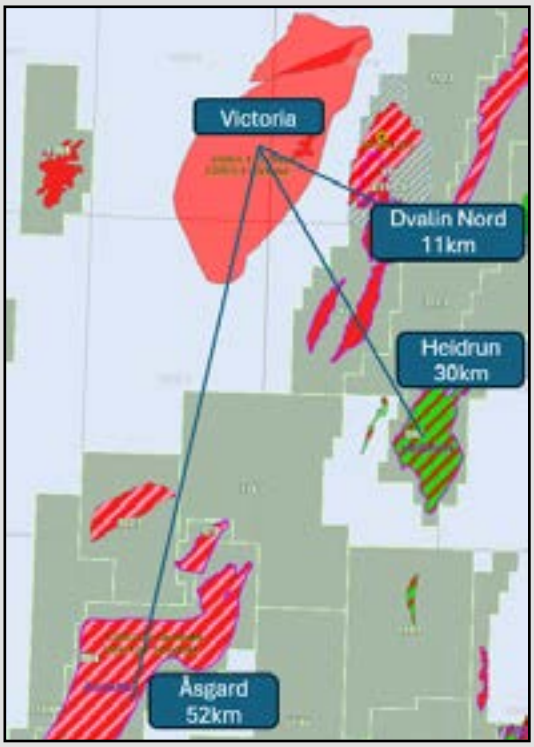
Victoria-
A Path to Success

Hydraulic Fracturing Study of Victoria Field,
Norwegian Continental Shelf

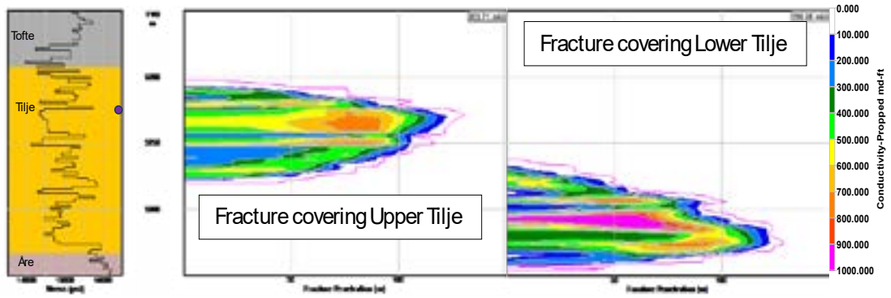


Victoria Background

- Victoria, was discovered in 2000 with well 6506/6-1, and second appraisal well 6506/9-1 in 2009.
- Gas inplace in Jurassic Ile and Tilje reservoirs are estimated at ~140 GSm^3.
- The HPHT reservoir conditions (@ 5400 m) are 820 bar and 190°C.
- Victoria has a high CO_2 content, at 8-10%.
- Historically, hydraulic fracturing has not proved to be an economical solution, due to lengthy fracturing campaigns, and the need for CT on a necessary semi-submersible rig due to water depth (420 m).
- Industry advancements in hydraulic fracturing execution has removed the requirement for a CT spread, by utilizing drill pipe to manipulate frac sleeves, with fracturing frequency up to 2 fractures per day.
- This, along with environmentally compliant luids developed for HPHT environments, brings Victoria to economical viability.

Geomechanics for Hydraulic Fracture Modelling

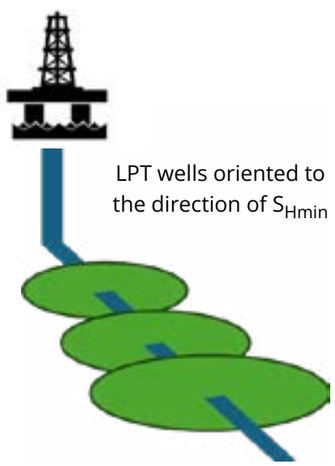
- A very detailed geomechanics model was generated for one of appraisal well and calibrated with available data.
- The fracture gradient profile has a reasonable amount of character and stress contrast, and fractures initiated in the Ile were not contained, with low chance to connect to the permeable layer at the top of the Ile reservoir.
- However, hydraulic fracture simulations suggest that fractures with sufficient resulting properties can absolutely be placed in the upper and lower regions of the Tilje formations, to cover the majority of this reservoir unit.
- Effective fracture properties are those that contribute to production, with safety factor applied to not over-estimate resulting fracture properties. It is these that should be modelled in a detailed subsurface reservoir simulator.



Resulting Fracture Parameter	Range
Propped length (m)	107 – 137
Effective Half-Length (m)	**80 – 103**
Average Conductivity (md-ft)	**336 – 570**
Max Fracture Height	72 – 94
Avg width at end of pumping (in)	0.4 – 0.6

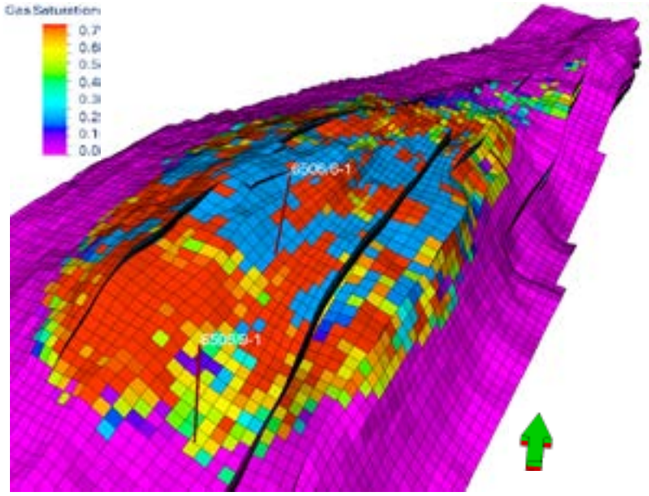
Optimising Well Path for LPT Reservoirs

- In low permeability reservoirs, multiple transverse fractures in horizontal wells increase the reservoir contact, and thus increases productivity.
- Well path has been optimized based on maximum stress azimuth data from the region.
- Orienting the wellbore parallel to the minimum stress will increase chance of transverse fractures, in this case. Based on regional data, this means aligning the well to 10 – 55 deg.

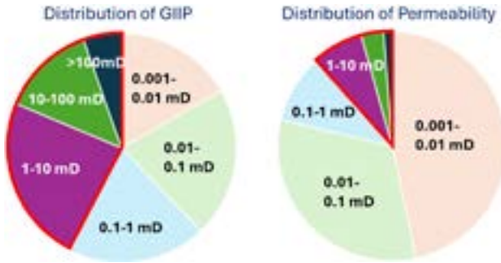


LPT wells oriented to the direction of S_{Hmin}

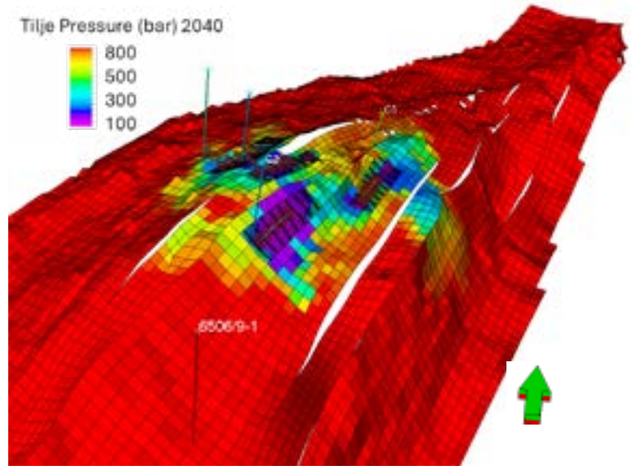
Victoria Full Field Simulation Model



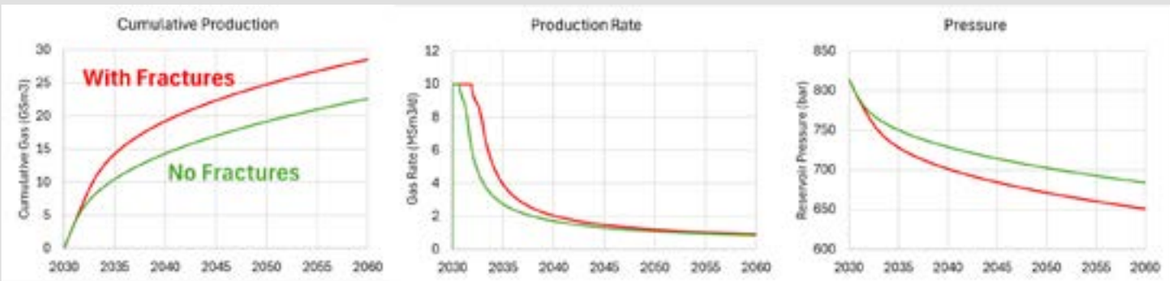
- Victoria full field simulation model contains 766k active cells, with dimensions 54 x 119 x 175.
- Gas initially in place is 137 GSm^3, of which 107 GSm^3 in the lower quality Tilje formation.
- Formation with permeability greater than 1mD make up 12% of field but 42% of GIIP.



- A possible development scenario with 4 wells used as basis for study.
- About 2000m horizontal wells with 9 transverse fractures, of which 8 located in Tilje formation.
- Results from hydraulic fracture modelling used to populate simulation model, with Local Grid Refinements representing fractures.
- 30 year production period with 10 Sm^3/d plateau rate.
- Compared to regular open hole completion.
- 29 GSm^3 cumulative production, with well production between 5 and 9 GSm^3. Compared to 23 GSm^3 without fracturing.



- 24 GSm^3 production from Tilje, with all fractures contributing to flow.



Hydraulic Fracturing Study Key Points

- There are no show-stoppers for Victoria, and hydraulic fracturing operations can be carried out safely and effectively.
- Today's completion and fracturing fluids solutions will contribute significantly to a successful fracture campaign in Victoria.
- 29 GSm^3 production with 4 wells appear to be a feasible field development scenario. There is significant scope for additional optimization in terms of number of wells and locations.
- Multistage fracturing give substantial benefit over regular open hole completion.
- This would be among the largest remaining resources on NCS.

Acknowledgement to TotalEnergies Norge
for making dynamic model available