Q/1-Q/2c Halfweg
Tight Gas field history case

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Halfweg Field data

- Halfweg Gas field located 25 km west of Den Helder on boarder Q/1-Q/2
- Reservoir: Rotliegend Sandstone, southwest dipping fault block, 8 x 1.1 km, bounded by fault to the northeast side. 300 m thick sand. Maximum gas column 200m.
- Sandstone consists of foresets and bottomsets
- Permeability range results from flow tests 0.02 – 0.5 mD
- Three vertical wells and three horizontal wells drilled into the structure
Halfweg Top structure map

- Q/1-1: Exploration well, 1968
- Q/1-11: 1980
- Q/1-2: 1974
- A2: 11/1995
- A3: 9/1995
Halfweg Well test data

- **Q/1-1**:  
  - Welltest showed mainly water with gas shows  
  - Based on these results, continued further appraisal

- **Q/1-2**:  
  - Welltest rates in the order of 1.9 MMscf/d [52Mm3/d]  
  - Permeability in the order of 0.5mD

- **Q/1-11**:  
  - Welltest rates in the order of 0.9 MMscf/d [24Mm3/d]  
  - Permeability in the order of 0.09mD

- **Q/1-23 (A1)**:  
  - Welltest economic rates that triggered the development of Halfweg
Halfweg facility layout

- Halfweg Satellite connect with 12 ¾" pipeline to Hoorn facility
- Water separation and processing takes place on Hoorn facility
- Three Halfweg wells produce via one manifold into pipeline
- Flowmeter and pressure gauge on Xmas tree per well
- Total gas flow metered at Hoorn
- Self installing platform to reduce installation cost
Halfweg facility

4 piles with two decks and concrete base

Towed on location
used barge to install structure

4 winches pulled deck (& barge) in position. Weight of barge was used to set enough load on seabed
Halfweg PVT data

Gas specific gravity = 0.664 (rel.to air)

Bg = 236 scf/ft³

Reservoir Pi = 4549 psia @ GWC (313 Bara)

Reservoir Temp.= 231⁰F (110⁰C)

Dew point = 2700 psia (186 Bara)

Condensate / Gas ratio = 4.2 bbl/MMscf (ini.tests)
                      (0.025 m³/Mm³)

Formation water SG = 1.06
Halfweg Reservoir: Details

- Three reservoir units A, B, C
- Large transition zone (>150m)
- Interdune beds act as permeability barriers
- Foresets and bottomsets result in low vertical permeability
- Condensate drop out near wellbore

<table>
<thead>
<tr>
<th>Unit</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
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<tbody>
<tr>
<td>Thickness</td>
<td>18-30m</td>
<td>60-110m</td>
<td>Remaining, mainly below GWC</td>
</tr>
<tr>
<td>Porosity</td>
<td>11%</td>
<td>15-19%</td>
<td>14-16%</td>
</tr>
<tr>
<td>Permeability</td>
<td>&lt;0.5mD</td>
<td>&lt;1mD</td>
<td>0.5&lt; K &lt;5mD</td>
</tr>
<tr>
<td>Sw</td>
<td>60%</td>
<td>45%</td>
<td>55-100%</td>
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Halfweg Transition zone

Halfweg A unit

Halfweg B unit

Height above GWC versus Water saturation

Large transition zone, spread out over the total vertical section of the reservoir.
Halfweg production behaviour

- 1997 Start compressor at Hoorn
- 2002 re-negotiated sales contract
- 2003 Booster compressor at Halfweg
Halfweg A1

- THP (bar)
- Pr simulation
- Gas prod. (MMscf/d)

P reservoir [Simulator]
Production rate
THP

½ year well shut-in. Still building up pressure
Halfweg simulation work

Difficult to history match Tight gas fields. Issues:
- water production
- GIIP estimates
- VFP’s

Match on THP during period with no water production, indicating that GIIP should be correct.
Success and issues of Halfweg

Success
- Horizontal wells that can produce at economical rates
- Installation of a simple small satellite fit for purpose, to reduce capital cost

Issues
- Difficult to collect reservoir data during production life of the field
  - No downhole pressure data
  - No individual well production test data
- Limit access due to small platform / crane