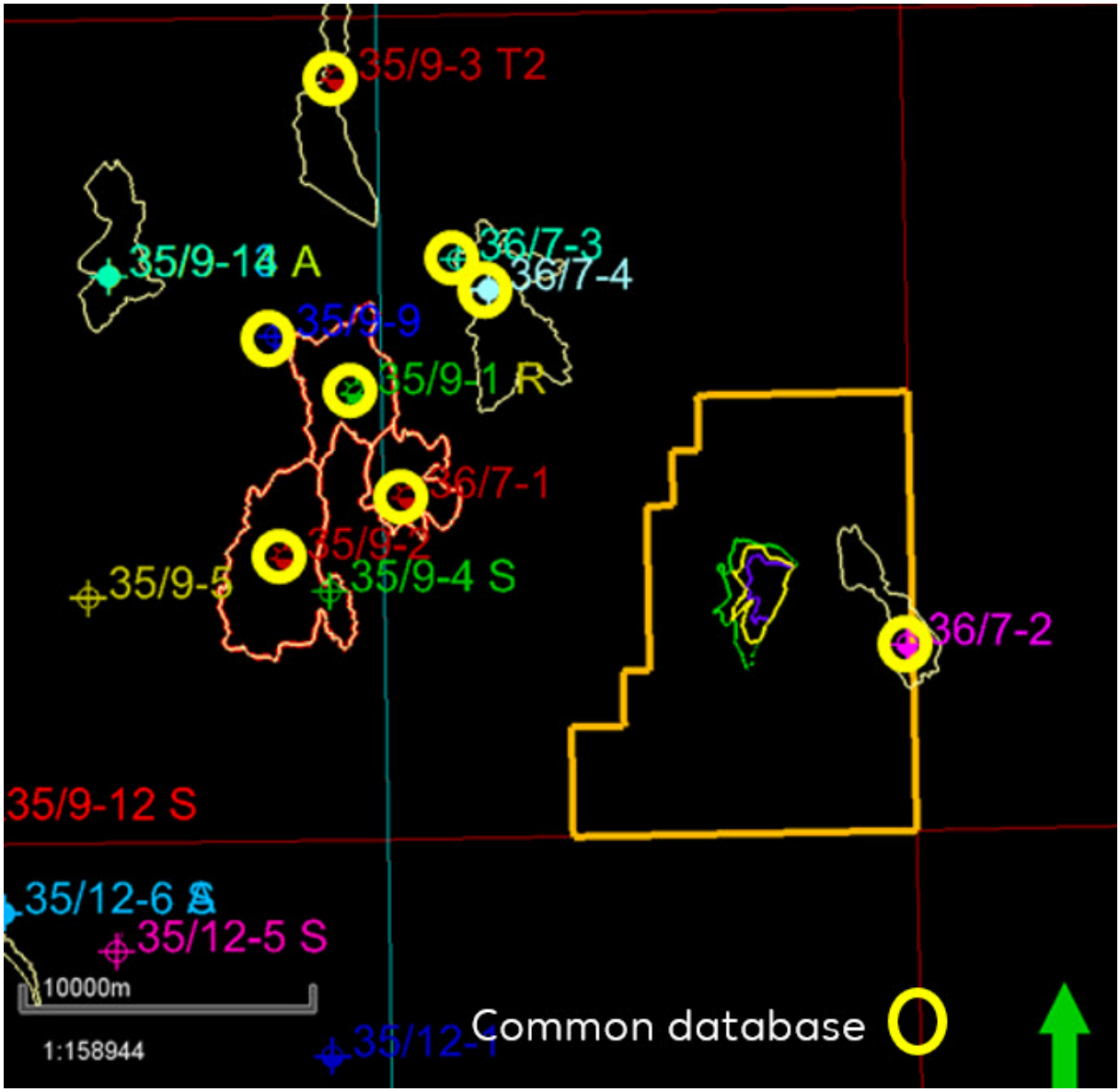


**Fig. 2.2 Well Database**

Wells in the database were used for seismic well-ties, seismic inversion, petrophysical input in volume calculation and a number of other studies conducted in the licence.

**Table 2.2 Well Database**

| Well | Year | TD Age | Field/Discovery/ Result |
|---|---|---|---|
| 36/7-2 Ulven South | 1997 | Basement | Oil discovery |
| 36/7-1 Gjøa | 1996 | Basement | Gjøa field |
| 35/9-1 Gjøa | 1989 | Basement | Gjøa field |
| 35/9-2 Gjøa | 1991 | Basement | Gjøa field |
| 35/9-3 T2 Hamlet | 1997 | Basement | Oil/Gas discovery |
| 36/7-3 downdip Cara | 2001 | Middle Jurassic | Dry |
| 35/7-4 Cara | 2016 | Early Cretaceous | Duva field |
| 35/9-9 | 2013 | Triassic | Dry |

## 3 Results of geological and geophysical studies

The main prospect in PL989 was "Ulven North". "Ulven North" was seen as appraisal of the stranded heavy oil discovery "Ulven South" 36/7-2. The proven excellent reservoir consisted of Upper Jurassic Sognefjord and Fensfjord formations, that were deposited in a subaqueous delta plain environment influenced by tidal distributary channels.

A digital rocks study has been done in order to prove the flowing ability of those sandstones also for lower API oil. With the help of Micro-CT scanning images of fragments of core plugs detailed porosity-permeability relationships were established.

A new biostratigraphic and palynofacies study re-evaluating cutting samples from the 36/7-2 is proving that the original chrono-/ lithostratigraphic age from the former operator Norsk Hydro Produksjon AS is outdated. The evaluation of Wintershall Dea Norge AS alined with the Ichron study indicating that there was no waste zone at the top of the Sognefjord formation but an unconformity and above the unconformity tight transgressive sandstones of Kimmeridgian age.

Geochemical work included a re-evaluation of the 36/7-2 oil showing that a minor amount of fresher oil was charged to the Sognefjord formation. Also in the deeper samples in the Fensfjord formation a second less biodegraded charge is present but less clear. All fluids seem to have a mid oil-window maturity and a similar marine shale source. API and mobility of the discovered oil constitute key risk of "Ulven North" and "Ulven South". However, migration modelling showed that there were chances to find better oil qualities in the northern structure.

"Ulven North" is a robust 4-way dip closure with spill to "Ulven South" forming an eight-shape. Both structures share a pronounced depth conform amplitude, which is seen to be the common GOC. The licence group has also done reservoir characterisation to evaluate the direct hydrocarbon indications.

**Work performed in the licence**

- Seismic imaging improvement.
- Interpretation of the 3D seismic data, CGG 17M01, and relevant offset wells.
- Fault seal evaluation.
- Petrophysics evaluation.
- 3D HC Migration modelling.
- 3D seismic QI analysis; AVO, inversion and fluid substitution.
- In-house SCAL / micro-CT study.Porosity and permeability determination from core fragments.
- Geochemistry study. Geochemical re-analysis of the heavy oil sample of 36/7-2 well.
- Biostratigraphic and palynofacies study. Sedimentological review based on palynologic facies.
- Volume and risks evaluation of all identified prospectivity in the licence.

## 4 Prospect update report

Direct hydrocarbon indicators were used in volumetrics to determine the GOC. The OWC was not seen on seismic but drilled by the well 36/7-2 "Ulven South".

**"Ulven North" and "Ulven South" Summary**

"Ulven North" prospect is a structural 4-way dip trap with spill towards the "Ulven South" discovery. Both structures are mapped on good quality 3D seismic data with calibration to the 36/7-2 discovery well. Amplitudes conforming to structure indicate a gas cap in both structures (i.e. discovery and prospect). The spillpoint is thought to be controlled by the Øygarden Fault zone to the east and lies 50 m above the LCC at 1000m TVDSS. The crest for the prospect is at 850m TVDSS. Key risk is related to oil API and mobility.

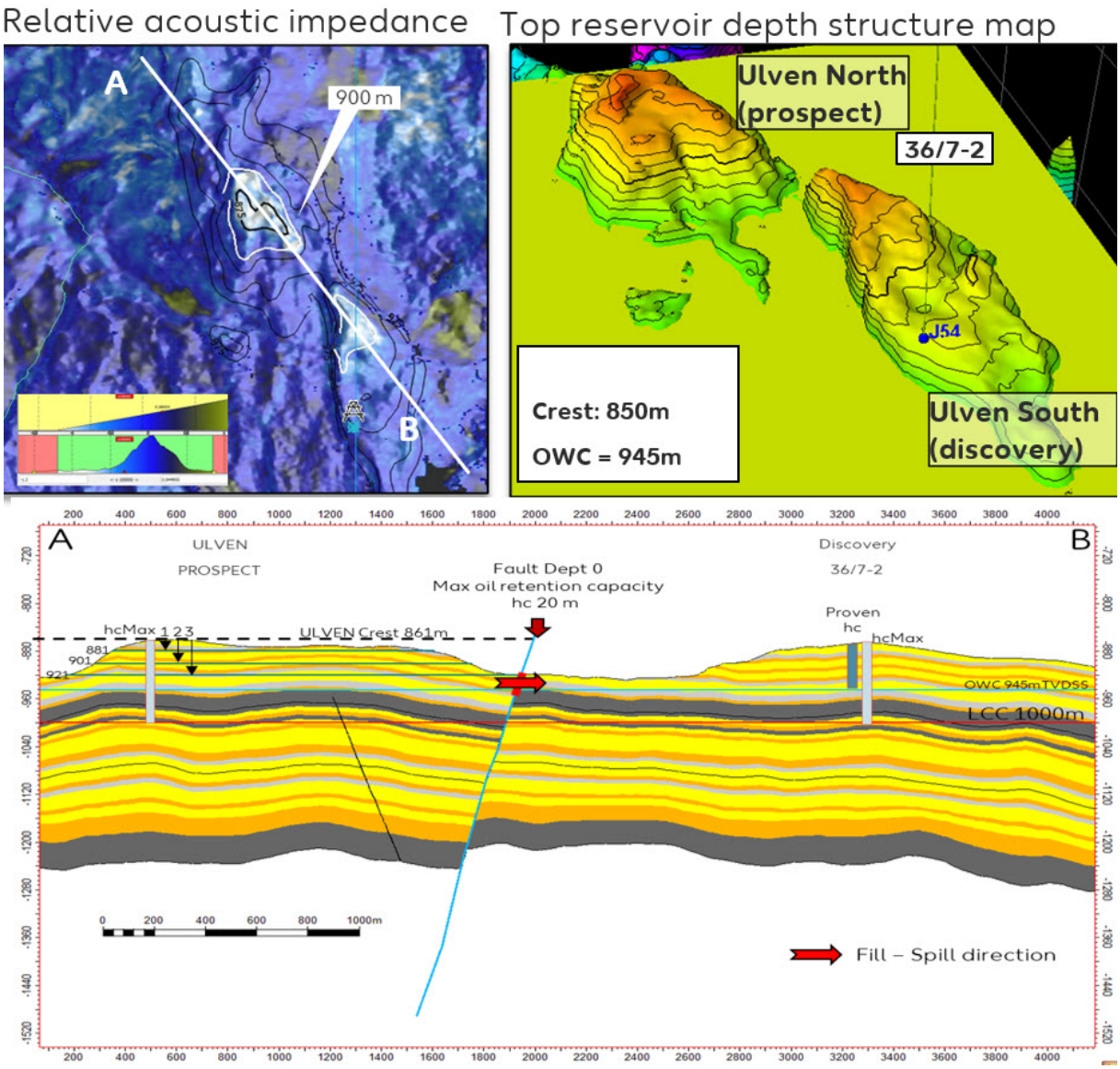


**Fig. 4.1 Ulven North prospect and Ulven South 36/7-2 discovery**

*Relative acoustic impedance map indicating GOC at 900m TVDSS; 3D top reservoir depths map with OWC at 945m; Fault model across main fault indicating fill spill direction. Line of section indicated on map above.*

- **Reservoir**: Callovian / Oxfordian subaqueous delta plain & tide influenced distributary channel
- **Seal**: Tithonian Draupne Shale / Kimmeridgian tight sandstone and Late Cretaceous Åsgard Fm
- **Source Rock**: Kimmeridgian / Oxfordian / Callovian / Bathonian Heather and Draupne shales
- **Hydrocarbon Type**: oil
- **Mean Recoverable Resources**: 23 mmboe

**Table 4.1 Technical Recoverable Resources "Ulven North" and "Ulven South"**

| | Mean | P90 | P50 | P10 | POSg (%) |
|---|---|---|---|---|---|
| Ulven North (MMSTBOE) | 16 | 10 | 15 | 22 | 63 |
| Ulven South (MMSTBOE) | 11 | 7 | 10 | 15 | 81 |
| Total * (MMSTBOE) | 23 | 10 | 23 | 36 | |
| ** Total is less than aggregated volumes as both segments are risked / discounted* | | | | | |

**Table 4.2 Technical Inplace Resources "Ulven North" and "Ulven South"**

| | Mean | P90 | P50 | P10 | POSg (%) |
|---|---|---|---|---|---|
| Ulven North (MMSTBOE) | 74 | 54 | 73 | 96 | 63 |
| Ulven South (MMSTBOE) | 52 | 38 | 51 | 68 | 63 |
| Total * (MMSTBOE) | 109 | 50 | 114 | 158 | |
| ** Total is less than aggregated volumes as both segments are risked / discounted* | | | | | |

## 5 Technical assessment

Prospect "Ulven North" and "Ulven South" 36/7-2 were dropped because of partner withdrawal.

## 6 Conclusion

Partnership in the PL989 thought that the opportunities identified in licence PL989 did not present drillable targets based on their current technical understanding, and the significant risks of finding an economic accumulation of hydrocarbons were too high.

An attempt was made by Wintershall Dea Norge AS to find new partners in order to drill "Ulven North", but this attempt failed.