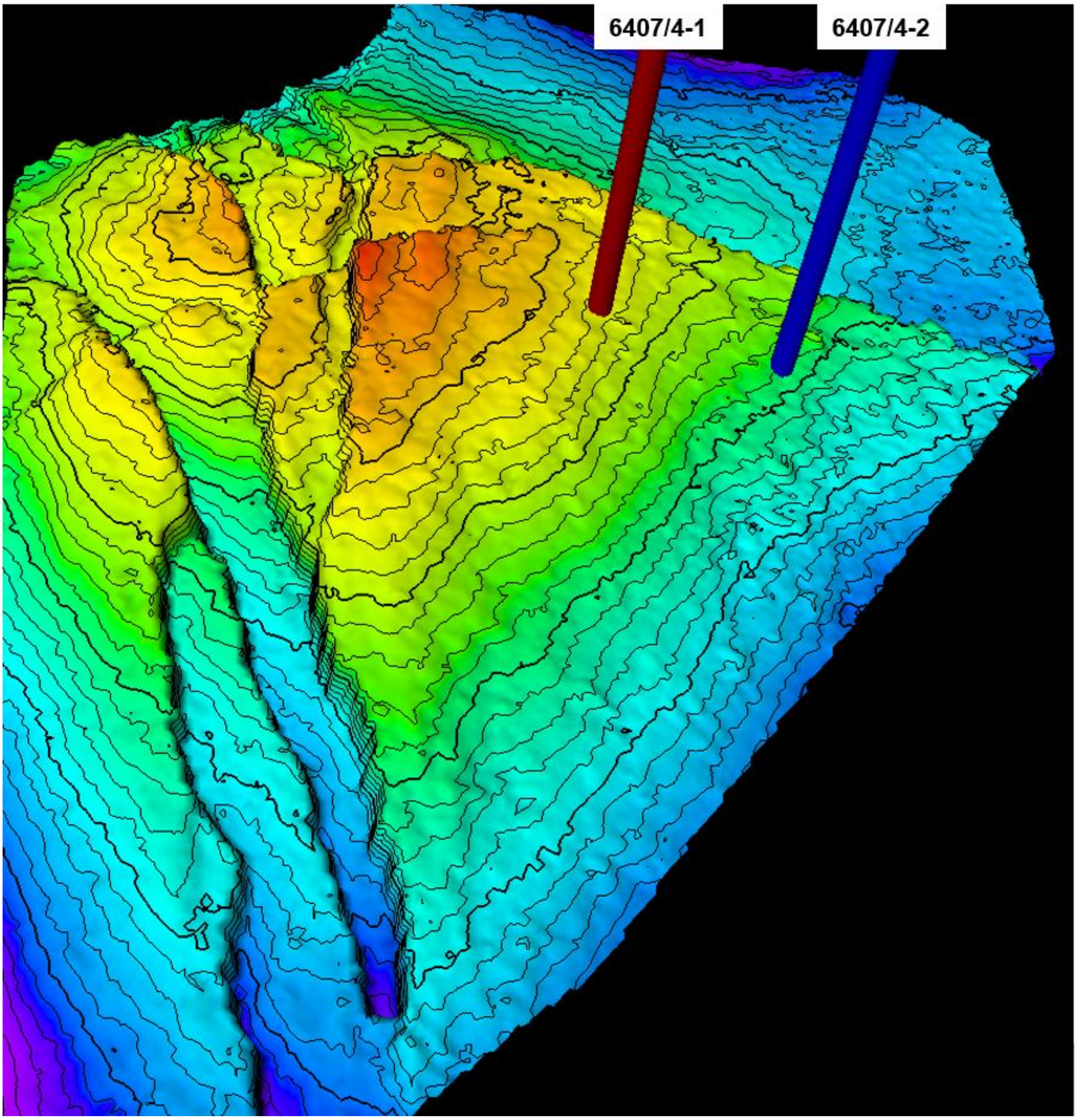
Relinquishment Report PL 690



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1 Introduction

1.1 License ownership

- Aker BP ASA (50%), operator
- Point Resources AS (50%)

1.2 Award and Work Program

The license was awarded on the 8th February 2013 for an initial period of 7 years following the APA Licensing Round 2012, with a Drill or Drop decision within two years. The Spinel structure was previously operated by Statoil twice, and this was the third time the area was awarded. This time the initial partners in the license were Bridge Energy (Op), Svenska Petroleum and Bayerngas. In 2015, Aker BP (Det norske) acquired Svenska Petroleum's assets, and in 2016 Aker BP took over the operatorship of the license.

The primary license work obligations have been fulfilled. These included:

- Reprocess 3D seismic
- G&G studies

1.3 PL 690 Prospectivity

PL 690 is situated in the middle to southern part of the Halten Terrace, between the North and South Gimsan Basins (Fig. 1.1). The extent of the license is identical with block 6407/4, and covers an area of 444km^2.

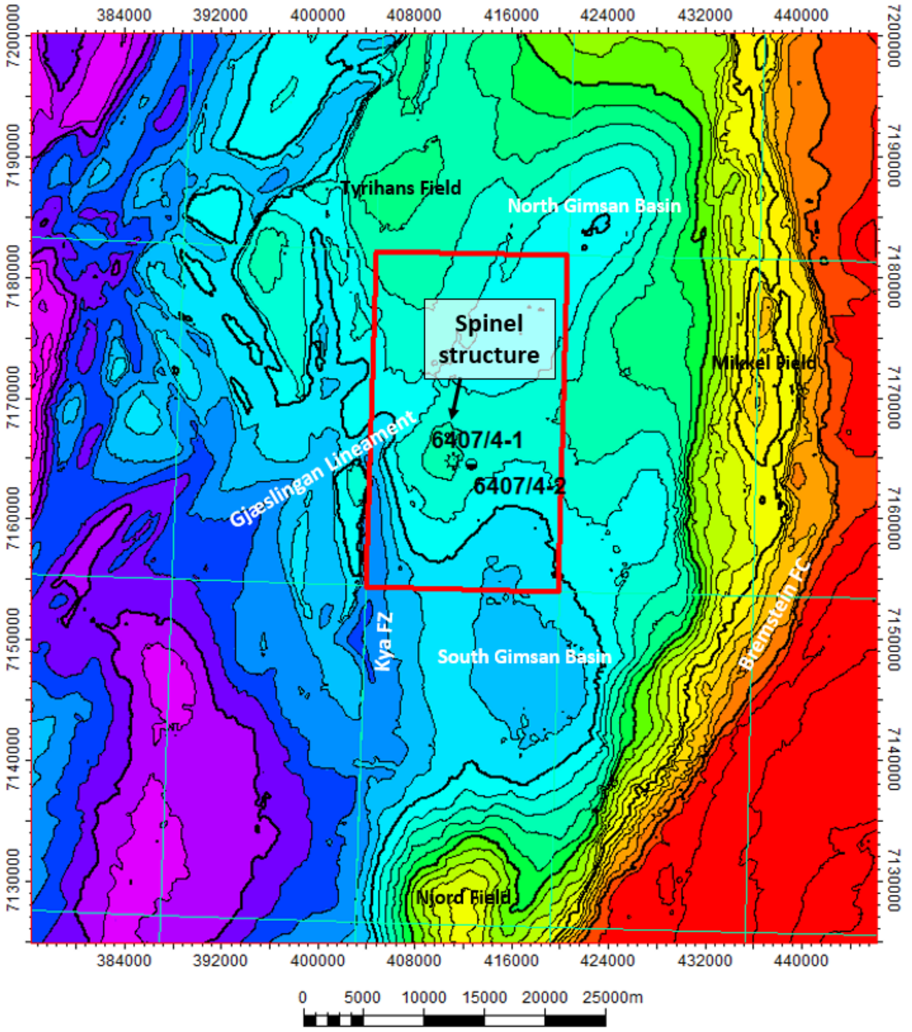

Fig. 1.1 Position of PL690 (red outline) on the Halten Terrace. BCU time map.

The Spinel structure is located at the intersection between the Kya Fault Zone and the Gjæslingen Lineament centrally in the Gimsan Basin (Fig.1.1). The structure is a large Lower to Upper Jurassic dome-like fault block with 3-way dip closure.

Due to its position directly over a large salt-pillow, the structure shows considerable internal complexity, and has been divided into three segments: Main/East, North and West (Fig. 1.2). The West segment is internally very complex, and in reality consists of several smaller fault blocks.

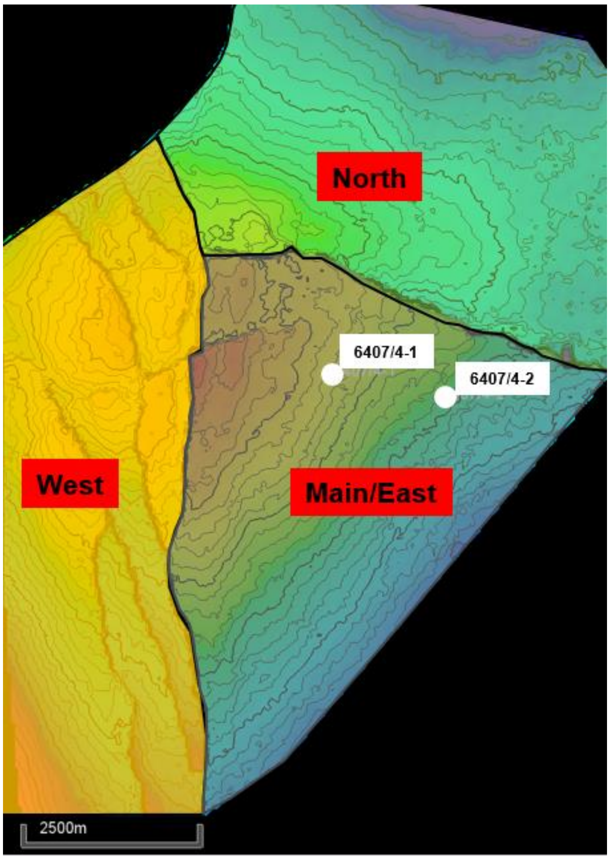

Fig. 1.2 Spinel structure, definition of segments: Main/East, West and North. Both the drilled wells, 6407/4-1 & 4-2 had the Main/East segment as target.

In 1985, Statoil as operator of PL 106, drilled well 6407/4-1 targeting the Main/East segment (Fig. 1.2) of the Spinel structure. Gas/condensate was found in a tight Garn Fm and a minor gas/condensate discovery was also indicated in the uppermost Tilje Fm.

Statoil later came back to the area as operator of PL 429, and drilled 6407/4-2 as an appraisal well on the same segment as the previous well (Fig. 1.2). Shows were recorded in the Garn Fm.

On account of the observed pressure differences between the reservoirs, as well as general observation of Halten Terrace inter-well pressure differences, Svenska Petroleum maintained that in particular Spinel's North segment could contain a large upside. According to Svenska Petroleum, oil shows in the Uppermost Tilje (Tilje 3) in well 6407/4-1 could be indicative of oil filling in the good Tilje 2 reservoir zone, both updip in the Main/East segment and in the separate North segment.

Svenska Petroleum's views on oil shows in the Tilje 3, and a North segment upside is not shared by Aker BP.
Aker BP interprets the Tilje 3 shows as caused by a previous filling by gascondensate. Also, the concept of a separate filling in the North segment is seen as highly unlikely based on seismic interpretation that shows no throw on critical faults.

In addition to the potential represented by the variuos segments and reservoirs at Spinel, Svenska Petroleum also identified two prospects/leads towards the northeast. The largest of these was named Runa and is situated wholly within block 6407/4. The Runa prospect/lead is a faulted 3-way dip closure on the footwall of the Gjæslingan Lineament. A similar, but smaller, prospect/lead named Alva straddles the block boundary towards 6407/1.

2 Database

2.1 Seismic Database

The initial common 2D and 3D seismic database for the license is listed in Table 2.1 and illustrated in Fig. 2.2. The ST0809 3D was acquired during Statoil's second license period and covers most of PL 690. The HBGS83 2D seismic survey was used to infill the 3D seismic gap to the southeast, and as tie lines between the two 3D seismic surveys.

Table 2.1 Seismic database in PL690

Survey	Vintage	2D/3D	public?	Comments
ST0809	2008/9	3D	yes	fast-track processed, fullstack
Terracube	2011	3D	no	Fugro/Mid-Norway merge
HBGS83	1983	2D	yes	

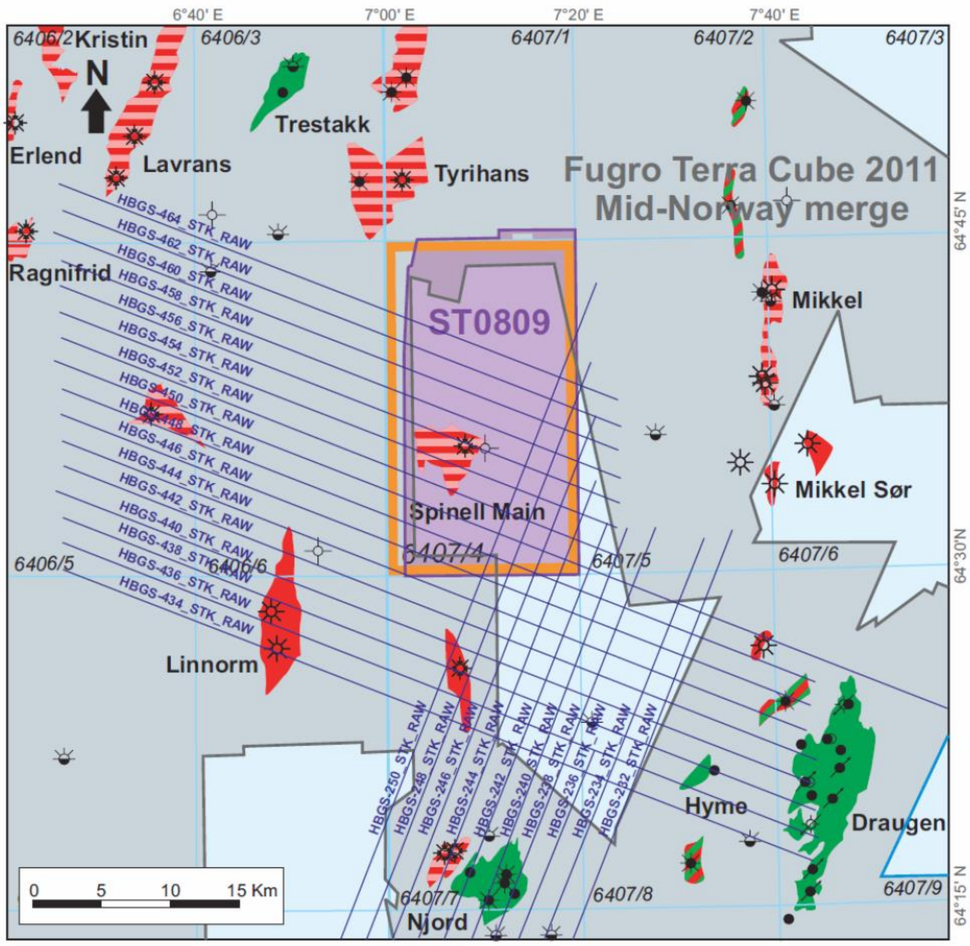

Fig. 2.1 Location of the seismic database in PL690. ST0809 is shown in purple, the Fugro Terra Cube 2011 is shown in gray and the utilized 2D seismic lines (HBGS83) is highlighted by the blue lines.

2.1.1 Seismic reprocessing

In 2013 TGS reprocessed 950 km^2 3D seismic data on behalf of Bridge Energy Norge A/S (KILDE!!). This dataset covers block 6407/4.

Statoil's primary 3D seismic survey, ST0809, was merged pre-stack with parts of HWE96 to provide desired data coverage over western parts of block 6407/4. Both surveys were matched in terms of amplitude, phase and time. Prior to migration, the primary survey (ST0809) covered an area of 400 km^2, and after migration, the resulting area covered was 511km^2.

The re-processing target was to improve the imaging and resolution in the Jurassic section below 3000ms and the complex fault definition at the target level.

2.2 Well Data

The common well database is listed in table 2.2 and illustrated in fig. 2.3.

The license area covers two key wells, 6407/4-1 and 6407/4-2. As previously mentioned, well 6407/4-1 was drilled in 1985 by Statoil as operator of PL106, and found gas/condensate in the Garn Fm. Well 6407/4-2 was drilled by PL 429 in Statoil's second phase of operatorship. The well was dry, but with shows in the Garn Fm. Other wells with importance for the prospectivity in the area include the Noatun and Linnorm discoveries.

Table 2.2 Well database PL690

Well	Year	Fm. at TD	Data	Comments
6406/6-1	1985	Tilje	Logs, CPI, Well Tops	
6406/6-2	2007	Tilje	Logs, CPI, Well Tops	
6406/9-1	2005	Åre	Logs, CPI, Well Tops	Linnorm discovery
6407/1-2	1983	Late Triassic	Logs, CPI, Well Tops	Tyrihans field
6407/4-1	1985	Åre	Logs, CPI, Well Tops, Core, Comp & Discovery Reports	Spinell discovery
6407/4-2	2011	Ile	Logs, CPI, Well Tops, Core	Spinell appraisal
6407/5-1	1988	Garn	Logs, CPI, Well Tops	
6407/7-8	2008	Åre	Logs, CPI, Well Tops	Noatun discovery

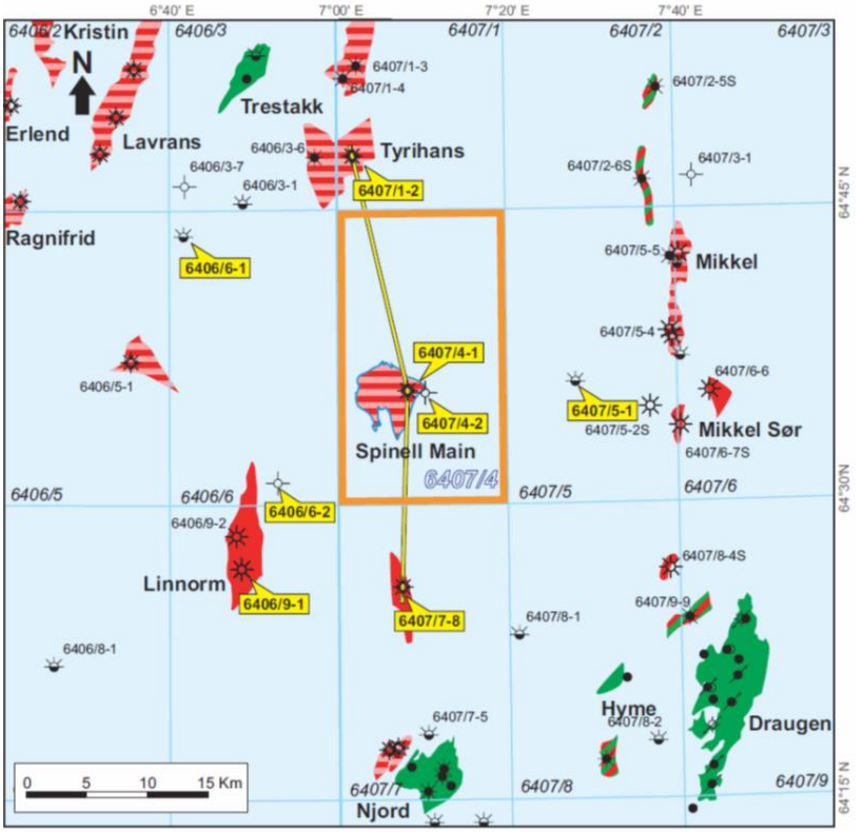

Fig. 2.2 Location of wells in common database PL690. The yellow labels show key wells with available CPI's.

2.3 Special Studies

Stress and Fault Reactivation Analysis

June 2014 Badleys completed a stress and fault reactivation analysis of eight selected faults within the PL690 (Clarke, 2014). The aim of this study was to investigate the fault reactivation potential, and hence hydrocarbon leakage potential for different stress states and overpressure scenarios. In this work, a cellular model of the area was imported into TrapTester together with well data (well paths, picks and curves). Fault surfaces and polygons were also created and edited.

Petrography and reservoir quality analysis

In 2014, CGG Robertson completed a petrography and reservoir quality analysis in the Spinel area (Davidson et al., 2014). The aim of this study was to identify depositional and diagenetic factors controlling reservoir quality to aid understanding and prediction of reservoir quality distribution.

The study has involved the detailed analysis of core samples from wells 6407/4-1, 6407/4-2 and 6407/7-8, from between 3889m and 4967m. The interval analysed includes sandstones from the Garn, Ile and Tilje Formations, of Lower to Middle Jurassic age. The reservoirs in question all show degradation due to quartz sementation and clay mineral precipitation, the only exception being the Tilje 2 interval where abundant grain coating chlorite to a large extent has preserved porosity and permeability.

Petroleum System Analysis

In 2014 Schlumberger completed a study of the 3D Petroleum System of the Spinel structure in PL690 (Thiakalingam, 2014). The aim of this 3D petroleum system model was to understand the main factors that control the generation, migration and accumulation of HC in the Spinel structure. Accordingly, the key targets was to observe gas in the Garn Fm and hydrocarbon shows in the Tilje Formation.

Textural petrophysical analysis
In 2014, Nutech completed a Nulook textural petrophysical analysis of well 6407/4-1, 6407/7-1S and 6406/6-3 (Nutech, 2014). Each well have been evaluated using the following data: Gamma ray, Spontaneous Potential, Resistivity, Caliper, Neutron, density and Sonic data. In addition, Core samples and Gas Logs was used as auxiliary data.

Pressure analysis
In 2013 a pressure analysis was carried out in the Jurassic formation pressures, in and around the Gimsan Basin (Bridge Energy, 2013). The main objectives was to summarize the distribution of pressures in the Jurassic sandstone units and establish a pressure model for the Gimsan basin and the surroundings.

In this work, the general pressure distribution on the Halten Terrace was used (Nordgård Bolås and Hermanrud 2003, Lothe et al. 2003, Lothe et al. 2004). The overpressures analysis has been based on data from about 50 wells with pressures recorded mainly in the Garn, Ile and Tilje Fms. The pressure measurements are mainly recordings of MDT, RFT and DST.

Reservoir production evaluation study
PERA A/S did a reservoir study of Spinel on the basis of the 6407/4-1 well results (Whitson & Juell, 2006). This showed that the Garn Fm reservoir at Spinel is extremely sensitive to permeability variations and that in order to get satisfactory production from the reservoir one would have to rely on drilling horizontal producers with stimulation to achieve sustained rates. This effect was especially noticeable for condensate rates.

3 Prospect Evaluation

Aker BP has performed petrophysical analyses of the discovery well 6407/4-1 and performed G&G work using Petrel software in order to arrive at a best assessment of proven and hypothetical resources for the various reservoirs and segments at Spinel.

The cases that have been evaluated by Aker BP are given in Table 3.1. Gascondensate is considered proven in the Garn Fm in the Main/East segment, with additional, but hypothetical volumes in the West segment. In the Uppermost Tilje Fm a small column of gascondensate is considered proven in the Main/East segment and hypothetical volumes may exist in the West segment. With regards to the Tilje Big case, this is considered as a higher risk filling case involving the entire Tilje Fm down to a common HCW contact. Aker BP does not consider the North segment as defined by Svenska Petroleum as a valid separate segment.

Table 3.1 Cases evaluated by Aker BP

Case	Phase	Segments	Status
Garn	Gascondensate	Main & West	Proven (Main) & hypothetical (West)
Tilje Upper	Gascondensate	Main & West	Proven (Main) & hypothetical (West)
Tilje Big	Gascondensate	Main & West	Hypothetical (Main & West)

3.1 Garn gascondensate case filling Main/East and West segments

There is some uncertainty as to the position of the HCW in the 6407/4-1 well, but petrophysical analyses indicates a mode value of 3971m TVDSS. The parameters used in the volume calculations are given in Table 3.2, and the mode filling case for the Main/East and various elements of the West segment is shown in Fig. 3.1. The Garn Fm is underfilled either due to lack of enough charge from a lean Spekk/Melke source rock, or alternatively, reflects leakage.

Table 3.2 Parameters used for the Garn Fm filling case, Main/East and West segment

Parameter	Min	Mode	Max
HCW(mTVDSS)	3960	3971	3982
N/G	0.4	0.7	0.9
Porosity	0.08	0.11	0.13
Reservoir thickness	53	79	85
Gas saturation	0.5	0.6	0.85
Recovery factor condensate	0.2	0.3	0.4
Recovery factor non associated gas	0.3	0.45	0.5
Wet gas shrinkage factor	0.96	0.98	1.0
Expansion factor gas	265	285	300
Condensate yield	475	540	625

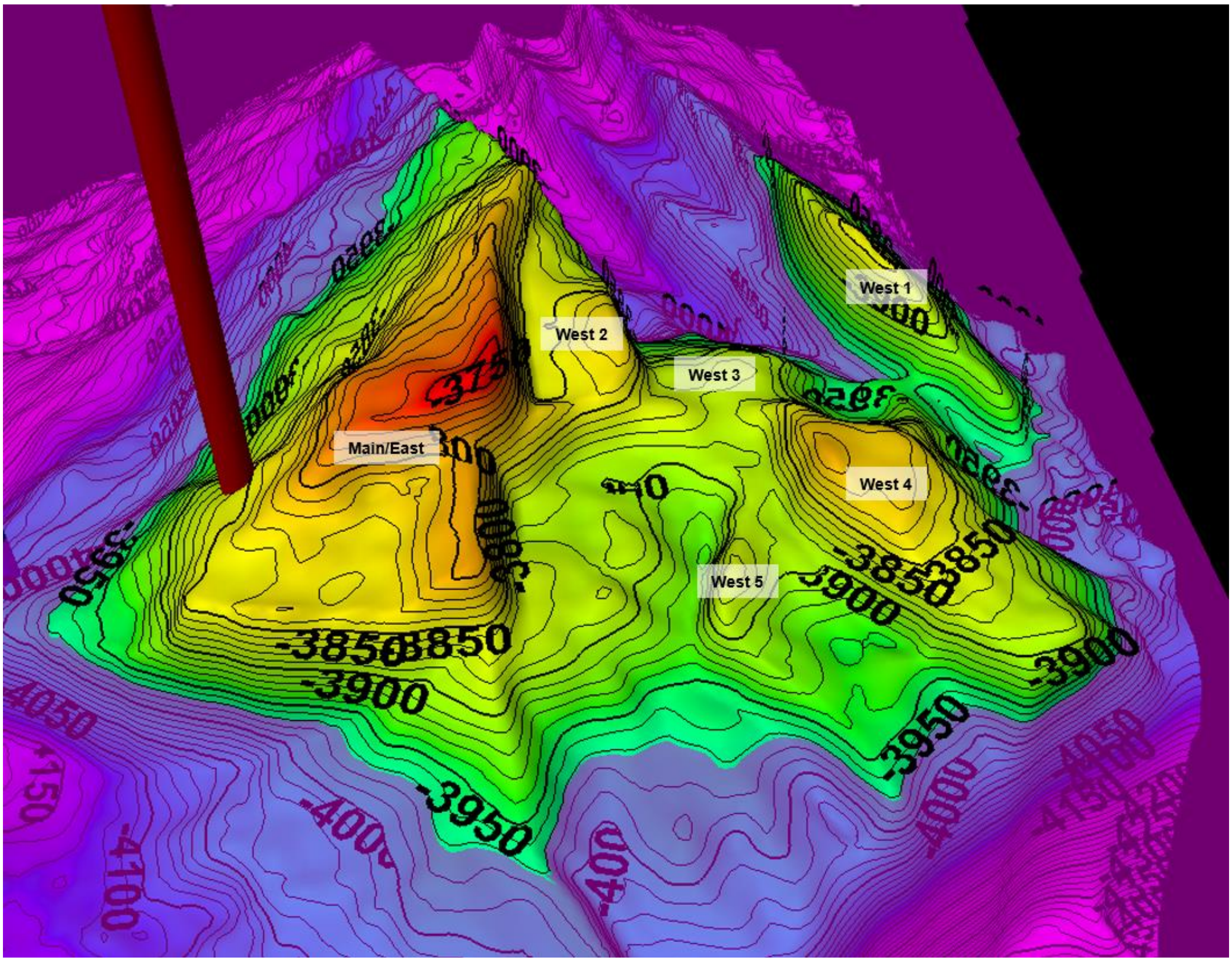

Fig. 3.1 Illustration of the mode filling case at 3971m TVDSS for the Garn Fm in the Main/East and the complex West segment. 3D look direction towards the southwest.

The calculated recoverable volumes, proven and hypothetical for this filling scenario is given in Table 3.3. Note that only volumes in the Main/East segment is considered proven. The filling of the various fault blocks of the West segment is considered as hypothetical volumes, with low to medium risk.

Table 3.3 Recoverable resources Garn Fm gascondensate. Undifferentiated proven (Main/East) and hypothetical (West)

Case	P90			P50			P10		
	Gas 10^9Sm^3	Cond 10^6Sm^3	Total 10^6Sm^3	Gas 10^9Sm^3	Cond 10^6Sm^3	Total 10^6Sm^3	Gas 10^9Sm^3	Cond 10^6Sm^3	Total 10^6Sm^3
Garn gascondensate	3.58	1.31	4.98	**4.96**	**1.86**	**6.83**	6.61	2.57	9.06

3.2 Tilje Upper gascondensate case filling Main/East and West segments

The petrophysical logs indicates that the uppermost Tilje Fm in well 6407/4-1 has a filling of gascondensate trapped between the Ror Fm shales and most probably with an intra formational Tilje Fm shale as base seal, Fig. 3.2.

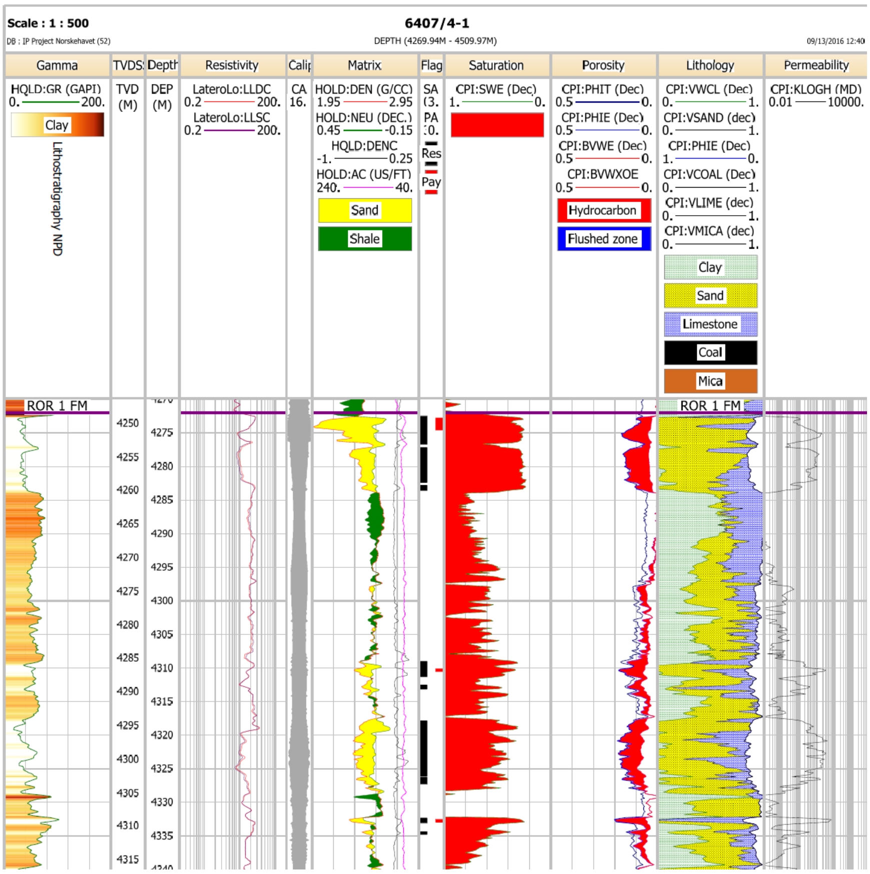

Fig. 3.2 Aker BP's CPI for the Uppermost Tilje in the 6407/4-1 well.

Table 3.4 lists the parameters that have been utilized in the Tilje Upper case. This filling scenario for the Uppermost Tilje is seen as the most realistic filling case for the Tilje Fm. It represents underfilling, or alternatively leakage, of the Tilje Fm reservoir, which is most likely sourced from an Åre Fm source rock.

Table 3.4 Parametres for the Tilje Upper case

Parameter	Min	Mode	Max
HCW Case Tilje Upper	4265	4285	4325
N/G Case Tilje Upper	0.45	0.6	0.75
Porosity Case Tilje Upper	0.13	0.15	0.17
Reservoir thickness Case Tilje Upper	10	12	20
Gas saturation	0.5	0.6	0.85
Recovery factor condensate	0.2	0.3	0.4
Recovery factor non associated gas	0.3	0.45	0.5
Wet gas shrinkage factor	0.96	0.98	1.0
Expansion factor gas	265	295	325
Condensate yield	475	540	625

The calculated recoverable volumes, proven and hypothetical for this filling scenario is given in Table 3.5. Note that only volumes in the Main/East segment is considered proven. The filling of the various fault blocks of the West segment is considered as hypothetical volumes, with low to medium risk.

Table 3.5 Recoverable resources Tilje Upper case, gascondensate. Undifferentiated proven (Main/East) and hypothetical (West)

Case	P90			P50			P10		
	Gas 109Sm3	Cond 106Sm3	Total 106Sm3	**Gas 109Sm3**	**Cond 106Sm3**	**Total 106Sm3**	Gas 109Sm3	Cond 106Sm3	Total 106Sm3
Tilje Upper gascondensate	1.12	0.41	1.56	**1.53**	**0.58**	**2.12**	2.12	0.82	2.91

3.3 Tilje Big gascondensate case filling Main/East and West segments

The Tilje Big case is considered as a higher risk filling case involving the entire Tilje Fm down to a common, most likely HCW contact at 4285m TVDSS.

The petrophysical parametres used in the Tilje Big case is given in Table 3.6.

Table 3.6 Parametres for the Tilje Big case

Parameter	Min	Mode	Max
HCW Case Tilje Big	**4284**	**4285**	**4310**
N/G Case Tilje Big	**0.45**	**0.6**	**0.75**
Porosity Case Tilje Big	**0.13**	**0.15**	**0.17**
Reservoir thickness	**220**	**230**	**240**
Gas saturation	**0.5**	**0.6**	**0.85**
Recovery factor condensate	**0.2**	**0.3**	**0.4**
Recovery factor non associated gas	**0.3**	**0.45**	**0.5**
Wet gas shrinkage factor	**0.96**	**0.98**	**1.0**
Expansion factor gas	**265**	**295**	**325**
Condensate yield	**475**	**540**	**625**

The calculated recoverable volumes, mostly hypothetical for this filling scenario is given in Table 3.7. Since this case involves filling of the entire Tilje Fm it carries a fairly high risk, and Aker BP has risked this scenario to 0.18.

Table 3.7 Recoverable resources Tilje Big case, gascondensate. Risk 0.18.

Case	P90			P50			P10		
	Gas 109Sm3	Cond 106Sm3	Total 106Sm3	**Gas 109Sm3**	**Cond 106Sm3**	**Total 106Sm3**	Gas 109Sm3	Cond 106Sm3	Total 106Sm3
Tilje Big gascondensate	6.81	2.48	9.51	**8.79**	**3.3**	**12.1**	11.3	4.4	15.4

3.4 Total recoverable resources in Spinel

Aker BP has investigated the most likely, probable, resource base for development at Spinel, and in doing so, two alternatives with resources in the Garn and Tilje Fms have been considered (Chapters 3.1-3.3).

The two alternatives are:

1. Garn gascondensate plus Tilje Upper gascondensate
2. Garn gascondensate plus Tilje Big gascondensate

The resource base for the two alternatives are given in Table 3.8 and 3.9. Alternative 1 is considered to be the most likely scenario to materialise, whereas in Alternative 2 the Tilje Big case has an estimated risk of 0.18.

Table 3.8 Alternative 1: Garn plus Tilje Upper gascondensate case.

Cases	P90			P50			P10		
	Gas 109Sm3	Cond 106Sm3	Total 106Sm3	**Gas 109Sm3**	**Cond 106Sm3**	**Total 106Sm3**	Gas 109Sm3	Cond 106Sm3	Total 106Sm3
Garn gascondensate	3.58	1.31	4.98	**4.96**	**1.86**	**6.83**	6.61	2.57	9.06
Tilje Upper gascondensate	1.12	0.41	1.56	**1.53**	**0.58**	**2.12**	2.12	0.82	2.91
Total	4.7	1.72	11.5	**6.49**	**2.44**	**8.95**	8.73	3.39	11.97

Table 3.9 Alternative 2: Garn plus Tilje Big gascondensate case.

Cases	P90			P50			P10		
	Gas 109Sm3	Cond 106Sm3	Total 106Sm3	**Gas 109Sm3**	**Cond 106Sm3**	**Total 106Sm3**	Gas 109Sm3	Cond 106Sm3	Total 106Sm3
Garn gascondensate	3.58	1.31	4.98	**4.96**	**1.86**	**6.83**	6.61	2.57	9.06
Tilje Big gascondensate	6.81	2.48	9.51	**8.79**	**3.3**	**12.1**	11.3	4.4	15.4
Total	10.39	3.79	14.49	**13.75**	**5.16**	**18.93**	17.91	6.97	24.46

4 Remaining Prospectivity

In Chapter 3, alternatives for the resource base of the Spinel structure has been given which include both proven and hypothetical resources. Proven reserves are restricted to the Main/East segment, whereas in the complex West segment all resources are hypothetical, although with a low risk.

To give a more strict estimate of reserves at Spinel, at least 1 or 2 of the internal fault blocks of the West segment would have to be drilled. In a possible dry case, this would detract volumes from those given in Chapter 3. Only in a case with deeper contacts in any of the blocks of the West segments would an upside case materialise. Aker BP does not consider the North segment defined by Svenska Petroleum as a separate segment, and the case made for a considerable upside here is not considered valid.

Two separate prospects/leads northeast of Spinel remains to be drilled. Runa is wholly within block 6407/4 whilst Alva is split between 6407/4 and 6407/1. A combination of high risk on reservoir quality and moderate to small potential recoverable volumes does not make these two leads attractive targets.

5 Conclusion

In the Garn Fm a rich gascondensate with a GOR at ~ 1700 is proven in a tight reservoir, displaying a down-to situation in the Spinel Main/East segment where the Garn Fm is underfilled.
Reservoir studies have shown that cumulative production from the Garn Fm is extensively sensitive to permeability variations and this constitutes a major uncertainty with regards to produceability.

With regards to recoverable volumes in the Tilje Fm, unrisked recoverable volumes for the Tilje Big case are quite large, but risked volumes Pd=0.18 are more moderate.
Aker BP considers that the much smaller Tilje Upper case is a far more likely filling case, gascondensate being trapped between the Ror shale and an internal Tilje Fm shale.
Since hydrocarbons have not been encountered in the overlying Tofte and Ile fms, it is difficult to believe in the case of substantial Tilje fill (Tilje Big) as one would have expected hydrocarbons to migrate upwards in the structure, given the amount of reservoir/reservoir juxtaposition and general fault zone complexity.

Concerning segmentation and complexity, the western segment actually consists of 5 individual fault blocks and although one may hope that this is adequately drained by producers in the two largest blocks (West 1 & West 4, Fig 3.1) this is by no means certain. Additional wells may be needed.
The Garn formation, as mentioned, is tight and needs advanced well solutions (horizontal wells and fracturation) to produce adequately. It will probably not be trivial to drain the many fault blocks in the complex West segment.

On account of the work presented in previous chapters, we do not consider recoverable volumes to be large enough for a stand-alone development. Although no tech ec evaluation has been done, low risked volumes combined with a challenging development solution with advanced wells (Garn Fm) does not favour a positive financial outcome.

On the assumption that a tie-in to the Njord Field is the most likely solution for a possible development, one have to take into account that other fields will be preferred for tie-in before Spinel is considered, and the timing of a potential exploration/delineation well at present is not optimal. Both Noatun (Statoil operated), Linnorm (Shell operated) as well as other tie-in candidates will be preferred for development first.

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