



PL 908 License Surrender Report

Table of contents

Contents

1	License history.....	4
2	Database overviews.....	5
2.1	Geophysical data	5
2.2	Well data	5
3	Results of geological and geophysical studies	7
4	Prospect update report	9
5	Technical evaluation.....	10
6	Conclusion	10

1 License history

License: PL908

Location: Blocks 9/11, 9/12, 10/10 and 10/11 (Norwegian-Danish Basin)

Awarded: 02.03.2018 (APA 2017 application)

License period: Expires 02.03.2025
 Initial period: 7 years

License group:

Equinor Energy AS	70% (Operator)
DNO North Sea (Norge) AS	30%

License area: 1742.614 km²

Work programme: **Work obligation:** EM acquisition (completed)
Decision: Decision to drill (Exp date: 02.03.2020)

Meetings held:

25.04.2018	EC/MC startup meeting
30.10.2018	EC/MC meeting
07.06.2018	Meeting between PL908 members and NPD, discussion on work obligations
13.02.2019	EC workshop
05.04.2019	EC/MC meeting

Work performed:

2018:	License start-up.
2018/2019:	CSEM survey acquisition and geological/geophysical re-evaluation of prospectivity.
2019:	Decision made to surrender the license.

Reason for surrender

The work program in PL908 has focused entirely on maturation of Oligocene prospectivity. EM data has been acquired and integrated into the prospect evaluation. The re-evaluation of the Oligocene opportunities mapped in PL908 has resulted in a decrease in volume, below the current economic threshold. A possible maturation plan for the deeper prospectivity has been discussed within the license. However due to the current immaturity of these concepts in the license area together with the short timeframe available to mature prospectivity to a drill decision before the planned drill or drop date, it has been decided to drop the license.

2 Database overviews

2.1 Geophysical data

Table 1: List of seismic surveys in the common license database (see also Figure 1)

Survey name	Type	Company - responsible	Year	NPDID for survey	Market available
CGME96	2D	Nopec AS	1996	3758	YES
EBS00	2D	Nopec AS	2000	4036	YES
FB92	2D	Geoteam Exploration AS	1992	3496	YES
FP13001	3D	Faroe Petroleum Norge AS	2013	7849	YES
GNSR-91	2D	WesternGeco AS	1991	3391	YES
MC3D-CGR2015M	3D	PGS Geophysical AS	2015	7787 (MC3D-CGR2013), 7904 (MC3D-CGRN13), 7922 (MC3D-NDB2013)	YES
MN9206	2D	Mobil Exploration Norway INC	1992	3521	YES
NSE-R96	2D	Statoil Petroleum AS	1996	-	NO
NSR03R06	2D	Statoil Petroleum AS	2007	738465064 (NSR03 (Survey ID)), 4373 (NSR06)	NO
NSR04	2D	TGS Nopec Geophysical Company ASA	2004	4260	YES
NSR05	2D	TGS Nopec Geophysical Company ASA	2005	4308	YES
NSR06	2D	TGS Nopec Geophysical Company ASA	2006	4373	YES
NSR07	2D	TGS Nopec Geophysical Company ASA	2007	4465	YES
NS-R96	2D	Statoil Petroleum AS	1996	-	NO
NSR-STR07	2D	TGS Nopec Geophysical Company ASA	2007	738465064 (NSR03 (Survey ID)), 4260 (NSR04), 4308 (NSR05), 4373 (NSR06)	YES
PGS16M02	3D	PGS Geophysical AS	2016	7787 (MC3D-CGR2013), 8178 (PGS15001), 8184 (PGS15008)	YES
SET96	2D	Nopec AS	1996	3802	YES
SG8726	2D	Saga Petroleum ASA	1987	3023	YES
SH9203F002_B	2D	A/S Norske Shell	1992	3555	YES
SHD97	2D	Nopec AS	1997	3879	YES
SKAGRE96	2D	Nopec AS	1986	2890	YES
ST8712	2D	Den norske stats oljeselskap a.s	1987	3056	YES
ST99M1-AREA3	3D	Statoil Petroleum AS	1999	273010747 (Survey ID)	YES
UG97	2D	Geoteam Exploration AS	1997	3897	YES
UGI98	2D	Geoteam Exploration AS	1997	3898	YES
VGCNS06NQ8	3D	Det Norske Veritas	2006	4405	YES

Table 2: List of CSEM surveys in the common license database (see also Figure 1)

Survey name	Type	Company - responsible	Year	NPDID for survey	Market available
EMG18256	3D	Electromagnetic Geoservices ASA	2018	8798	YES

2.2 Well data

Table 3: List of wellbores in the common license database (see also Figure 1)

Wellbore name	Completed year	Drilling operator	Content	Oldest penetrated age	NPDID wellbore
2/2-1	1982	Saga Petroleum ASA	Oil/Gas	Late Permian	46
2/2-2	1982	Saga Petroleum ASA	Gas	Late Permian	80
2/2-4	1988	Saga Petroleum ASA	Gas	Late Triassic	1188
2/3-1	1969	Norske Murphy Oil Company	Gas	Late Permian	162
2/3-4	1984	Norwegian Gulf Exploration Company AS	Dry	Late Permian	129
3/6-1	2000	Norsk Agip AS	Dry	Late Cretaceous	4117
4/4-1	2013	Repsol Exploration Norge AS	Dry	Late Cretaceous	7270
8/12-1	1971	Conoco Norway Inc.	Dry	Triassic	193
9/8-1	1988	Esso Exploration and Production Norway A/S	Oil Shows	Late Permian	145
9/10-1	1970	Norske Murphy Oil Company	Dry	Late Cretaceous	183
9/11-1	1971	Conoco Norway Inc.	Shows	Triassic	194
9/12-1	1969	A/S Norske Shell	Dry	Triassic	163
10/4-1	2015	Wintershall Norge AS	Dry	Permian	7724
10/7-1	1992	Esso Exploration and Production Norway A/S	Dry	Late Permian	1972
11/10-1	1969	Syracuse Oils Norge A/S	Dry	Triassic	170
35/2-1	2005	Norsk Hydro Produksjon AS	Gas	Late Pliocene	5135
DK-Francisca 1	1998	Dansk Operatørselskab	Gas	Lower Tertiary	-
DK-Sandra 1	1998	Statoil E&P A/S	Dry	Late Cretaceous	-
DK-Vivi 1	2004	DONG E&P A/S	Shows	Late Cretaceous	-

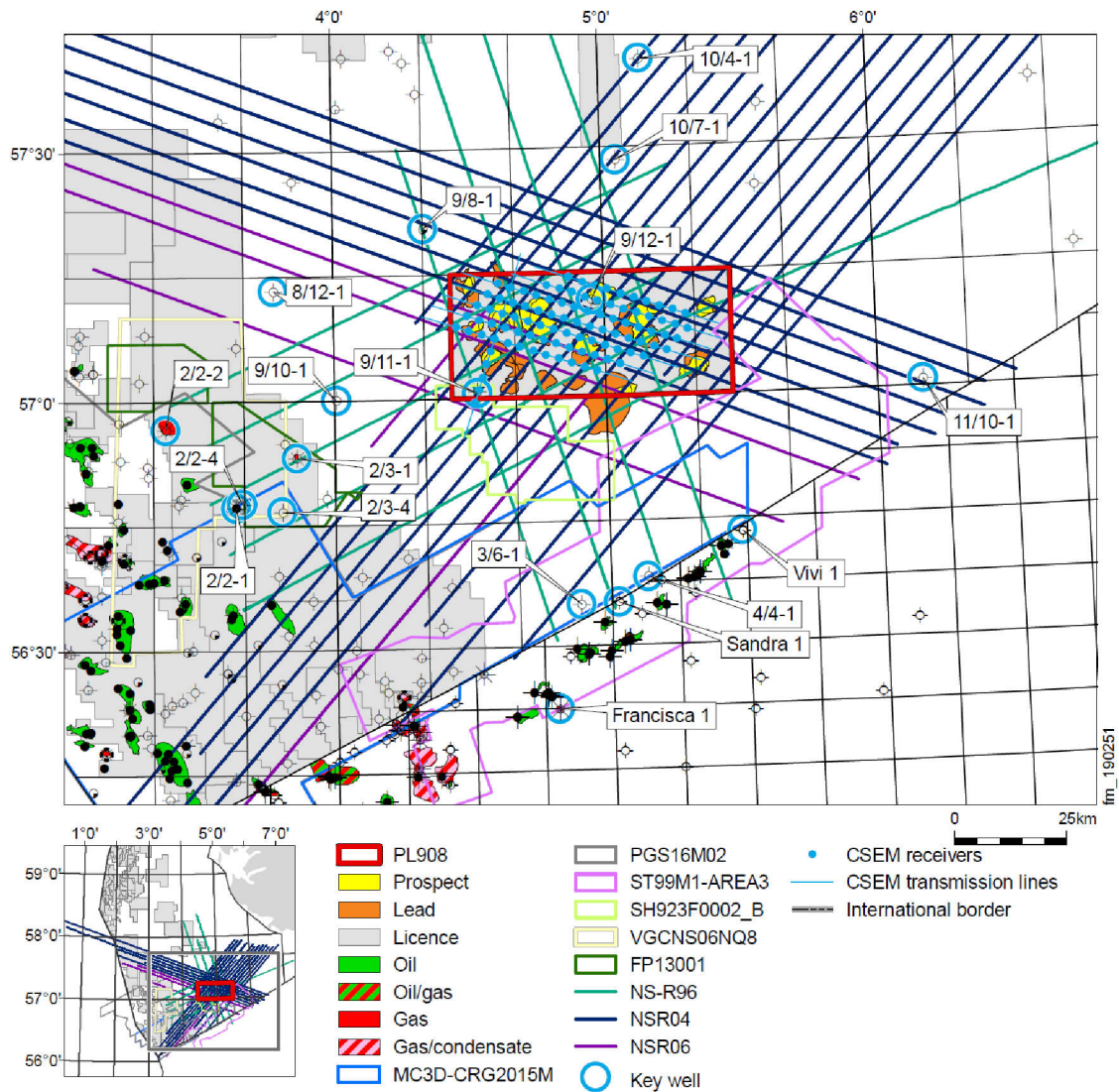


Figure 1: Seismic, CSEM and well database. Only the most important surveys are included on the map.

3 Results of geological and geophysical studies

The PL 908 main prospectivity is a cluster of shallow four-way closures of Oligocene age, with the Vade Formation as reservoir. Eleven prospects and leads have been mapped on multiple 2D seismic vintages. The main risk component is source presence and migration. Dry gas, generated through a biogenic process, is the most likely phase in place. Most structures are associated with seismic DHIs (amplitude anomalies, flat-spots and pull downs) leading to high probability of success. A systematic inconsistency can however be observed between amplitude shut-offs and structural closures. The mapping and resulting estimated in place volume are uncertain. A higher weight was ultimately given to amplitude anomalies during the initial evaluation to build a success case.

A 3D CSEM survey was acquired within PL 908 to reduce resource estimate uncertainty and constrain the high-end of the volume distribution. Through scenario modelling EM data can address hydrocarbon saturation, degree of filling and reservoir parameters. The survey was collected in July 2018 by EMGS. The main opportunities are covered by a 3km x 3km receiver grid. The data quality is adequate within the frequency and offset range required to resolve the interval of interest. Data QC, processing and imaging (3D Gauss-Newton inversion) was conducted by Equinor on behalf of the license. The overall CSEM inversion results are robust and the retrieved background resistivity are comparable to well measurements. Among the three largest prospects identified within PL908 only Viby shows a clear resistivity anomaly, conformant with the mapped structure but confined to the crestal area (see Figure 2).

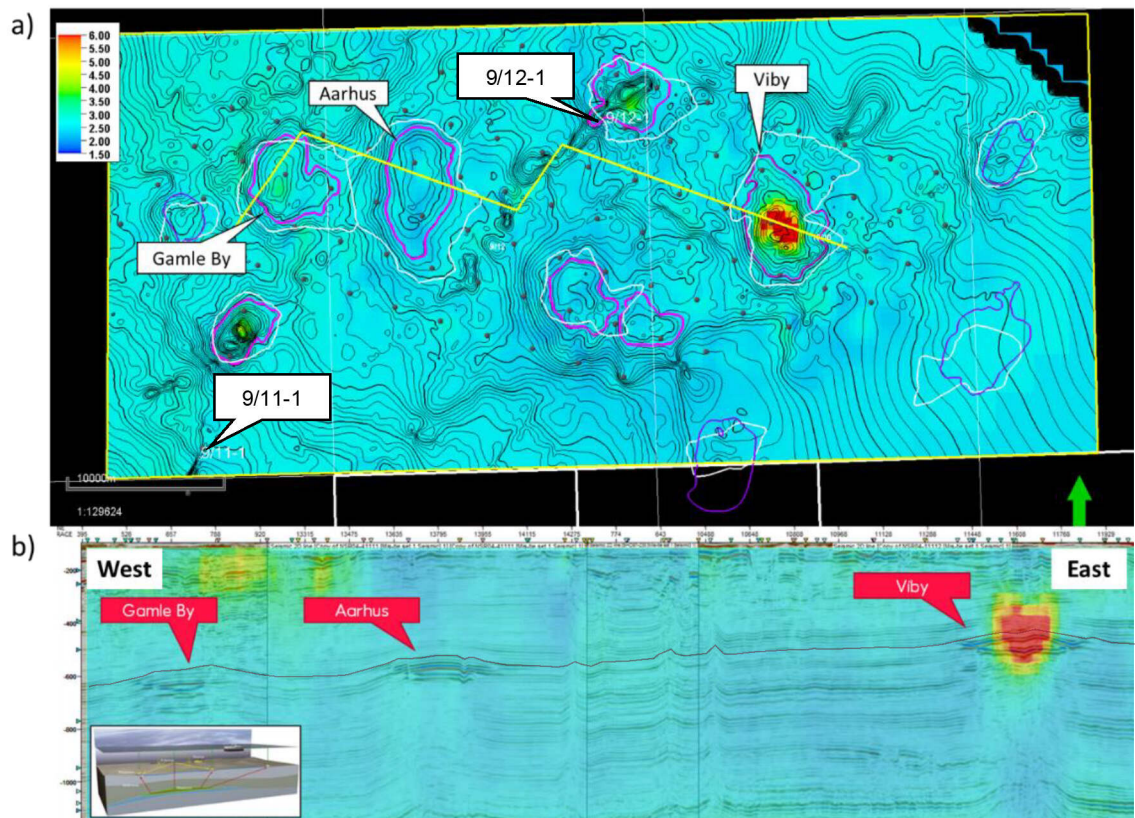


Figure 2: a) Top Vade Fm. depth map overlaid with mean vertical resistivity (+/- 200m). The white and purple outlines show amplitude shut-offs and structural closures, respectively. The black dots show the location of the CSEM receivers. b) Composite line through Gamle-By, Aarhus and Viby, showing the CSEM response (vertical resistivity) on top of the 2D seismic.

Integrated interpretation was conducted to build a model consistent with CSEM, seismic and well data available. Scenario testing (post inversion modelling) was first conducted on Viby for a fill-to-spill and under-filled scenario (see Figure 3c and 3d). The anomaly retrieved from the fill-to-spill scenario is significantly larger than the observation, indicating that smaller volumes are required. The under-filled scenario fits the CSEM data better in term of anomaly size, but depth placement appears to be incorrect. This scenario would also imply charge or retention capacity limitations challenging to explain.

Seismic facies are also incompatible with an underfilling of the structure. Viby shows indeed a clear “lens like” feature, within the lower half of the prospect, that could on the contrary indicate the presence of a thick gas filled interval towards the base of the Vade Formation (see 2D modelling results, Figure 4). Additional scenario testing was completed and proved that, in addition to honouring seismic observations, this model fits the CSEM data the best (see Figure 3b). For such a heterogeneous vertical sand distribution, the bulk of the net reservoir is sitting deep into the structure and is mostly contained within the crestal area (see Figure 5). As a result, the areal extend and magnitude of the CSEM anomaly can be explained while still filling the structure to the spill point.

Aarhus and Gamle-By show a much more compact sequence of reflectors, most likely indicating a low net-gross/interbedded reservoir (see Figure 4). It should also be noted that closure height is significantly shorter than Viby. Aarhus and Gamle-By have an estimated closure height of 26 and 30 m, respectively, against 50m on Viby. A thick sand package could therefore exist in this area (as indicated by well 9/11-1, Figure 3), but be trapped below the Gas Water Contact (GWC) due to insufficient structural relief (see Figure 5). A sensitivity study was completed to define the detection threshold for CSEM on those two prospects. The results are presented and discussed in the next chapter.

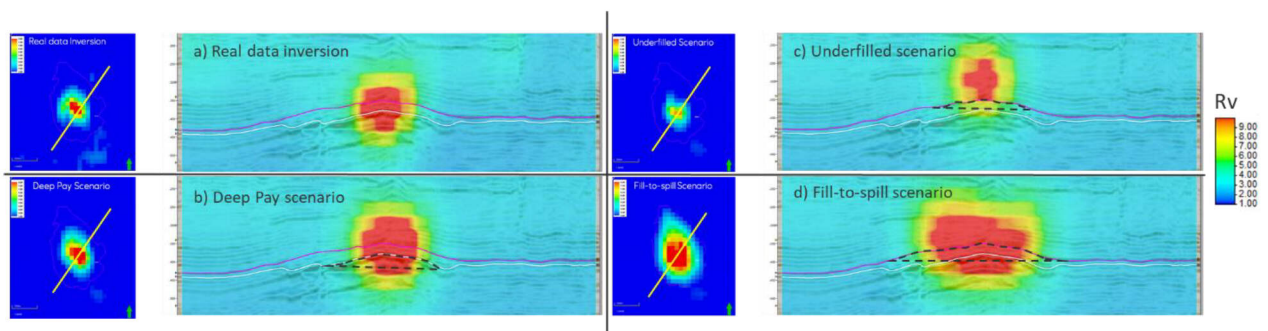


Figure 3: Scenario testing, comparison of real data inversion and inversion of synthetic data for different reservoir scenarios on Viby. For each scenario, the resistivity filled section of the reservoir is outlined with a dash line. Model resistivities were adjusted for each scenario to match the transverse resistance (product of resistivity and thickness) observed in the real data inversion.

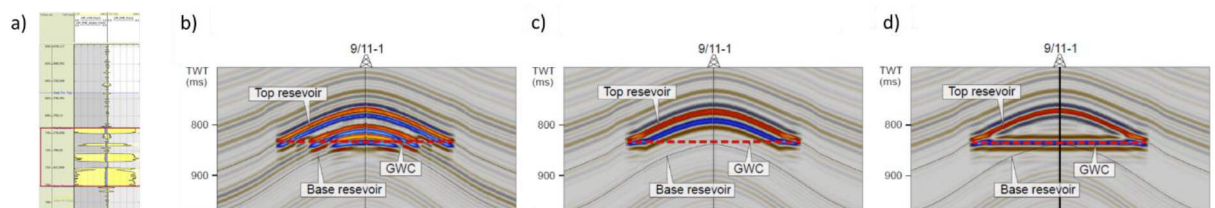


Figure 4: Well 9/11-1: sand distribution within the Vade formation (a). 2D zero offset modelling of interbedded reservoir (b), thin homogeneous reservoir (c) and thick homogeneous reservoir (d). This exercise demonstrates that a thick, continuous sand interval is necessary to build a feature similar with what observed on Viby (see Figure 1)

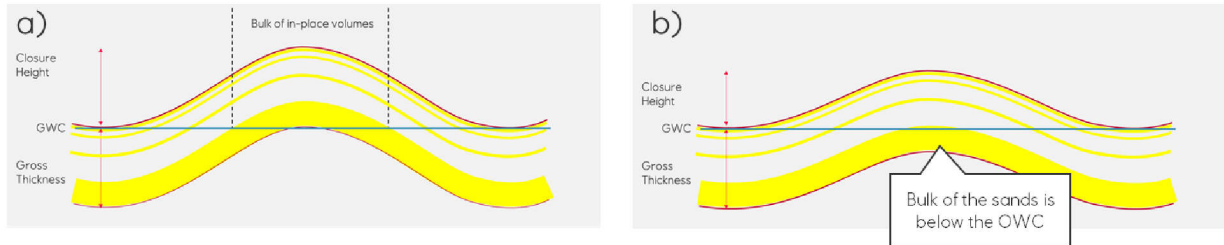


Figure 5: Illustration showing how net pay can be affected by vertical sand distribution for a high relief (a) and a low relief (b) four-way closure. If the structure is tall enough, some of the thicker sands can emerge above the GWC contact. Most of the in-place volume are then located within the crestal area. If the structure has a lower relief, the thick sandy interval will most likely be below the GWC. Only the low Net/Gross section of the reservoir unit is left above the GWC.

4 Prospect update report

The scenario testing demonstrated that the lower sands are most likely the main contributors to the expected in place volume in Viby. High resistivity ($\sim 150 \Omega.m$) is required to replicate the observed anomaly. A saturation model was built using petrophysical parameters derived from well 9/11-1, 9/12-1, 2/2-1, 2/2-2 and 2/3-1 (see Figure 6). This model indicates that the resistivity required to replicate the Viby anomaly should correspond to hydrocarbon saturation in the order of 85-90%.

The prospect model for Viby has been revised. The top reservoir map, net-to-gross ratio, GWC and saturation distribution were adjusted, and an EM uplift was applied. The probability of success (P_g) on Viby increased from 63 to 80% but the mean in place volumes were reduced from 14.3 to 2.82 MMBOE (Table 4).

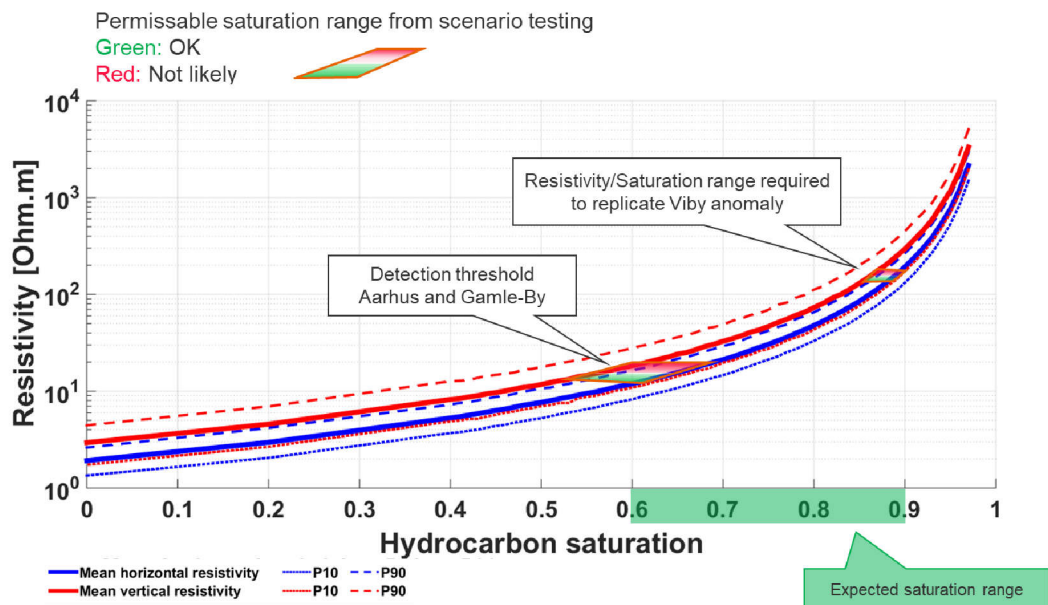


Figure 6: Saturation vs resistivity model built for the Oligocene play in PL908

Scenario testing was also conducted for Aarhus and Gamle-By. The detection threshold for hydrocarbons within those prospects was established at 55-65% saturation for a fill to spill scenario, indicating that most of the model space is incompatible with the EM results (Figure 6). If the degree of filling within those targets was as deep as the mapped amplitude shut-off with saturations within the expected range, CSEM anomalies should have been observed on Aarhus and Gamle-By. The contact distribution within Aarhus and Gamle-By was restricted to the structural spill and an EM downgrade was applied. As a result, the Pg was reduced from 63 to 42% and the mean in-place volumes reduced from 28.9 to 7.07 MMBOE and from 18.8 to 5.91 MMBOE on Aarhus and Gamle-By, respectively (Table 4).

Table 4: Updated recoverable resources for Aarhus, Gamle-By and Viby

Aarhus	Unrisked Recoverables (Gas, MMBOE)			Pg (%)
	P90	Mean	P10	
APA 2017	9.87	28.9	58.8	63
2019 Update	4.07	7.07	10.6	42
Gamle By	Unrisked Recoverables (Gas, MMBOE)			Pg (%)
	P90	Mean	P10	
APA 2017	8.2	18.8	34.9	63
2019 Update	3.4	5.91	8.68	42
Viby	Unrisked Recoverables (Gas, MMBOE)			Pg (%)
	P90	Mean	P10	
APA 2017	5.05	14.3	29.5	63
2019 Update	2.15	3.82	6.09	80

5 Technical evaluation

Given the location of PL908, a standalone development including an Unmanned Production Platform (UPP) located on Aarhus and further gas export to Europipe II was assumed as a concept. Provided the outcome of the updated prospect evaluation it was not found necessary to revisit the development plan.

6 Conclusion

The work program for PL 908 has been completed with the acquisition of a 3D CSEM survey. The new data were used, in combination with other geological and geophysical elements to update the prospect evaluation. The updated volumes are significantly reduced and are below the economic threshold. As a result, the PL 908 partnership has decided to drop the license.