Brent Abandonment Monitoring

The importance of annulus characterisation for safe and efficient decommissioning

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Agenda

- The Technical Challenge
- Simplified Value Process
- Data, Data, Data!
  - But what data and why?
- The Team Work Engine
- Demonstrating Value through Case Studies

Summary
The Points to Remember

The value of data comes from collection, interpretation and action.

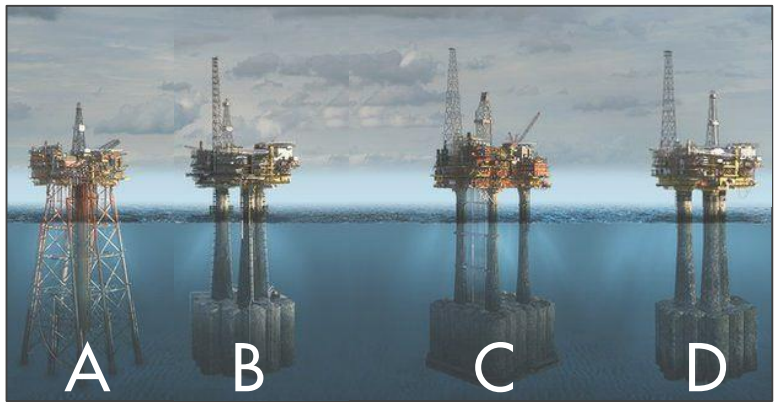
Team work makes the decom work.

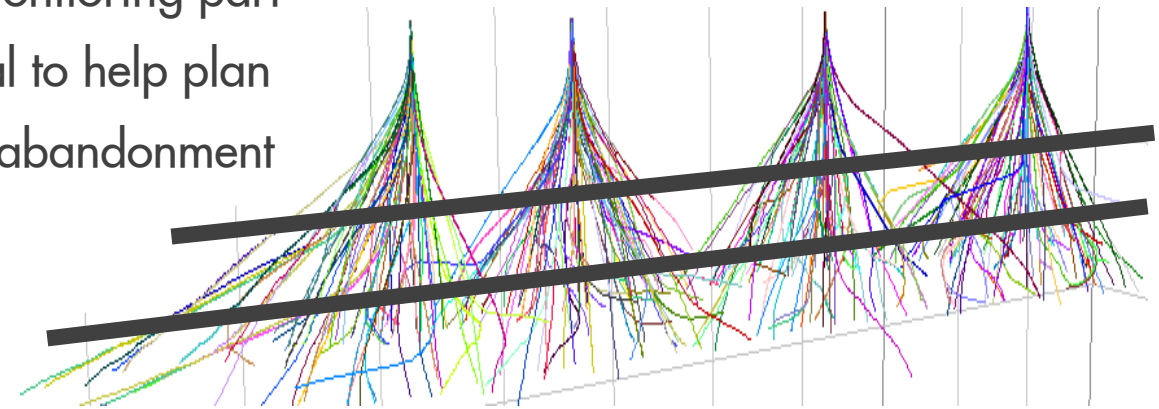
As an industry we can continuously improve abandonment efficiencies and reduce decommissioning costs

The Technical Challenge

The Brent Field as an example

- Abandonment philosophy is based on a risk based approach. This outlines how to abandon routine and non-routine wells.
- The data gathered in the monitoring part of abandonment is essential to help plan and execute the successful abandonment of the wells.





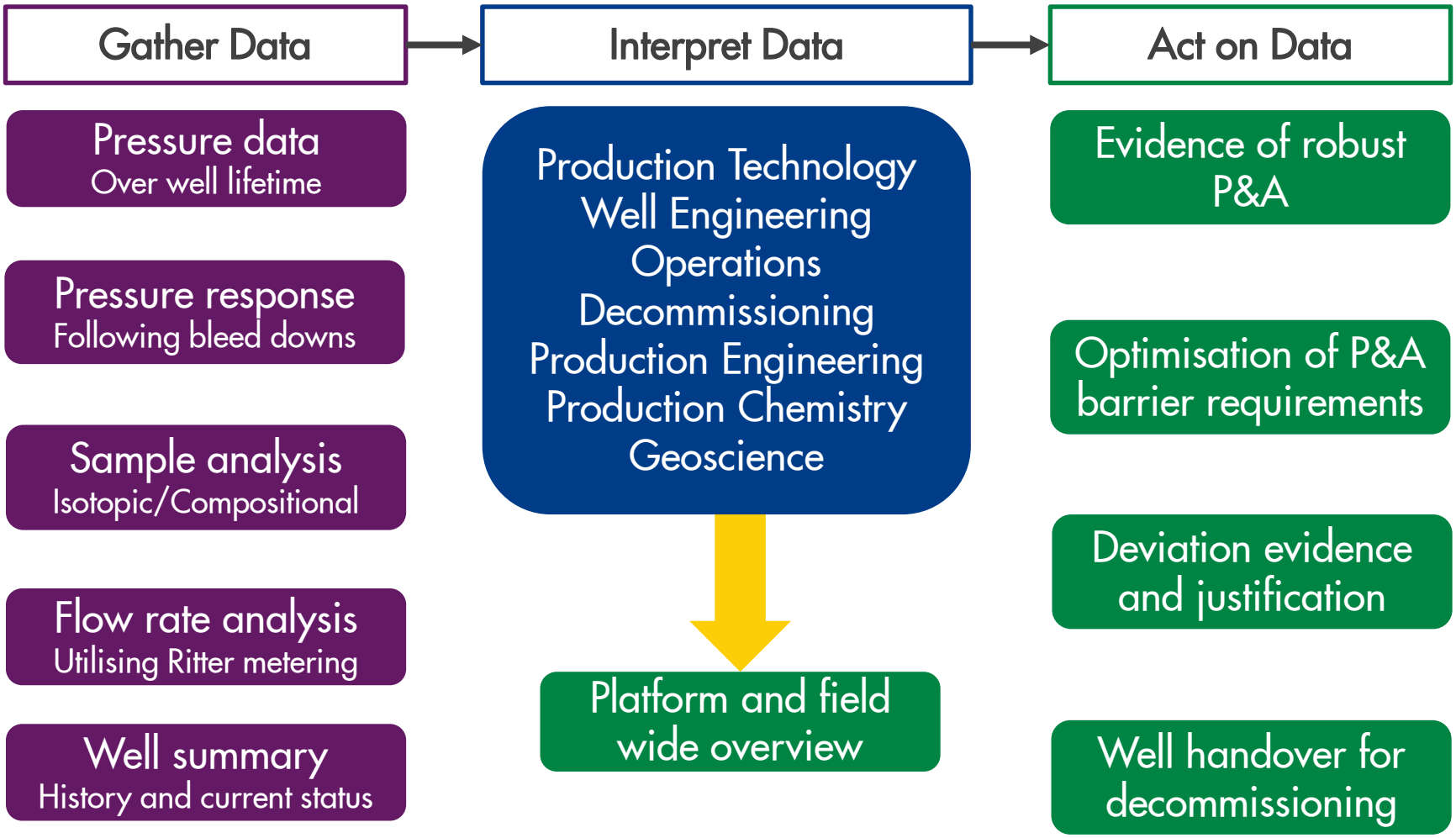
Provide evidence to optimise well abandonment design

"so far as is reasonably practicable, that there can be no unplanned escape of fluids from the well"

Provide evidence to show a successful abandonment delivery

The Well Abandonment Monitoring Strategy

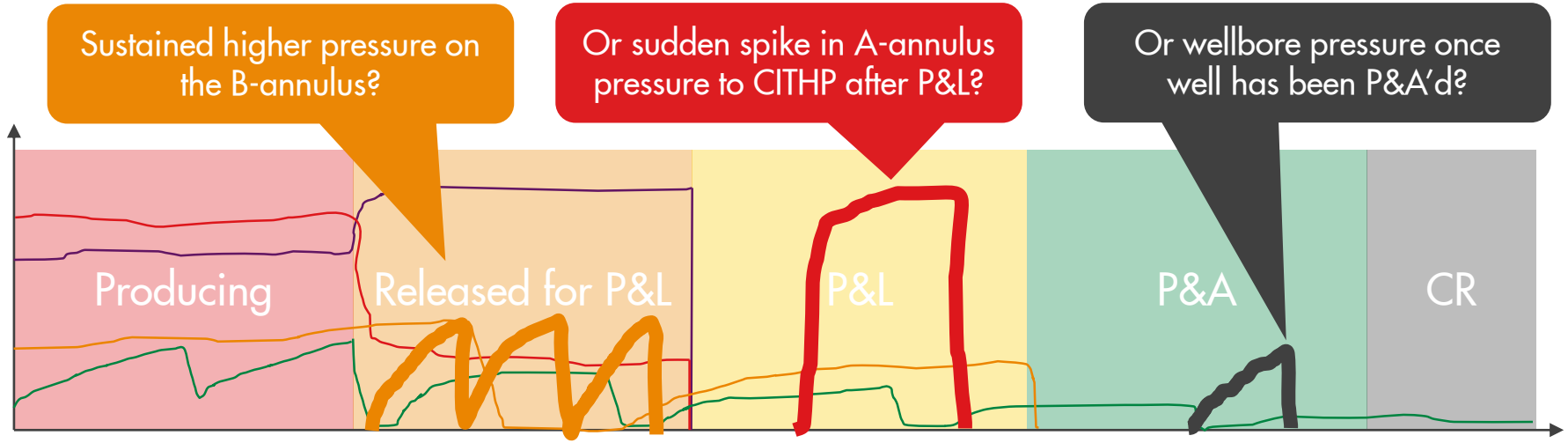
A Simplified Value Process



Well Pressure Data

The Monitoring Backbone and Early Indicator

- Sounds obvious, right? Have pressure data constantly?
- What about post LTSI – are electronic gauges still there?
- VITAL that (at least) daily readings are taken.
  - Keep high resolution trends over time.
  - HSSE aspect – act faster on signals such as…

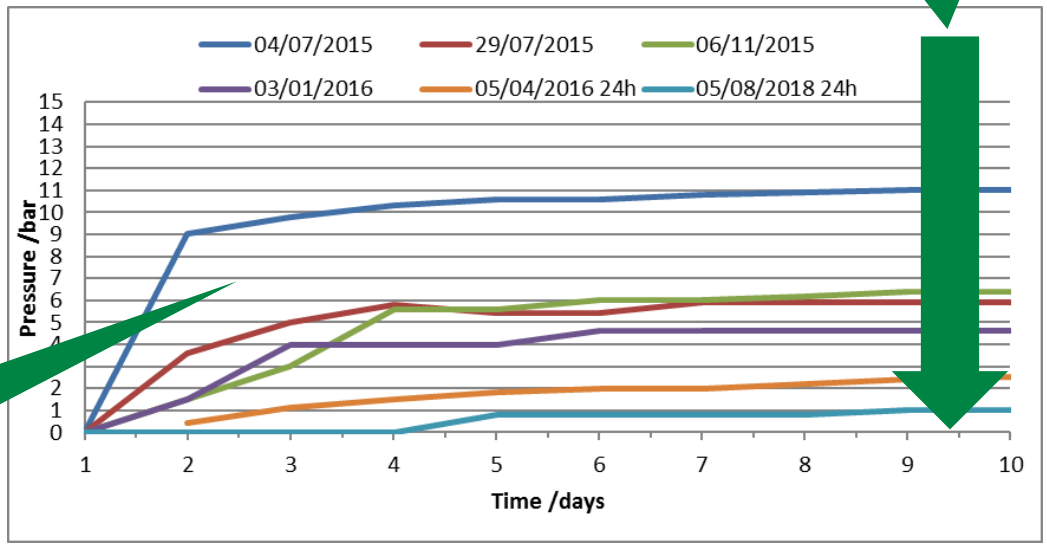


Pressure Response Trends

How does the connected volume behave?

- If there is sustained pressure over a long period of time…
  - Is it a tight, isolated pocket? Any connected volume?
  - Is it extensive? If so, how extensive?
- Bleed it down to zero bar and hold for 8/24/72 hours
- Monitor closely:
  - Rate of pressure return.
  - Final equilibrium pressure.
- Has it changed? If so, how?
- Understand response.

Reducing equilibrium pressure suggests finite source being exhausted



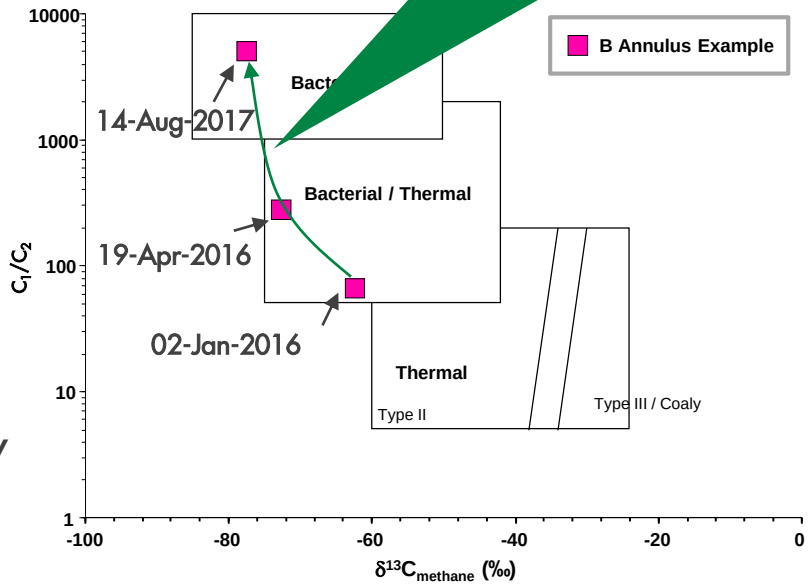
Sample after every bleed down an build up!

Sampling and Analysis

What is the source of the connected volume?

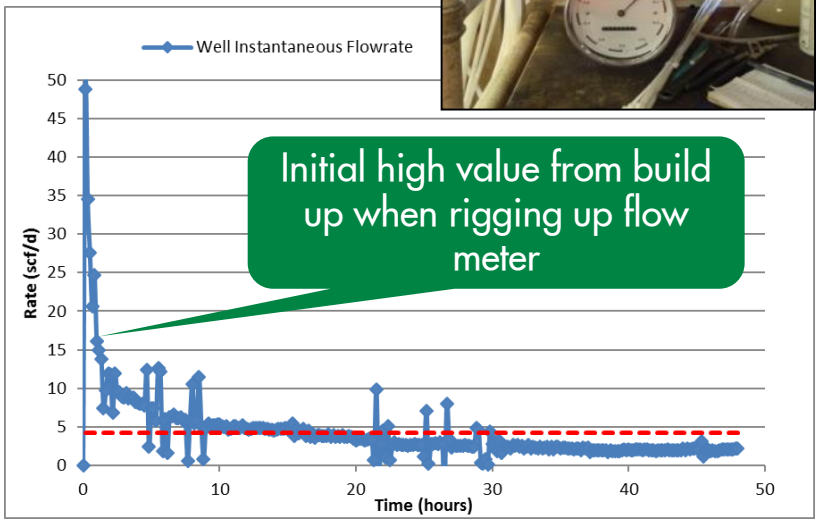
- Does there appear to be sustained pressure? If so, what's causing it?
- Analyse two main components:
  - Gas compositional fingerprint (focus on C1/C2 ratio).
  - Gas isotopic fingerprint (focus on dC13 fraction).
- Broadly distinguish between:
  - Biogenic (naturally produced).
  - Lift-gas.
  - Thermogenic reservoir gas.
- Example to the right on how extended bleed downs can affect gas source.
- Validate data quality through repeatability of readings.

Clear movement to a biogenic result – suggesting bleeding off non-biogenic gas, replaced by newly generated biogenic gas



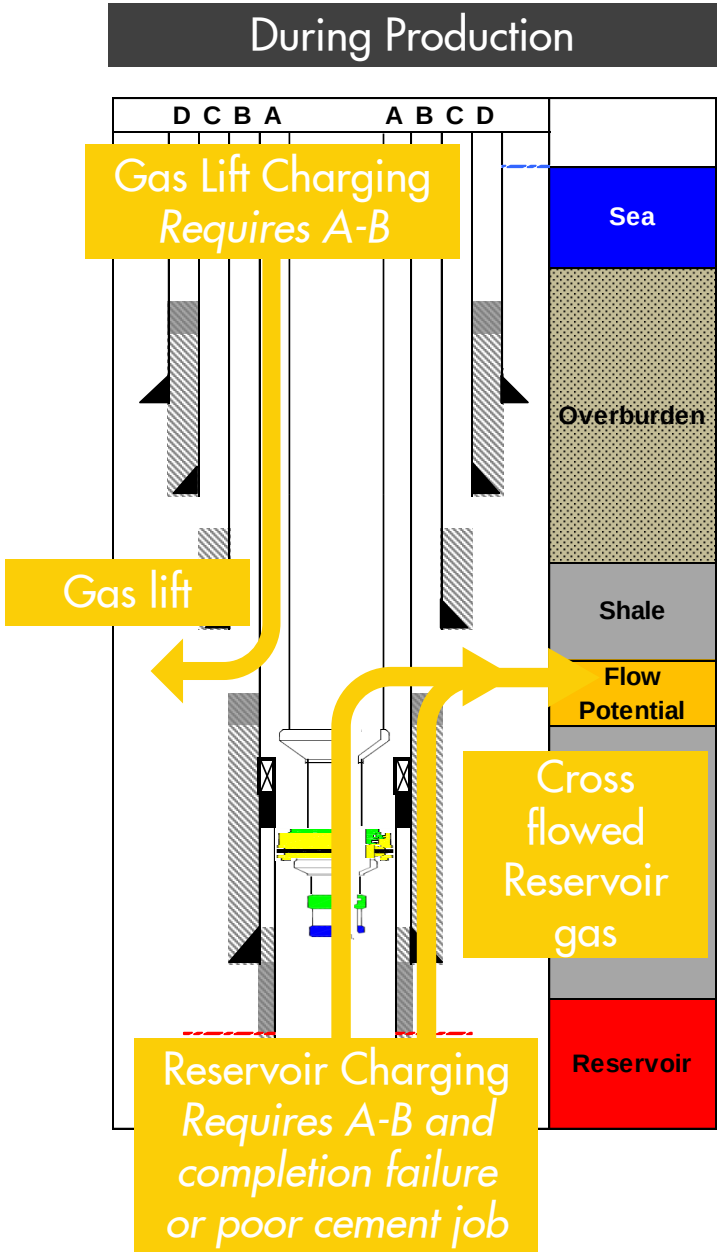
Flow Rate Analysis
What is it's flow potential?

- If there is sustained pressure, a quantitative flow measurement is obtained. Natural biogenic gas is expected to bubble from the seabed.
- Rig up wet gas flow meter during a 48 hour bleed down period.
- Demanding on resources (permanent manning required).
- Measured 26 annulus rates, all less than 9 scf/d.
  - Average was 3.26 **standard** cf/d.
  - Essentially small biogenic bubbling.
- Can we manage during P&A?
- Can HVAC manage during conductor recovery?



Well Summary
Historical and Current

- Well history is vital to understanding annulus behaviour.
- Side track construction assessments and abandonment risk assessments.
- Well integrity failures (e.g. lift gas in an open shoe at the B-annulus?).
- Production history?
- Gas during drilling a water injector?
- Gathering experience from the crew is essential where early data might be fragmented.



The Task-Team

Regular Interdisciplinary Monitoring Meetings

- All of this data needs a structured team to Analyse – Interpret – Act.
- The team then conjointly agree upon the implications of the interpretation, which could be:
  - Continue further monitoring & bleed down activity to reach conclusion or;
  - Deem the well successfully P&A'd and handover well for conductor recovery or;
  - Conduct remedial P&A scope.

Continuous learning and collaborative spirit is the key

Real HSSE and cost reduction benefit comes from getting this done early

Summary
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Q&A

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Special thanks to Duncan Manning, Andrew Parkinson, Al Tucker, Dave Wilkinson, Brent Well Engineering, Brent Operations, Geoscience and Production Chemistry.